HOW DOES CLIMATE CHANGE IMPACT WOMEN AND CHILDREN ACROSS AGROECOLOGICAL ZONES IN INDIA:
A SCOPING STUDY

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Ministry of Women and Child Development
Government of India

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May 2024

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Suggested Citation: MSSRF., (2024). How does climate change impact women and children across agro-ecological zones in India: A scoping study. M S Swaminathan Research Foundation.

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FOREWORD

While it is now widely recognizsed that climate change and the resultant extreme weather events pose serious threats to our lives, the disproportionate impacts on women and children have not been as widely studied or documented. In this report, we explored the impacts of climate hazards on the health, livelihoods, education and other aspects of women and children's lives in India. The request came from the Honourable Minister for Women and Child development, Government of India, signaling the commitment of the government to understand this issue better and take appropriate action. We believe that this maybe the first report that has comprehensively examined this subject.

An unique aspect is that we have use an agro-ecological lens to look at the effects of climate change. While the limits of these 20 AE zones in India do not match state or district boundaries, it is important for all to realize that this is why we need collaborative action across borders. Floods and droughts do not stop at state borders, and people living in a particular agroclimatic region face similar problems, underlining the need to have comprehensive plans that are people-centred. We need much more detailed research following an agroecosystem approach to generate the appropriate solutions, which take into consideration long-term impacts of climate hazards, and specifically to look at women through an intersectional lens.

The needs of children also need much more attention, as they too suffer disproportionately and if not addressed, some of these hazards can have long lasting physical and mental health impacts. A systems approach is needed so that health, education, nutrition, leisure and other emotional needs of children can be met through convergence of programmes and innovations in policys.

There is no doubt that the effects of climate change are felt disproportionately by the socioeconomically weaker sections of society as they have less scope for adaptation. Hence, social safety nets need to be strengthened and climate action plans should proactively address equity and focus on protecting the most vulnerable. The impacts on our food systems as well as the changing profile of many diseases (water borne, vector borne, heat related and air pollution related) implies that we must plan ahead, and our health and food systems will need to adapt and become more resilient.

The findings in this report were informed by many experts from academia and NGOs, as well as women's groups, in addition to the literature reviewed. We need more high quality research and data to inform policies and also need to develop and test innovative, affordable solutions, including the use of new technologies. These solutions will be appropriate and sustainable only if they are developed in consultation with communities. Local urban bodies and panchayats must take more responsibility, and also be given more resources and autonomy to address climate change impacts on women and children more effectively.

Soumya Swaminathan
Chairperson, MSSRF

ACKNOWLEDGEMENTS

We are immensely grateful to the Hon Minister of Women and Child Development Smt. Smriti Zubin Irani for identifying this important topic and we feel privileged to have been tasked with this responsibility. The issue of climate change impacts on women and children is under-researched and often overlooked in policy formulation, making this effort even more important and timely. We extend our sincere thanks to the Bill & Melinda Gates Foundation for funding this project and for their unwavering support.

We express our deepest thanks to the dedicated members of the study team (Dr Amit Mitra, Dr Nitya Rao, Dr R. Rengalakshmi, Dr Arundhita Bhanjdeo, Ms Anjali Sharma, Mr Saif Nihal, Mr Jayant Kadgaye, Mr Nagarajan R), Dr Priyadarshini Rajamani and Mr Charu Chandra Devshali whose unwavering commitment and expertise have been instrumental throughout this journey. Their sincere efforts and collective wisdom have significantly enriched the quality and depth of this report. We also want to extend our heartfelt gratitude to the CEEW team (particularly Ms. Shreya Wadhawan) for sharing detailed data on the climate vulnerability index developed by them and helping us interpret the data, and to Dr. Srinivas Goli of IIPS for guiding the statistical analysis. Special thanks to the ClimateRISE alliance partners, particularly Rukmini Banerjee, Kirti Jain and Akshay Shetty from DASRA for assistance with the case studies. We appreciate and acknowledge the support of Dr. Rama Narayanan for her input and suggestions by meticulously reading and editing the report.

We also extend our sincere appreciation to the eminent participants of the consultative and dissemination workshops held in Chennai, Delhi, Guwahati and Jaipur as well as in three online consultations (list of participants appended). Their active engagement, insightful contributions, and constructive feedback have been pivotal in shaping the direction and outcomes of this report.

Further, we extend our heartfelt thanks to our partner organisations, Karmannya (Ms. Devanshi Shah) and ASSOCHAM (Mr. Sandeep Jain and Ms. Shubhangi Agarwal) whose collaboration and support have been instrumental in the success of this project. Your shared vision, mutual respect, and collaborative efforts made this a pleasant and productive exercise.

We extend our gratitude to everyone who contributed to this project. We were working on a short timeline and made a lot of demands but received support from all quarters. We look forward to continuing our journey together towards addressing the critical needs of women and children in response to the effects of climate change.

Soumya Swaminathan
Chairperson, M S Swaminathan Research Foundation

LIST OF ABBREVIATIONS

AEZ	Agro-ecological zones
ANC	Antenatal care
ARI	Acute respiratory Infections
ASER	Annual Status of Education Report
CCRI	Children's Climate Risk Index
CEEW	Council on Energy, Environment, and Water
CVI	Climate Vulnerability Index
FAO	Food and Agriculture Organisation
IAP	Indoor air pollution
ICDS	Integrated Child Development Services
IHDS	India Human Development Survey
IIPS	International Institute for Population Sciences
IMD	India Meteorological Department
IPCC	Intergovernmental Panel on Climate Change
IPV	Intimate partner violence
MoSPI	Ministry of Statistics and Programme Implementation
MoWCD	Ministry of Women and Child Development
MSSRF	M S Swaminathan Research Foundation
NAPCC	National Action Plan on Climate Change
NDMA	National Disaster Management Authority
NFHS	National Family Health Survey
NIUA	National Institute of Urban Affairs
NTFP	Non-timber forest products
PM	Particulate Matter
PTSD	Post-traumatic stress disorder
SAPCC	State Action Plan on Climate Change
SRH	Sexual and reproductive health
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
WHO	World Health Organisation
WMO	World Meteorological Organisation

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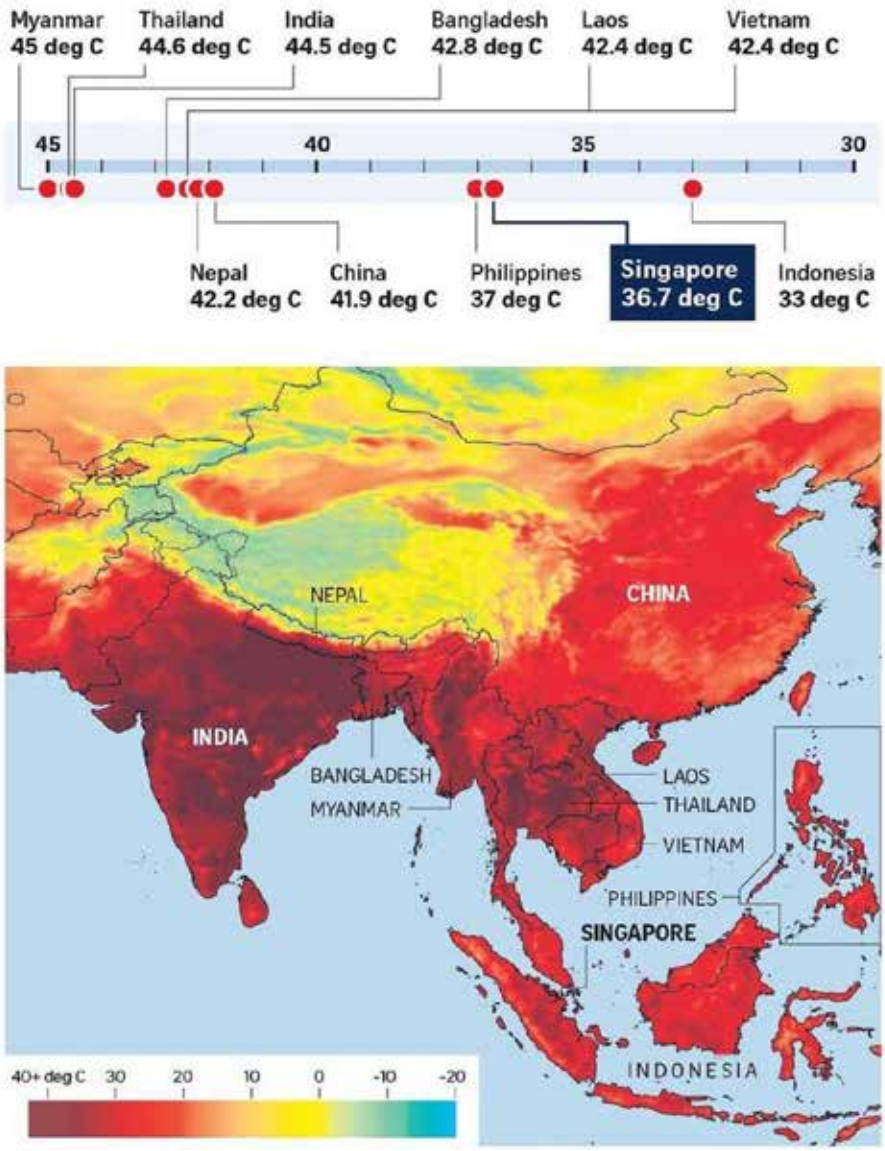
CHAPTER 1: INTRODUCTION

1.1 The Harshness of Climate Change

April 2024 was the 11th consecutive warmest month in a row globally, according to the Copernicus Climate Change Service (C3S). The global surface air temperature for the month was 15.03°C, 0.67°C above the 1991-2020 average for April and 0.14°C above the previous high set in April 2016. C3S noted that "while such a long series of records is unusual, a similar series of record temperatures was observed in 2015/2016, lasting up to 15 months. Globally, the last 12 months (May 2023-April 2024) were warmer than any previous 12-month period, at 0.73°C above the 1991-2020 average and 1.61°C above the pre-industrial average" (Copernicus Climate Change Service, 2024).

Map 1.1: *Heatwave in south and south-east Asia, May 2024*



Source:
https://www.reddit.com/r/MapPorn/comments/1cj9m92/heat_wave_in_south_and_south_east_asia/#lightbox

Indeed, climate change is a harsh reality now across the world. The World Meteorological Organisation (WMO) reported that 2023 was the warmest year on record according to six globally averaged datasets. Each year is warmer than the previous years. The nine years 2015 to 2023 were the nine warmest years on record in all datasets (WMO, 2024).

It is not just rising temperatures but an overflowing Pandora's box: Sea Level Rise, Ocean Temperatures rising, Glacial Melts, Droughts, Floods, Cyclones and Changing Precipitation patterns. These set of climate risks makes Asia as the world's most disaster prone region in 2023 (WMO, 2024).

Box 1.1. Interactions among climate change and health impacts

The Sixth Assessment Report of the United Nations Intergovernmental Panel on Climate Change (IPCC) has a strong focus on the interactions among the coupled systems climate, ecosystems (including their biodiversity) and human society.

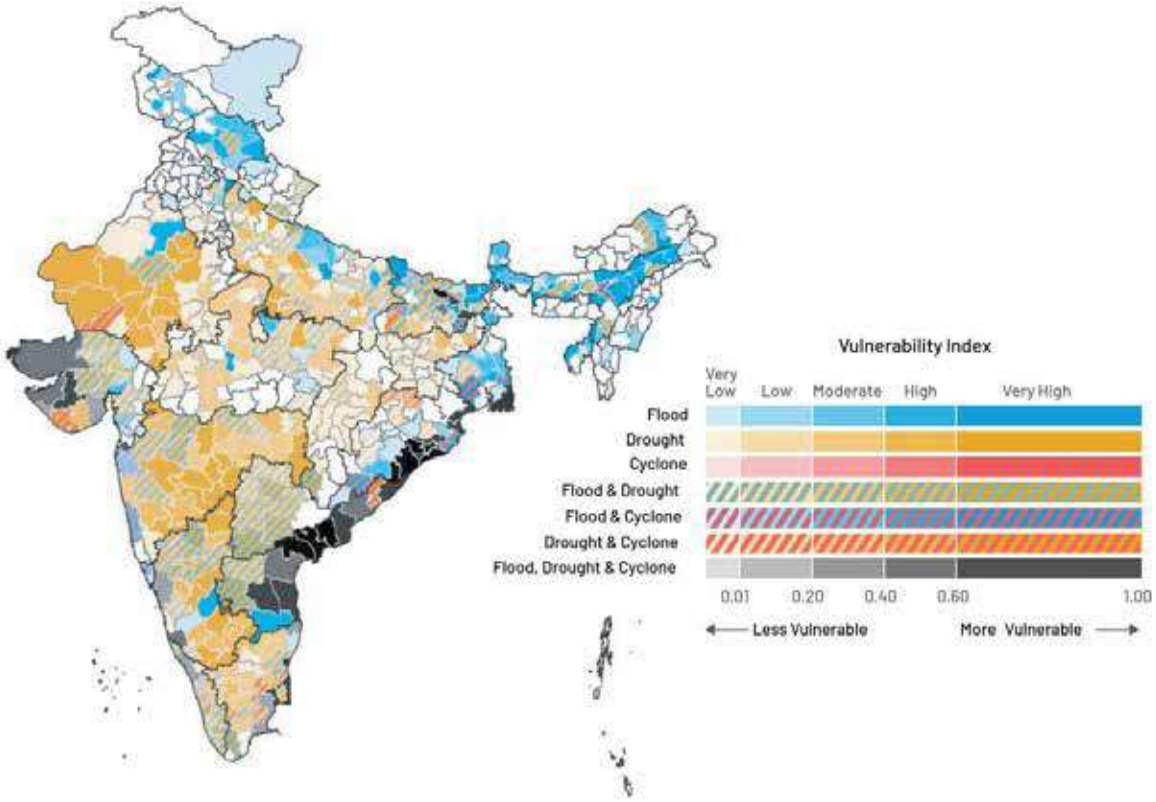
Climate change, through hazards, exposure, and vulnerability, generates impacts and risks that can surpass limits to adaptation and result in losses and damages. There are multiple impacts of climate change ranging from mortality, morbidity, malnutrition, and increase in susceptibility to other health problems, including mental health problems, and impairment in cognitive and work performance, with resulting economic impacts.

Children and pregnant women experience adverse health and nutrition impacts of climate change disproportionately Climate-related food borne diseases, vector borne diseases, water-borne and zoonotic diseases, and respiratory diseases are increasing rapidly across the globe. Future global burdens of climate-sensitive diseases and conditions will depend on emissions and adaptation pathways and the efficacy of public health systems, interventions and sanitation.

Rapid climate change is impacting every aspect of human life, through both extreme weather events and slow onset events (Rockström et al., 2023). These events have direct and indirect adverse impacts on sustainable development goals in general and population health in particular (Rana et al., 2023).

At the same time, livelihoods, especially of the poor, are expected to be seriously threatened. They are the most vulnerable with low capacities to adapt and recover from recurring climate-induced shocks, despite their own negligible contribution to greenhouse gas emissions (St Louis and Hess, 2008). Climate change not only effects the most basic health requirements such as clean air, safe water, and, adequate food and shelter, it also poses new challenges to the control of infectious diseases, and gradually increases the pressure on the natural, economic and social systems that sustain health (WHO, 2024). To make matters worse, the changes as well as their impacts are mostly unpredictable, leaving climatologists as well as health specialists guessing continuously.

Map 1.2. *Vulnerability of states and Union Territories to extreme hydro-met disasters*



Source: CEEW, 2021, Study on Mapping India's Climate Vulnerability: A District Level Assessment.

1.1.1 The Right to Climate Justice Equated to the Right to Life in India

On March 21, 2024, India's Supreme Court ruled that people have the right to be free from the adverse effects of climate change which should be recognized by Articles 14 (Right to Equity) and 21 (Protection of Life and Personal Liberty) of the Indian Constitution. (Cheema, 2024). Effectively, this means that in India climate rights and justice have been equated to the right to life.

Actualising this right makes it imperative to urgently adopt a broader multisectoral systems perspective to understand the impacts of climate change. This would entail taking into account the linkages between a range of interconnected policies including

health, employment, energy, and water, to name a few. Fiscal policies are of paramount importance as without adequate budgetary support no policy will work. Researchers and practitioners need to support policymakers to appreciate, anticipate and work towards preventing and mitigating the effects of climate change on human health and well-being. This study is a modest effort towards that end.

1.1.2 Climate Change and Risks in India

According to the Climate Risk Index 2021, India was among the top 10 most affected countries (Eckstein, et al, 2021). India faces a high level of vulnerability to the negative effects of climate change, experiencing more frequent and severe hydro-meteorological disasters along with extreme temperature variations (Kagawa, 2022). India ranked 138 out of 185 countries in 2023 in the ND-GAIN rankings, underscoring its vulnerability (University of Notre Dame, 2023). Climate change effects include drought, floods, extreme weather events, rising disease rates, and heightened food and water insecurity that affects billion of global poor, with women comprising majority among them (Karmakar, 2021).

Twenty seven out of 35 states and Union Territories are highly vulnerable to hydro-meteorological disasters like cyclones, floods and droughts (Mohanty and Wadhawan, 2021). While the north-eastern and eastern zones of the country are highly exposed to extreme floods, the western and central zones are more vulnerable to drought-like conditions. India's agriculture sector relies on the monsoon, however, the rainfall patterns have become erratic (more precipitation but lesser number of rainy days) with longer drought spells. 29 percent of India's land experienced over three months of extreme drought per year from 2013-2022 (Romanello et al., 2023). Sea level rise, glacial melts and ground water shortages have been predicted (Lee et al., 2023) with a rise in extreme weather events (Mohanty, 2020).

Between 1901 and 2018, the average annual temperature in India rose by around 0.7°C (Singh et al., 2021; PIB, 2023) Increasing temperature and changing meteorological parameters have increased the prevalence of heat waves, often termed as a silent killer in India (Aadhar and Mishra, 2019; Lee et al., 2023). India witnessed a 34 percent rise in death due to heat waves in 2013-2022 as per Indian Meteorological Department (IMD) data (Pandey, 2023).

Air pollution is one of the most significant environmental hazards to human health globally. In 2019, 99 percent of the world's population resided in areas where the air quality standards set by the World Health Organization (WHO) were not met. The consequences of this pervasive issue are evident in the annual toll it exacts on human life, with ambient and home air pollution contributing to an alarming about seven million premature deaths worldwide each year (WHO, 2022). Indeed, air pollution is a silent but deadly adversary on a global scale.

Fine particulate air pollution, especially PM 2.5, slashes an average of 5.3 years off the lifespan of Indian citizens (AQLI, 2023). About 67 percent of the population in India live in areas that exceed the country's own national air quality standard of 40 ug/cubic metres of air (University of Chicago, 2021). Risks to women are higher because of exposure to indoor air pollution caused by burning of biomass for cooking or heating.

Exposure to pollutants is linked to a spectrum of deadly illnesses, including lung cancer, stroke, and heart disease, further amplifying the urgency of addressing this issue (World Bank, 2023). All these factors underscore the need for urgent action to mitigate the impacts of air pollution on public health.

Floods are a recurrent phenomenon that causes huge loss of lives and damage to livelihood systems, property, infrastructure, and public utilities. India is highly vulnerable to floods. According to the National Disaster Management Authority (NDMA), 40 million hectares (mha) of the country's total geographical area of 329 mha are flood prone. India saw the highest number of flood-related deaths in Asia and between 2013 and 2020, the estimated economic loss from floods increased from approximately $1.4 billion to $ 11.5 billion (Chowdhury and Goel 2023). Floods harm millions of people in the Indian subcontinent, they have become more frequent in recent decades and are expected to become more frequent due to climate change, but the Indian subcontinent's shifting flood patterns and related hazards due to global warming are still mostly unknown (Ali et al., 2019).

Drought is a prolonged dry period in the natural climate cycle characterized by a lack of precipitation, resulting in water shortage. Nearly 700 million people could face displacement due to drought by 2030 globally, accounting for 40 percent of the world population affected by water constraints (WHO, 2019). The effects of drought extend to every aspect of our surroundings and social groups with varying social, economic, and environmental effects of different types of droughts. Droughts are likely to affect about 18 percent of India's land area, which is primarily dry, semi-arid, and sub-humid (Shah and Mishra, 2020), the impact is substantial. Currently, meteorological drought conditions, ranging from mildly dry to extremely dry, are being reported in over 500 of India's 718 districts that the India Meteorological Department (IMD) monitors (Pandey, 2023).

Most importantly an area may be subject to multiple climate hazards one after the other and sometimes even simultaneously like heavy rains can occur in the middle of a heat wave.

1.2. Vulnerability of Women Across Stages of Life

The climate crises are not gender neutral. According to the UNDP, women and children are 14 times more likely than men to die in a disaster. Women often face higher risks and greater burdens from the impacts of climate change in situations of poverty, due to their existing roles, responsibilities and cultural norms (UNFCCC, 2022), specifically to their livelihoods, health, safety and security (UN Women, 2022). Agriculture is the most important livelihood source for women, particularly in rural India. Climate-driven crop yield reductions increase food insecurity, adversely impacting poor households who already suffer higher nutritional deficiencies (Bhuyan et al., 2020). Within small and marginal landholding households, while men face social stigma due to unpaid loans leading to migration, emotional distress and sometimes even suicide, women experience higher domestic work burdens, worse health, and intimate partner violence (Mitra and Rao, 2019; Lambrou, 2010; Singh et al., 2021). For women, the increasing food and nutritional insecurity, work burdens and uncertainties lead not only to physical health issues but also impact their mental health and emotional well-being.

However, it has to be emphasised that women are not a homogenous category nor are all women affected equally. In fact, as is often the case, a poor tribal male agricultural labourer is more affected by climate change than the upper caste landlady he works for. Indeed, the specific context matters. Interestingly, both the international and national literature on the adverse impacts of climate change speak of women as a homogenous generic category.

1.3. Impact of Climate Change on Children

Children are particularly vulnerable to, and disproportionately affected by, climate hazards. (Sheffield and Landrigan, 2011; Perera, 2017). Some 352 million children across the country risk facing at least one climate event annually (The Save the Children Fund, 2022). It is worth mentioning that India ranked 26th out of 163 countries in UNICEF's child-focussed Climate Risk Index (CCRI) of 2021, making it one of the countries where children face serious vulnerability to the consequences of climate change (UNICEF, 2021). Needless to say, children will suffer the most in terms of food and nutrition security, health, water and sanitation, well-being and education (Mahapatra et al., 2021; Helldén et al., 2021). Apart from diseases due to nutritional deficiencies, there is a resurgence of vector borne diseases like malaria, dengue and zika due to changes in temperatures and humidity, especially affecting populations with weak immunity (Lee et al., 2022; Kaliappan et al., 2022). Again, it must be noted that children are not a homogenous category as they are treated in the discourses on climate change by and large, Thus, children from affluent urban homes will not suffer the ill-effects of heatwaves as their homes and sometimes even schools are air-conditioned.

1.4. Equity Considerations

Some population groups are more vulnerable in the face of the health effects of climate change due to socio-economic inequalities, geographical location, cultural norms, or fundamental physiological factors. Climate-change induced hazards like floods, droughts and heatwaves, pose immediate risks to health and at the same time intensify the scarcity of resources for the particularly vulnerable groups (Arpin et al., 2021), comprising women, young children, and the elderly, as well as people with existing health problems (Udmale et al., 2015). For instance, in cases of displacement due to extreme weather events, girl children lose their education first, to help support their families in times of crisis (UNICEF, 2021; Castañeda-Babarro et al., 2020). Differential impacts reinforce and even amplify existing inequalities of caste, ethnicity, class, gender, and location unless ameliorative action is taken (Singh et al., 2021) Thus, though climate change has a distinct gender dimension, there is need for more evidence not only on clear implications of extreme climate events on women and children, but also a differential and intersectional understanding of the same. Climate change intersects with other drivers of socio-political and economic change and these intensify existing vulnerabilities and inequalities. Ultimately the focus has to be on reducing the consumption and carbon footprint of the rich and focus on adaptation pathways that reduce poverty and enhance livelihoods in gender just ways and in ways that are not maladaptive. For example, the Mumbai coastal road is now consider to be maladaptive by the IPCC.' It's very bad for a coastal city already vulnerable to climate change and a disaster for Indigenous artisanal Koli fishers, especially women and children.

1.5. Why climate action needs to focus on women and children?

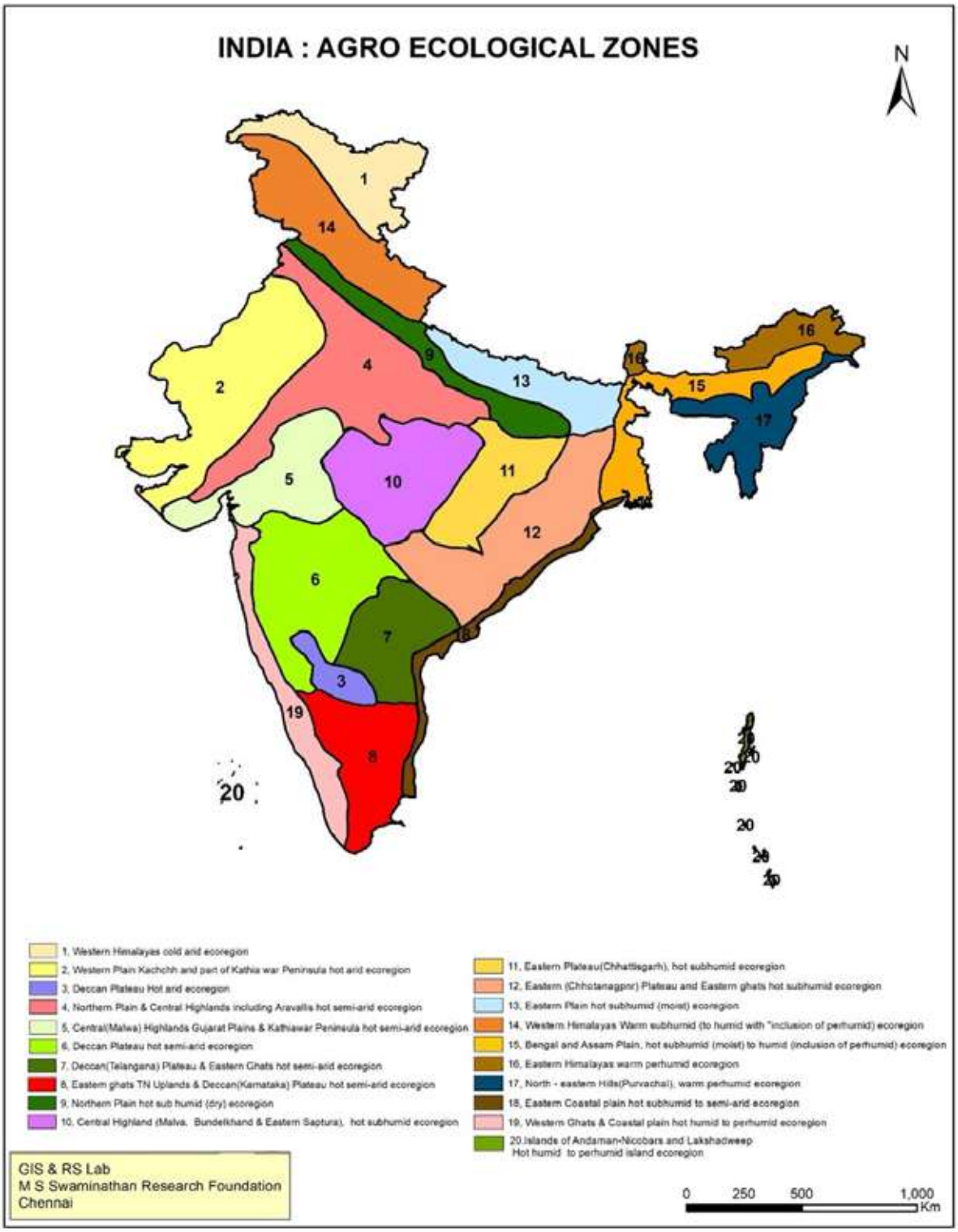
Climate action needs the involvement of 100 percent of the population - if we want to achieve the Paris Agreement goal of limiting global temperature rise to 1.5 degree Celsius. At the same time, empowering the poor, especially poor women mean better climate solutions–When provided with the same access to resources as men, women can increase

their agricultural yields by 20 to 30 percent. Tribal and rural women, in particular, have been at the forefront of environmental conservation and have invaluable knowledge and expertise that can help build resilience and reduce greenhouse gas emissions. Empowering children and youth are important to enable them to meaningfully participate in developing just and equitable climate action, especially on decisions and actions that affect them. (FAO 2024).

1.6. An Agro-Ecological Approach

The impacts of climate change in general and particularly on women and children vary across the 20 agro-ecological zones of the country (Map 1.1) and need to be understood for better policy formulation and implementation.

Map 1. Twenty Agroecological Zones in India



Source: National Bureau of Soil Survey and Land Use Planning

It has to be borne in mind that while states are ultimately political/administrative boundaries, climate change (or nature) does not follow them. The manifestations of climate change are according to agro-ecosystems hence the requirement for considering them in building sustainable adaptation and resilience systems.

The planning processes, including the State Action Plans (SAPs) need to take the agro-ecosystem diversity into account. Matters get complicated by the fact that one state might have several agro-ecosystems while some might have several states in its boundaries. Thus, Jharkhand, Gujarat, Maharashtra and Andhra Pradesh have five agro-ecosystems each while the North Eastern Hills, warm per humid eco-region (agro-eco region 17) has nine states and the Western Coastal Plains, hot humid to per humid eco-region (agro-eco-region 19) has eight. The latter calls for inter-state coordination of the action plans.

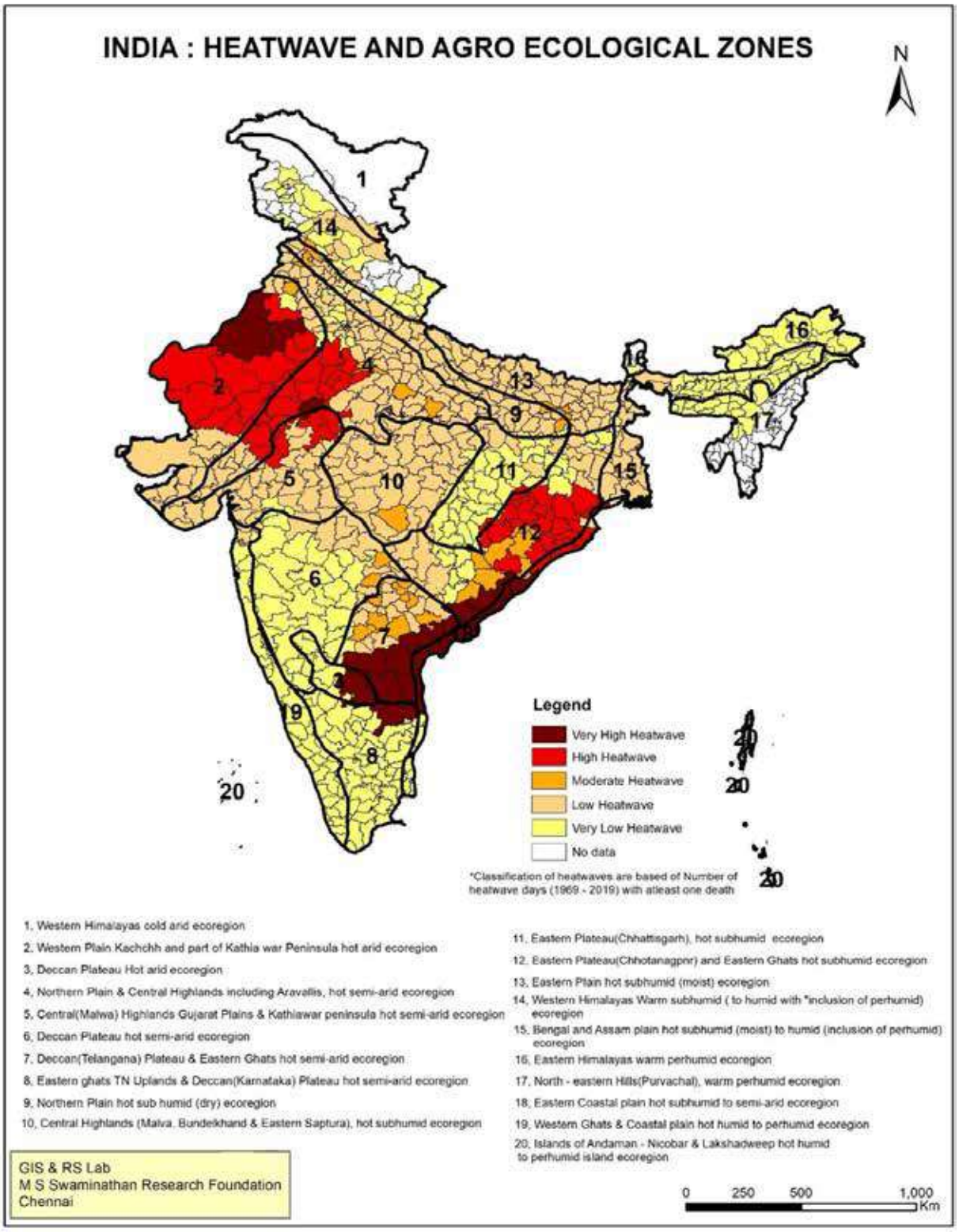
1.7. Objectives of the Study

a) Understand the multidimensional implications of climate change on women and children across agro-ecological zones of India
b) Adopt a differential lens to explore the implications on women and children (socio-economic, demographic and rural and urban categories) and analyse the extend to which this has been done in the research
c) Analyse the extend of differential and intersectional implications on women and children's mental and physical health, food and nutrition security and migration and work patterns
d) Identify existing gaps in literature, collect diverse and expert and community insights and perspectives and areas of further research and policies pointed out.

1.8. Setting the Context: Exposure to Climate Events

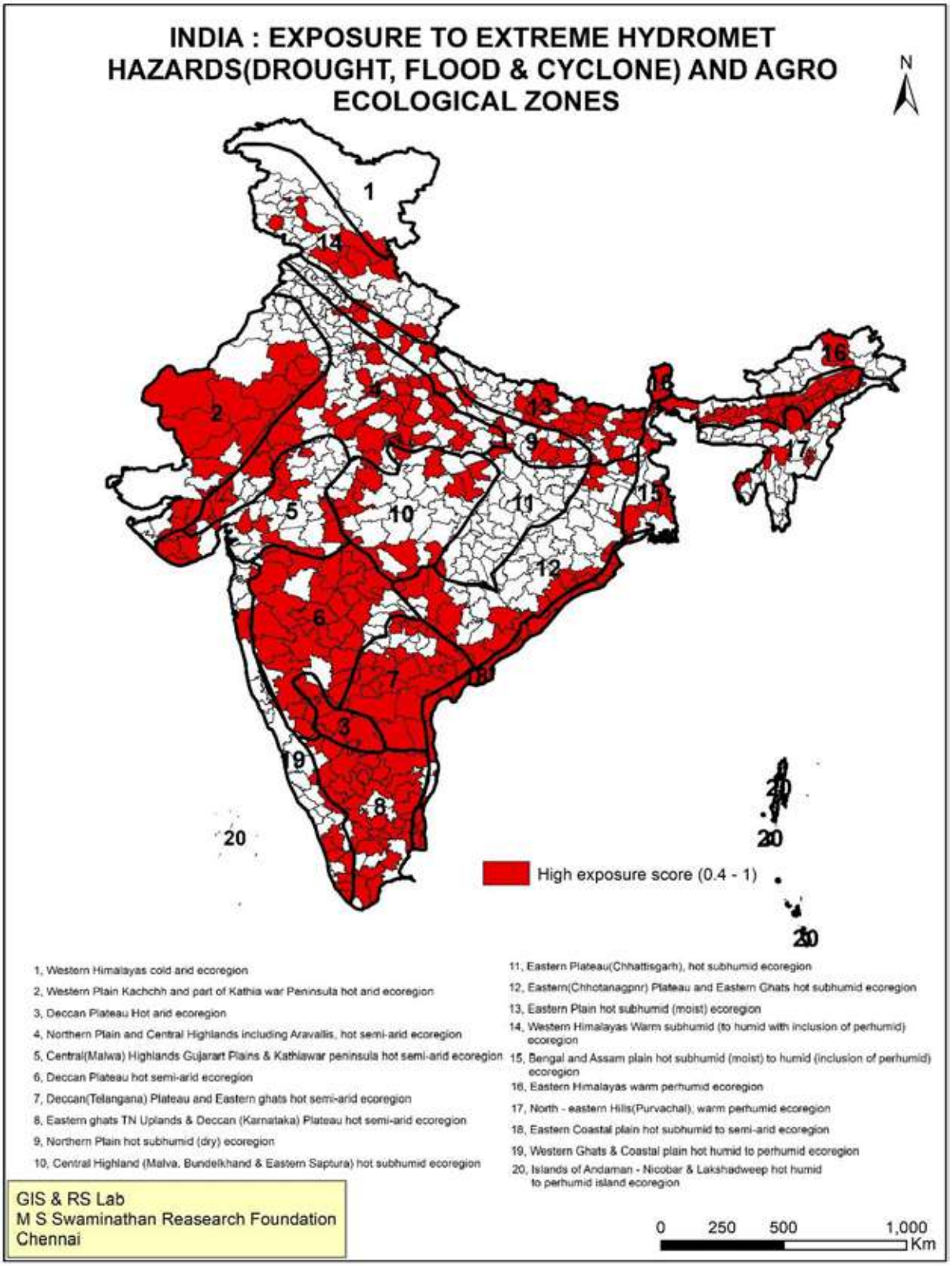
In India, according to CEEW, out of 640 districts, 183 districts are vulnerable to more than one hydro-met disasters and majority of districts (349 districts) witness drought. In India, a total of 54 percent of women and their children below the age of 5 years sampled for NFHS-5 belonged to districts with high exposure to hydro-met hazards in 2021. Seventy five percent of the Indian population of women and children are exposed to some climate hazard (IIPS and ICF, 2021; Mohanty and Wadhawan, 2021). Maps 1.4 and 1.5 show the overlaps between exposure to heatwaves and extreme hydromet hazards and agroecological zones respectively. For the latter, a score of over 0.4 is taken as high exposure risk to hydromet hazards (CEEW).

Map 1.4. Severity of Heatwaves across different AgroEcological Zones



Source: Data on Heat waves from Ministry of Earth Sciences, Government of India, 2019.

Map 1.5. Exposure of agro ecological zones to extreme hydromet hazards (Drought, flood and cyclone)



Source: CEEW, 2021, Study on Mapping India's Climate Vulnerability: A District Level Assessment.

1.9. Urban /Peri-Urban Areas Need More Attention

India is one of the fastest urbanising countries globally. In the country as a whole, the level of urbanisation increased from 27.7 percent in 2001 to 31.1 percent in 2011. Effectively, this reflects the migration from rural to urban and peri-urban areas with many of the migrants being climate refugees (Mitra and Singh, 2011, Mitra et al 2015). A large majority of these migrants live in poor conditions in slums and tenements, mostly informal/illegal. As these areas already suffer from a lack of clean water and sanitation facilities, they are worsened by sudden events, like the floods in parts of Delhi in 2023. These areas are under-researched. Also, as this study found, there is not much research on the health of migrants.

1.10 Chapterisation

This scoping study focused on looking at issues of women and children's health, women's livelihoods and children's education due to climate change. Many conceptual and data gaps were identified. These themes form the core chapters of this report. Thus, after this introductory chapter, the methodology of the study is discussed in chapter 2. Chapter 3 discusses the impact of climate change on women's health and wellbeing. The impacts of climate change on women's livelihoods are discussed in chapter 4. Chapter 5 discusses the susceptibility of children to climate change. In chapter 6 the knowledge gaps identified in this study are described. Chapter 7 summarises the main findings and makes recommendations and identifies areas for urgent action.

We received an overwhelming response from the participants in the workshops in the form of contributions about the aspects of climate change they were engaged with. The contributors included researchers/academics, journalists and civil society organisations from across the country. For reasons of space not every submission could be included.

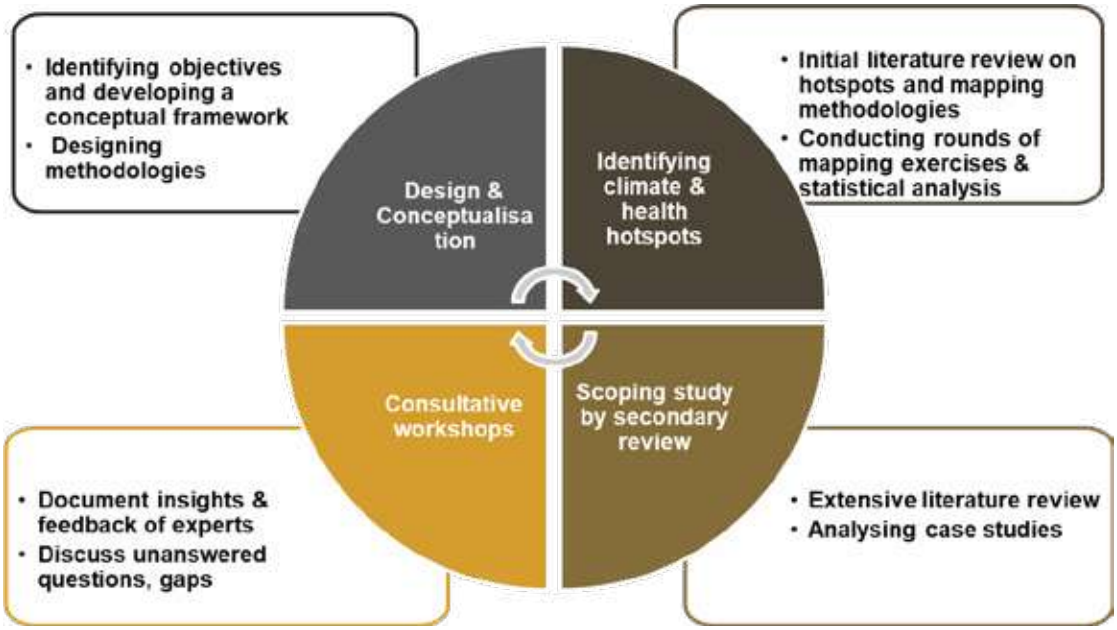
We do not claim any causality or attribution in our analyses but show the co-existence of multiple phenomena. Moreover, we argue that some phenomena, like intimate partner violence, already exist in society and the adverse effects of climate change might accentuate them. Also, the meteorological hazards might occur simultaneously or one after the other in quick succession. However, it has to be kept in mind that people, especially women, are not passive victims. They are organizing and adapting, often helped by an external organisation, to withstand the effects of climate change.

CHAPTER 2: METHODOLOGY

2.1. Methodology of the study

This scoping study is mainly based on secondary sources of data, including literature review, quantitative data analysis, and case studies, along with some primary data from stakeholders and experts. The study comprises four steps i.e. conceptualization and identifying objectives, followed by mapping and statistical analyses, extensive secondary literature reviews, case studies, and insights from subject matter experts (Fig 2.1). A brief description of each step is provided below:

Fig 2.1: Overall Methodology of the Study



Source: Study Team

I. **Design and Conceptualisation:** The initial phase involved designing and conceptualising the study. During this stage, the study's objectives and rationale were identified based on existing literature. A conceptual framework was drawn up and methodologies were devised to achieve the study's objectives.

II. **Identifying Climate and Health Hotspots:** The key variables associated with climate change vulnerability and indicators to assess the impacts on women and children were identified through a comprehensive literature review. Statistical analyses to measure associations and geospatial mapping was undertaken using existing national datasets.

III. **Scoping study by secondary review:** An extensive review of the literature was undertaken to understand the multidimensional implications of climate change on women and children. Also, case studies on local adaptation and resilience strategies were sought to be documented to lay the ground for a sustainable future plan of action.

IV. **A series of consultative workshops** organised with climate, health, womens studies and livelihood researchers and practitioners nationwide to gather evidence, insights

and firsthand experiences from those actively engaged in grassroots efforts. Additionally, state-level officials formulating the State Action Plans on Climate Change (SAPCCs), were engaged in discussions to better formulate gender transformative SAPs.

2.2. Overall Conceptual Framework adopted in the study

The Intergovernmental Panel on Climate Change (IPCC) in 2023 conceptualised climate risk as a function of hazards, exposure and vulnerability. Hazard refers to "the potential occurrence of a natural or human-induced physical event that may cause loss of life, injury, or other health impacts, as well as damage to property, infrastructure, livelihoods, service provision, ecosystems, and environmental resources" (Lee et al., 2023).

Based on the IPCC report, the scoping study classified hazards as sudden onset like floods and cyclones and slow onset like droughts, rainfall variability, heat waves, air pollution, and cold waves (Fig 2.2). Statistical and mapping exercises were undertaken to understand the impact of floods, cyclones, and droughts on women and children.

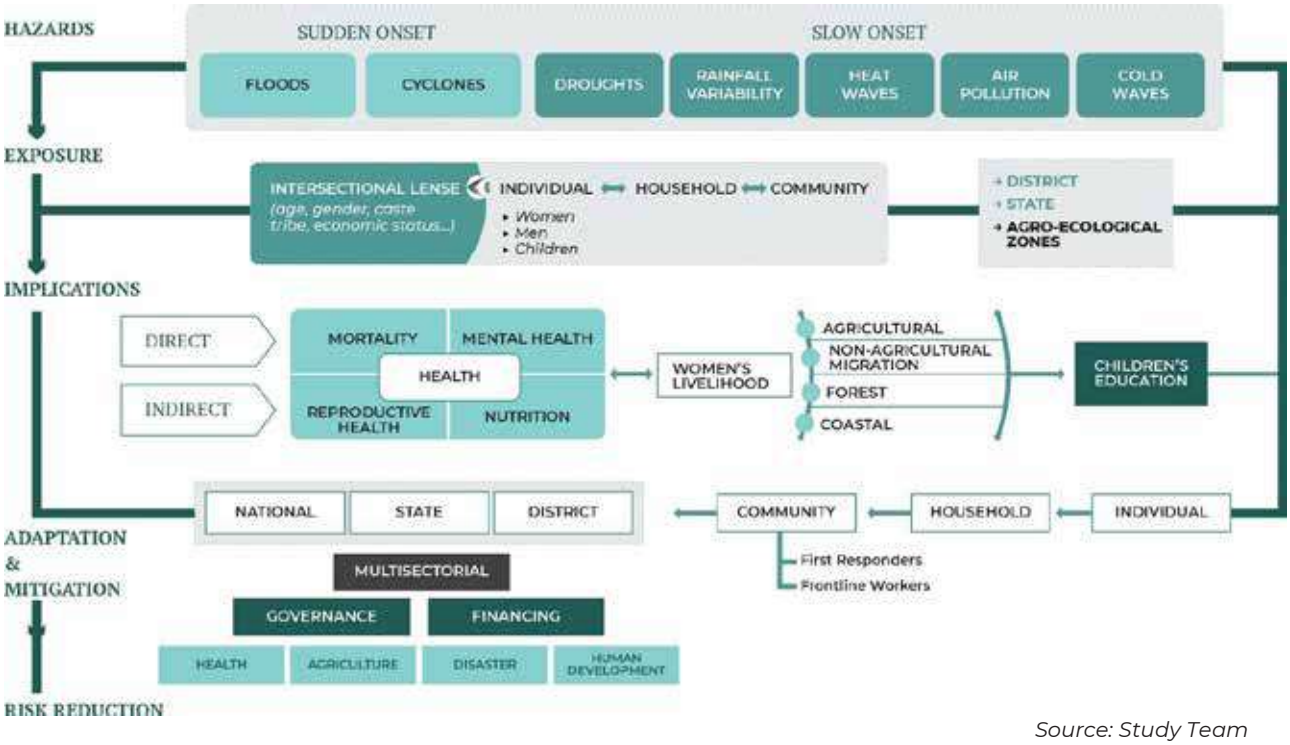
Exposure refers to "the presence of people, livelihood, species or ecosystems, environmental functions, services, resources, infrastructure, and economic, social, or cultural assets in places and settings that could be adversely affected" (Lee et al., 2023)

The study emphasised the need to view climate-related exposures through an intersectional lens, considering factors like gender, age, socio-economic status, education level, and the geographic area, be it administrative (district, state) or be it natural (agroecological zone) (Fig 2.2).

Further, the impact or implication defined as the "consequences of realised risks on natural and human systems, where risks result from the interactions of climate-related hazards, exposure and vulnerability" (Lee et al., 2023). Based on this definition, we have attempted to study both direct and indirect impact broadly on three aspects: women's and children's health, women's livelihood, and children's education (Fig 2.2).

Vulnerability refers to "the propensity or predisposition to be adversely affected due to a lack of capacity to cope. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to adapt" (Lee et al., 2023).

Fig 2.2: Conceptual Framework Adopted in this study



Source: Study Team

The following conceptual considerations were taken into account while assessing the impact of climate change (Fig 2.3):

- Implications of hazards differ based on whether they are slow onset or sudden onset.
- Implications can be either acute (short-term and immediately visible) or chronic (long-term and indirectly reflected). For instance, in this study, three hydromet hazards, namely Flood, Cyclone, and Drought, have been considered for statistical analyses. The pathways of the impacts of these hazards vary. Drought, a slow onset-long-term hazard, indirectly affects health and nutritional indicators, later impacting socio-economic levels and resulting in a loss of human capital. On the other hand, floods and cyclones are sudden and short-term hazards leading to an immediate loss of lives and property, causing an increase in poverty and social issues and further exacerbating poor health outcomes.
- It is important to note that the impact is not uniform across all population groups; certain social groups or population sub-groups are more vulnerable.

2.3. Data Sources and Indicators for mapping and statistical analyses

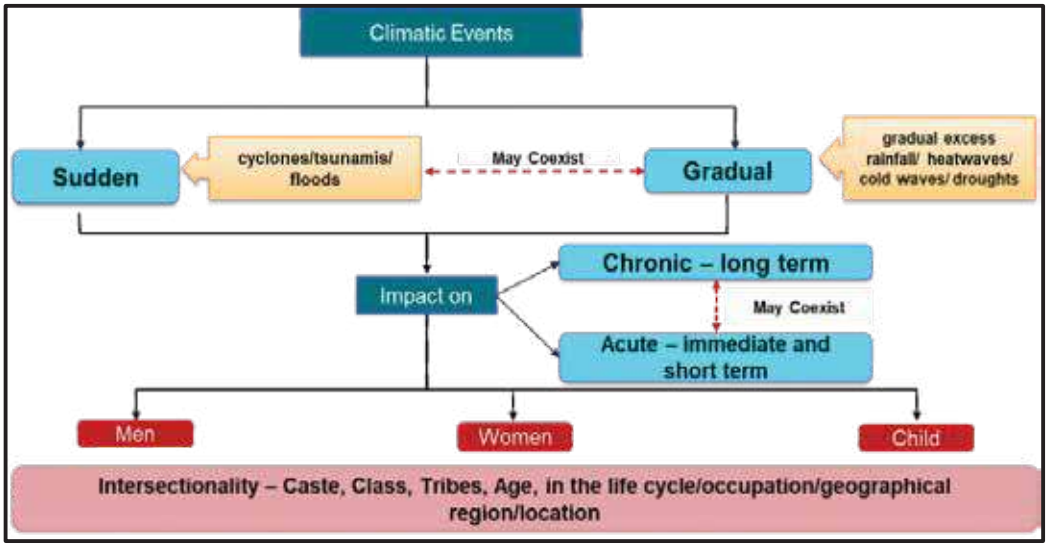
This study used two key data sources: district-level data from the Council on Energy, Environment, and Water (CEEW)[1] and individual-level data from the National Family Health

[1] In 2021, CEEW published a report titled "Mapping India's Climate Vulnerability- A District level assessment" (Mohanty and Wadhawan, 2021) where they analysed the data on the frequency and intensity of three extreme hydro met hazards, i.e., drought, flood, and cyclone for the period of 1970 to 2019 and generated exposure scores. A higher exposure score means that the area is highly vulnerable to climate change in terms of drought, flood, and cyclone. Further, along with these exposure scores, decadal frequency of drought, flood and cyclone are also obtained for the year 2010-19 from CEEW.

Survey (NFHS)[2]. These datasets provide comprehensive insights into climate vulnerability at the district level and the health status of individuals within those districts. Information on agroecological zones is obtained from National Bureau of Soil Survey and Land Use Planning (NBSS & LUP) of Indian Council for Agricultural Research (ICAR).[3]

Data on heat was obtained from the Ministry of Earth Sciences and Air pollution from University of Chicago database on air quality.

Fig 2.3: Conceptual Considerations in this study



Source: Study Team

Indicators

Climate vulnerability was assessed through two indicators: (1) exposure scores, and (2) whether a district is exposed to drought, flood, and/or cyclone. Implication of climate vulnerability on women was assessed through five indicators: (1), the percentage of underweight women, (2) girl child marriage, (3) experiencing Intimate Partner Violence (IPV), (4) miscarriage/stillbirth, and (5) drop-out from the minimum recommended Antenatal Care (ANC).

Implication of climate vulnerability on children was assessed through six indicators namely - (1), the percentage of children underweight, (2) minimum dietary diversity, (3) deaths under five years of age, (4) diarrhoea, (5) immunization coverage, and (6) uptake of Integrated Child Development Services (ICDS).

The indicators were selected after thoroughly examining more than 50 indicators available in NFHS data, their relevance based on literature and experts, as well as data limitations. Appendix 1 provides a detailed description of each of the indicators.

[2] The National Family Health Survey (NFHS) has been conducted since 1992 in India under the Ministry of Health and Family Welfare (MoHFW) with the International Institute for Population Sciences (IIPS) as the nodal agency to understand the population, health, and nutrition scenario of the country (IIPS and ICF, 2021). The fourth and fifth round of NFHS data conducted in 2015-16 and 2019-21 is considered in this study to obtain the women and child related health and socio-economic indicators.

[3] In 1992, the National Bureau of Soil Survey and Land Use Planning (NBSS&LUP) first published the Atlas of Agro Ecological Regions (AERs') in India, which delineated India into 20 zones based on the soil, climate, length of growing period (LGP) and related geographical and biodiversity data (Sehgal et al., 1992).

2.4. Methods and Analytical Considerations for Mapping and Statistical Analyses

Mapping and statistical analysis techniques were sought to fulfil three key objectives. Firstly, quantifying the exposure to hydromet hazards on women and children's health and wellbeing. Secondly, pinpointing the spatial hotspots where exposure to hydromet hazards coexists with poor health and well-being indicators. Thirdly, identifying vulnerable population sub-groups, because women and children are not homogenous. Hotspot identification was in two stages: firstly, identifying the most susceptible agroecological zones, and secondly, pinpointing the most vulnerable districts. This process offered comprehensive insights for prioritising strategies aimed at mitigating the compounded negative implications of climate change. The mapping and statistical analysis in this study followed a structured approach consisting of five key steps discussed below

2.4.1. Developing the database:

A set of women and child health and wellbeing indicators from NFHS were chosen to look for associations with climate vulnerability. Simultaneously, an exhaustive search was conducted to identify the most suitable index for measuring climate vulnerability. Indicators were constructed in alignment with Demographic Health Survey guidelines, assigning appropriate weights and carefully addressing sample size and missing values using individual files on women and children separately. From here, two sets of databases were constructed as given below:

- **District-level dataset for spatial analysis**: Proportions were calculated at the district level for health and wellbeing indicators from NFHS-5 data of 2019-21 and overlayed on CEEW data on exposure score and agroecological zones (AEZ). The data for NFHS-5 was available for 707 districts, but the data on exposure scores obtained from CEEW was available for 640 districts. The 707 districts of India in 2021 were superimposed on the maps of the 20 agro-ecological zones to determine the distribution of districts according to agro-ecological zones. The additional districts in the NFHS-5 have taken the value of the parent districts for CEEW exposure scores.

- **Analytical Considerations** - In this study, exposure scores indicate the change in frequency and intensity of hydromet hazards (drought, flood and cyclone) over the last 50 years (1970-2019). A higher exposure score reflects that the district is witnessing increasing hydromet hazards, and a lower exposure score is the reverse. To identify the hotspot districts, where climate change and poor status of health and well-being of women and children coexist, the data of the latest round of NFHS 5 (2019-21) was taken. It was assumed that the exposure score is indicative of climate change from 1970 to 2019, whose impact would be visible in 2019-21 NFHS data.

- **Individual-level dataset for multivariate analysis:** The data of NFHS-4 for the year 2015-16 and NFHS-5 for the year 2019-21 was pooled in order to understand the level of health and socio-economic indicators during 2015-21. Pooled data allows an increase in sample size and statistical power, thereby enabling more robust analyses and drawing more accurate conclusions.

Analytical Considerations - This study conceptually recognised that exposure to drought, flood or cyclone has a differential impact on women and children. To understand these differential implications of hydromet hazards, the districts were classified according to whether they were exposed to a particular hydromet hazard or not, based on the occurrence of these hydromet events between 2010 and 2019. It was assumed that all the individuals in the district had the same exposure to the hazards.

To ensure consistency between the NFHS data and the exposure data, the two most recent rounds of NFHS, conducted in 2015-16 and 2019-21, were combined to generate the database for 2015-21. The NFHS provides data on children born five years before the survey and their mothers. By combining the data of women and children from these two NFHS rounds, data could be obtained for a ten-year period 2010-21, which is equivalent to exposure data of CEEW. The objective was to examine the impact of droughts, floods, and cyclones between 2010 and 2019 on the health of women and children surveyed from 2015 to 2021.

2.4.2. Identifying climate-vulnerable regions:

The process of superimposing maps of climatic hazards on agroecological regions was adopted. It allows for identifying vulnerable regions at heightened risk of adverse impacts from climate change. This spatial analysis approach would help to prioritise resources and interventions to enhance resilience and adaptation in the most vulnerable areas.

Superimposing the map of exposure scores of extreme hydromet hazards with agroecological regions: This step overlapped maps of exposure scores for extreme hydromet hazards, such as droughts, floods, and cyclones, with maps delineating agro-ecological regions. An exposure score of 0.41 and above was considered a high exposure score reflecting higher vulnerability to climate change based on records for the period of 1970-2019. By superimposing the maps of exposure scores with agro-ecological regions, we identified the areas where the risks posed by hydromet hazards intersect with specific agro-ecological conditions.

Superimposing the maps of exposure to heat waves on agroecological regions: The data on heat waves were obtained from the Ministry of Earth Sciences, which classified the Indian districts into five categories i.e. Very High (more than 701 heat wave days), High (401-700 number of heat wave days), Moderate (201-400 number of heat wave days), Low (51-200 number of heat wave days), Very Low (less than 50 number of heat wave days) during the period 1969 to 2019.4 By superimposing the heat wave exposure map with agroecological regions, the areas where heat wave vulnerability coincides with specific agroecological characteristics were identified. This enables the identification of regions where heat waves are likely to have a pronounced impact on agriculture, livelihoods, and human health

Superimposing the maps of air pollution exposure on agroecological regions: The data on air quality were obtained from the air quality database developed by University of Chicago (University of Chicago, 2021). The states were classified based on National Ambient Air Quality Standards which defines poor air quality as that exceeding the annual average of PM 2.5 of 40 µg/m3. This standard was given by the Central Pollution Control Board. By superimposing the air pollution exposure map with agroecological regions, we identified the areas where air quality concerns intersect with specific agroecological conditions. This helps identify regions where agricultural activities and rural and urban livelihoods and health may be adversely affected by air pollution and where interventions to mitigate pollution-related risks are warranted.

2.4.3. Coexistence of climate vulnerability with health and socio-economic indicators:

Mapping was undertaken to highlight spatial hotspots using the district-level merged data, overlaying exposure scores, women and child indicators, and agroecological regions. The geospatial analysis was conducted through a spatial autocorrelation analysis for each set of variables separately. This analysis helped to determine if there is spatial clustering or patterns in the distribution of the variables. It has been calculated using Moran's I (Anselin, 1996), which tells whether there is spatial dependence between the two variables. In simple words, this indicates in each of the districts, how two variables relate to each other. The confidence interval is taken at 95 percent which means that it can be said confidently that the spatial relation between two variables holds true for 95 out of 100 cases. The geospatial mapping identified districts vulnerable to climate as well as with poor health and socio-economic indicators, shown in red in Maps 3.1, 3.2, 3.3, 4.1 and 4.2. Districts with high vulnerability in terms of climate but with good health and socio-economic indicators are shown in green (Maps 3.1, 3.2, 3.3, 4.1 and 4.2).

2.4.4. Quantifying the impact of climate vulnerability on women and children

Multivariable logistic regression analysis was conducted to quantify the impact of exposure to drought, flood and cyclone separately on women and child indicators using individual level pooled dataset. Adjusted logistic regression is a statistical modelling technique used to analyse the relationship between an outcome variable (in our case, women and child indicators) with predictor variables (i.e.whether exposed to drought, flood or cyclone separately) while controlling for the effects of other covariates or confounding factors. The confidence interval was taken at 95 percent.

The regression analysis was adjusted using different variables, identified through literature survey (Garg et al., 2021; Kumar et al., 2019; Shankar et al., 2023; UNICEF, 2021; Binu. et al., 2022). Women-related indicators were adjusted for place of residence, social group, wealth status, sanitation facility, clean water facility, clean cooking fuel, mass media exposure, mass media exposure, and women's education. Child-related indicators were adjusted for place of residence, sex of the child, social group, wealth status, sanitation facility, clean water facility, clean cooking fuel, mother's mass media exposure, mother's education, mother's BMI, birth order, mother's age at first birth, child current age, number of household members, and Integrated Child Development Service (ICDS). Since pooled data was used, the effect of time was controlled.

2.4.5. Disaggregated Analysis on the impact of climate vulnerability on women and children

The study population was further disaggregated based on place of residence (rural, urban) and social group (Scheduled Caste, Scheduled Tribes, Other Backward Class, and General), and adjusted logistic regression analysis was employed to see how the level of impact of climate vulnerability on women and children varied by place of residence and social group. The analysis was conducted for all three hazards, but it was found that drought being a slow-onset hazard provided a better understanding of the impacts. Also, the sample size reduces when the data is disaggregated, and many aspects of the model remain insignificant, which means we can't confidently say that the results hold true for at least 95 out of 100 attempts. It affected our results on social group analysis.

2.5. Limitations

Some of the major limitations of the study and the data analyses are listed below:

- **Data Scope:** The study primarily relies on data from the Council on Energy, Environment, and Water (CEEW) for assessing climate vulnerability at the district level. However, it is important to note that the CEEW exposure score predominantly focuses on hydro-meteorological hazards such as droughts, floods, and cyclones. While these hazards are undoubtedly significant, they represent only a fraction of the broader spectrum of climate-related risks. Other crucial factors, such as heat waves, air pollution, and variations in rainfall patterns, are not comprehensively captured by the CEEW data. This hampers the full understanding of the multi-dimensional nature of climate vulnerability and the implications for health and well-being in one frame.

- **Lack of data sources:** While undertaking the analysis for drought, flood and cyclone separately, an attempt was made to include heat waves and air pollution. Data constraints prevented a robust analysis for these variables.

- **Definition Clarity:** Another challenge pertains to the varying definitions of key hazards, including droughts, floods, and cyclones. Different regions and stakeholders employ distinct definitions and criteria for identifying and categorising these hazards, leading to inconsistencies in interpretation and analysis. The lack of standardised definitions complicates efforts to compare and synthesise findings across different contexts and geographic regions. Also, there have been definitional changes over a period of time to define drought and other hazards, which has remained out of scope from the CEEW study.

- **Data Consistency**: The study relies on NFHS for health and socio-economic data. However, there is a temporal discrepancy between NFHS data collection and CEEW exposure scores. NFHS data at the district level are available only from 2015-16 onwards, whereas CEEW exposure scores span a much longer timeframe from 1970 to 2019. This disparity in data timelines poses challenges in aligning and contextualising the findings, potentially affecting the robustness and accuracy of the analysis.

- **Challenges in capturing impact of hazards**: NFHS survey may not be conducted just after the occurrence of extreme climatic events, capturing its impact. So, it is very difficult to capture the impact of hazards, particularly sudden onset events like floods and cyclones.

- **No Projections: The present scoping study is based on climatic hazards data till 2019, and is not projecting trends in climatic hazards**. It is assuming if the present trends continue then there will be a certain level of impact on health and wellbeing of women and children. It doesn't predict whether the intensity of these climatic hazards will be increasing or decreasing in future – to do that, there is need for more robust data and projection-based analysis.

- **Confounding Factors:** Controlling confounding factors was a fundamental challenge in the study. Health and well-being indicators are influenced by a myriad of contextual and intervening variables, including programmatic interventions, socio-cultural dynamics, and economic disparities. While the study attempts to elucidate the relationship between climate vulnerability and health outcomes, disentangling the effects of climate variables from these confounding factors

remains inherently complex. This limitation underscores the need for more nuanced and context-specific analytical approaches to tease apart the intricate interplay of factors shaping health outcomes in vulnerable populations.

- **Seasonality Considerations:** The seasonal dynamics of hazard exposure represent another dimension that warrants attention. Hazards such as droughts, floods, and cyclones may exhibit pronounced seasonal variability, with distinct patterns of occurrence and intensity across different seasons. However, the study does not explicitly account for these seasonal variations in hazard exposure, potentially overlooking important temporal dynamics in climate vulnerability. This limitation underscores the need for more temporally nuanced analyses that consider the seasonality of hazard exposure and its implications for health outcomes over time.

- **Migration Dynamics:** Finally, the study does not analyze the influence of climate vulnerability on migration dynamics and health outcomes. In fact, no significant literature could be found on this subject.

CHAPTER 3: IMPACTS OF CLIMATE CHANGE ON WOMEN'S HEALTH AND WELLBEING

3.1. Background

The disproportionate impact of natural disasters and climate change on women is a multifaceted phenomenon deeply influenced by the complex interplay of socioeconomic factors, cultural norms, and gender dynamics shaping women's experiences and vulnerabilities (World Bank Group, 2011). Women, who are marginalised and excluded from decision-making processes due to their social roles and responsibilities within communities, bear the burden of climate-related hazards (Sorensen et al., 2018). Their vulnerability is not a reflection of inherent weakness but rather a consequence of systemic inequalities including limited access to resources, educational and economic opportunities, restricted mobility and decision-making power (UNDP, 2008). These disparities enhance women's climate-induced risks, amplifying their exposure to adverse health outcomes, especially in contexts marked by poverty. According to UN Women's Gender and Climate Data Works, under a 'Worst-case Climate Path' scenario, by 2050, approximately 160 million women and girls worldwide could be forced into poverty directly due to climate change. The number of women and girls affected by food insecurity caused by climate change is expected to rise by nearly 240 million, in contrast to 131 million more men and boys (UN Women, 2023).

The implications of climate change on women's health are far-reaching and complex, spanning across multiple dimensions of well-being. Pregnant women, for instance, face heightened risks during disasters, including exposure to contaminated water sources, limited access to prenatal care, and challenges in securing safe childbirth facilities (Sorensen et al., 2018). These challenges not only risk maternal health but also impact the health and survival of infants, prolonging intergenerational cycles of vulnerability. As primary caregivers, women play a critical role in mitigating the impacts of climate change and building resilience within their communities. However, their efforts are often hindered by systemic barriers mentioned previously, The health consequences of climate change are projected to intensify, posing unprecedented challenges to global health systems and exacerbating existing health disparities (WHO, 2014). Described as a health emergency by the World Economic Forum (Eitelwein et.al, 2024), climate change is transforming the landscape of morbidity and mortality by undermining the fundamental determinants of health, such as access to clean air, safe drinking water, adequate food supply, and secure shelter (Campbell-Lendrum et.al., 2018). In this context, women emerge as a particularly vulnerable group, facing multiple challenges that compound the impacts of climate change on their health and well-being. Integrating a gender perspective into climate change adaptation and mitigation strategies is imperative to address the unique needs and vulnerabilities of women (Sorensen et al., 2018). By recognising and addressing the gendered dimensions of climate change, policymakers can foster more inclusive and effective responses that promote health equity and resilience across diverse populations.

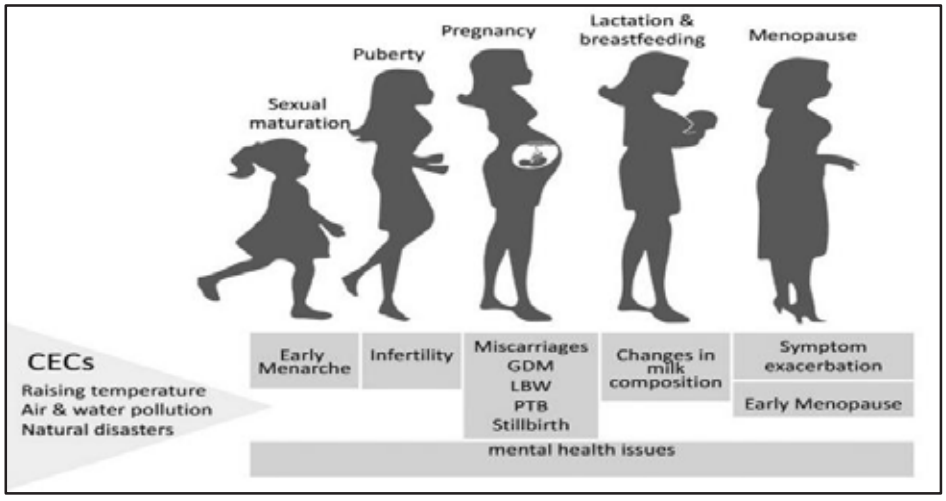
This chapter outlines the implications of climate change on women's health and wellbeing and highlights how women face disproportionate impact across life stages. It provides a thematic review of implications of various extreme climatic events and sheds light on

quantifying the impact and identifying hotspots for selected health and wellbeing indicators.

3.2. Vulnerability of women across life stages

The vulnerability of women to climate change is attributed not only to the physiological differences but primarily to the social roles and existing inequalities which disproportionately affect women. The work of Dunne (2020) clearly brought out the fact with evidence; out of 130 climate and health studies globally, around 68 percent concluded that women were more affected than men. The continuum of an individual's life spans four broad stages—infancy, puberty, adulthood, and elderly—each defined by distinct characteristics; while menstruation, pregnancy, and childbirth are unique to women's life stages (Takeda, 2010). There are unique needs, opportunities and challenges associated with each of these stages. Around 303,000 women die due to preventable causes associated with pregnancy and childbirth; 18 per cent of early adolescent girls experience sexual abuse; 12 million girls witness girl child marriage; women are more likely affected by infectious diseases and witness many health problems in their post-reproduction years, globally (WHO, 2019). Climate change is said to be a "threat multiplier" (UN Women, 2022), it intensifies the already existing challenges in women's lives through an interplay of socioeconomic, political and legal barriers like limited access to financial resources, burden of unpaid work, discriminatory laws, lack of voice in decision making, limited land ownership and lack of technology and capacity building resources (Gunawardena, 2020). Girardi and Bremer (2022) highlight the effects of climate and environmental changes on women across reproductive life stages in the form of early menarche, infertility, miscarriages, gestational diabetes, low birth-weight, stillbirth, changes in milk composition and early menopause along with continued impact on mental health (Figure 3.1).

Figure 3.1. Effects of Climate and Environmental Changes on women across reproductive life stages



Source: Girardi et.al, (2022)

Due to climatic vulnerability, women and girls face an increased risk of malnutrition and limited access to health and educational services (Algur et al., 2021). In India, the vulnerability of pregnant women is heightened during floods (Krishna et al., 2018). In reproductive years, pregnant women and fetus undergo psychological and physiological changes, and disruption in the environment could lead to both immediate and long-lasting

effects on the health of the mother and the child (Ha, 2022). After climate-related disasters, women and girls, particularly those who are elderly or living in disadvantaged socioeconomic conditions, are at elevated risk of experiencing physical, sexual, and domestic violence (Sorensen et al., 2018). Various socio-economic and cultural factors, which intersect across the different life stages of women increase their susceptibility to climate-related impacts. However, there is a lack of studies in the Indian context tracing the impact of climate change on women through a life course approach; there is a dire need for such studies in order to develop strategies at early ages in order to break this vicious cycle of transmission of compounding impacts from one life stage to another.

3.3. Impact of climatic events on women's health and wellbeing

Climate change is expected to lead to 2.5 lakh additional deaths per year between 2030 and 2050 globally due to indirect pathways of undernutrition, malaria, diarrhoea and heat stress (WHO, 2023). Climate-related challenges are interconnected to each other. However, each climate event has differential impacts and pathways; hence, an intersectional and context-specific perspective on the impacts of various climatic events is much needed (Brown et al., 2019). This section examines the impacts of four climatic events: heat waves, drought, floods, and air pollution on women.

3.3.1. When the Heat Hits Home: Women are on the frontlines of climate change's Health Crisis

Heatwaves, characterised by a sustained period of exceptionally high maximum and minimum temperatures both during the day and at night, have emerged as a significant global public health concern. In 2018, over 220 million vulnerable individuals globally experienced the adverse effects of heat waves. The prediction studies in India also highlighted that heat waves intensity rise about 30 times in India by 2022, accentuating the urgent need for effective mitigation strategies (WMO, 2023). Gender plays a vital role in exposure to extreme heat; the most vulnerable groups include the elderly, pregnant women, infants and children, outdoor workers, and the poor (WHO, 2018).

The association between heat waves and increased mortality rates is evident in various studies, globally and in the Indian context. During the years 2010 and 2014, when Nagpur witnessed major heat waves, there was a notable rise in all-cause mortality by 30 per cent in 2010 and 14 per cent in 2014 compared to non-heat wave days (Dutta et al., 2020). Expert perspectives from specialist doctors in Hyderabad further corroborate the adverse health impact of extreme heat, indicating a rise in heat-related illnesses in the region (Chandra et al., 2023). Several studies in the Indian context show the relative vulnerabilities of men and women when exposed to heat waves. Men were found to experience higher relative risk than women due to occupational factors in Western India and Pune city, particularly through the pathway of non-infectious diseases (Ingole et al., 2015 and Ingole et al., 2021).

Another study in Puducherry shows contrasting findings, as it found women above 60 years of age to be more vulnerable to heat than men, as they spend relatively more time inside houses with inadequate air conditioning, which makes them more vulnerable to urban heat island effects. Thus, conditions in the places where people work, and the duration appear to determine their health outcomes. Nevertheless, the physiological differences among the sexes, like differential thermoregulation thresholds and menopausal transition

among women, put them at increased risk of cardiovascular diseases and vulnerability to heat (Shrikhande et al., 2023). In Varanasi, diurnal temperature variability was found to cause more mortality among men as compared to women, but for women the heat wave posed a greater risk of mortality. This suggests that women are likely to be more vulnerable to extreme heat (Singh et al., 2019).

The existing studies fail to establish context-specific differences between men and women that could explain such gender differential impacts. They also do not capture the details about women's working conditions, particularly of those engaged in agricultural activities leading to exposure to heat waves.

More detailed analysis linking the nature and duration of exposure across various sectors and between the genders is required to comprehensively understand women's occupational heat vulnerability. In yet another study, female brickfield workers in Nadia, Hooghly, and Howrah districts of West Bengal experienced a decline in productivity with rising temperatures, attributable to physiological strain and significantly higher cardiovascular parameters with implications for overall well-being (Sett and Sahu, 2014). Limaye (2023), in a review, highlighted that extreme temperature damages both physical and mental health and consequently leads to financial burdens on individuals, families and communities. However, gender-specific dimensions of heat-related impacts are poorly captured in current policy responses in the global south, including India.

Studies from other countries highlight various forms of impact of extreme heat on women's health. A study in Pakistan points out the impact of outdoor temperature on hypertensive women in the form of elevated blood pressure, (Riaz et al., 2020). In the United States of America, it has been found that pregnant women face heightened health risks if exposed to heatwave, particularly in the second and third trimesters, with increased incidents of pregnancy-related hypertension, uterine bleeding, eclampsia, and incompetent cervix (Cil and Cameron, 2017). Similarly, studies in China and other parts of world also reaffirm that there is a significant association between ambient temperature and gestational hypertension among pregnant women who may develop pre-eclampsia (Xiong et al., 2020). Stressors experienced by families due to climate change could lead to 'marrying off' girls. A study in Bangladesh found girls marrying during periods of extreme heat waves tended to enter households of lower socioeconomic status (Carrico et al., 2020).

It is clear from these studies that there is a huge impact of heatwaves on public health, and women are disproportionately affected due to the nature of their work and underlying physiology. There are substantial research gaps in understanding the differential impact of heat on men's and women's health. Distinguishing heat-related mortality from overall reported mortality data, exploring the emotional and psychological impacts on women instead of focusing just on physical health and understanding the differential pathways of the impact of heat on women based on their place of residence (urban and rural), place of work and the conditions that prevail there, and geographical region are major areas for future research in the Indian context to estimate the true impact of heat-related gendered health challenges.

3.3.2. Silent suffocation: The hidden cost of air pollution for women

Studies conducted across various regions of India reveal a concerning trend that exposure to different forms of air pollution significantly impacts women's health. For instance, research demonstrates a compelling association between exposure to ambient particulate matter, especially PM2.5, and decreased bone mineral content in women, affecting critical areas like the lumbar spine (Ranzani et al., 2020). The adverse health effects of poor indoor air quality are noticeable, with a significant proportion of women reporting symptoms such as breathlessness, coughing, and nasal congestion (Priyadarsini et al., 2022). Further, extreme heat events exacerbate the risks posed by air pollution, with women bearing the brunt of the impact. During periods of extreme heat, there is a notable increase in all-cause mortality among women, emphasising the critical importance of implementing protective measures (Rathi et al., 2021).

Women from certain population groups are more vulnerable to the health effects of air pollution due to differential vulnerabilities faced by them. Women living in industrial towns face heightened risks of air pollution experiencing a higher prevalence of angina and cardiovascular symptoms compared to their male counterparts, underscoring gender-specific vulnerabilities to industrial air pollution (Nautiyal et al., 2007). In homes where biomass is used regularly for cooking, daily concentrations of indoor air pollutants can be 10-20 times higher than WHO's norms for household air pollution (Balakrishnan et al., 2004). In urban slum settings, women face compounded effects due to inadequate ventilation; the use of kerosene oil for cooking contributes to a host of respiratory issues among women, highlighting the urgent need for improved indoor air quality (Maharana et al., 2018).

Women in rural areas, especially in households using wood or biomass for cooking are equally susceptible to indoor air pollution (Mohapatra et al., 2018). A study in a rural district of Karnataka found women's average exposure to high levels of black carbon was like that of auto-rickshaw passengers in New Delhi (Norris et al., 2016). The same study also established the association between women's exposure (within minutes to hours) to black carbon and systolic blood pressure. At the same time, multiple studies in India underscore adverse respiratory consequences of indoor air pollution on pregnant women and their foetuses due to exposure to biomass smoke from cooking stoves (Amegah et al., 2014; Page et al., 2015). Parikh et al., 2021 further confirm the problems of respiratory diseases due to indoor air pollution through an interview of pregnant women in villages of Nagpur district in Maharashtra. Rural middle-aged and elderly women in India, particularly those from lower socio-economic backgrounds, are found to face significant impacts of indoor air pollution on their cognitive health (Dakua et al., 2022).

Balakrishnan et al.(2015) explore the complexity of rural-urban continuums in Southern India to exposure to air pollution, and the differential impacts on maternal and child versus adult outcomes, acting as a valuable step in prioritising mitigation and control strategies for specific population groups. This also underscores the lack of attention to the vulnerability of women in peri-urban areas and calls for more research. Also, there is a considerable scope for future research following the cohort or longitudinal design and clinically testing the concentration of air pollutants to understand the extent of health problems directly associated with air pollution. Most of the existing studies are cross-sectional and depend upon qualitative interviews to report health issues. The multifaceted

and severe impacts of air pollution on women's health calls for comprehensive strategies aimed at reducing exposure to indoor and outdoor pollutants, both in urban and rural area.

3.3.3. Uneven Downpour: Unseasonal Rains and the Health Risks for Women

Floods impact women differently across the life stages: on the one hand, elderly women experience high vulnerability due to morbidities and restricted mobility in a difficult flood situation; and on the other, younger women have caregiving responsibilities in addition to being earners, placing significant double burden on them within the household (Madhuri, 2015). The same study further revealed through a focus group discussion in flood-affected districts of Bihar that existing gender inequalities and limited access of women to information and relief materials often exacerbates the situation for them after flood events. Reaffirming this, Sam et al., 2017, based on an analysis of 220 flood-prone rural households in Odisha, highlighted that the vulnerability to flood is multi-dimensional: weak housing structure, low literacy rate, and high dependency rate exacerbate the risk among women. Even in urban flooding in the Mumbai Metropolitan Region, Singh (2020) pointed out that unequal gender relations, combined with socioeconomic disadvantage, are significant factors of gendered vulnerability, which gets compounded due to flooding. Also, he showed that urban flooding poses increased health risks for women, entailing exposure to unhygienic conditions, contaminated water, and the potential spread of water-borne diseases. Gender issues emerged prominently in shaping the recovery experience of women and girls, who face challenges related to privacy, access to sanitation facilities, and overall safety in shelters (Krishna et al., 2018). Flooding also contributes to the discontinuation of education and an increased risk of child marriage, particularly affecting girls in flood-affected areas (Krishna et al., 2018; Khanna and Kochhar, 2020).

Studies from other countries reveal a significant impact on Sexual and Reproductive health (SRH) caused by floods. Kamal et al (2018) point out that floods lower the standard of living, hamper health care responses and increase stress among women. Women experience a higher prevalence of leucorrhoea, pregnancy-related complications, urinary infection, and malnutrition during floods compared to non-flood times. In addition, it was found in developed countries like the USA that there is a significant decrease in crude birth rates in response to flood situations, but higher low-birth-weight babies if born during or after floods (Tong et al., 2010).

These studies, global and national, have highlighted a wide range of negative impacts like increased sexual and reproductive health problems, exposure to unhygienic conditions and contaminated water, disruptions in healthcare services and increased stress, which are often exacerbated by existing social inequalities in both urban and rural areas. However, research documenting the scale of vulnerability and impact of floods on women is limited in the Indian context. It is crucial to explore women's challenges and their specific needs while formulating flood preparedness, response and recovery strategies. Further, there is a need for quantitative analysis of the effects of the flood on reproductive health and the prevalence of vector-borne diseases through a gendered perspective and an intersectional approach. Addressing these research gaps would contribute to a deeper understanding of health risks faced by women in flood-prone areas of India, and inform better policies.

3.3.4. Drought's Double Whammy: How Women Bear the Brunt of Water Scarcity and Health Risks

Drought is a slow-onset hazard, often resulting from a prolonged dry period due to a lack of normal precipitation. Nearly 700 million people could face displacement due to drought by 2030, accounting for 40 percent of the world population affected by water constraints (WHO, 2019). Apart from this direct impact of water scarcity, there are several indirect impacts of droughts on women's health.

The immediate consequences of drought include reduced food supply in households due to disruptions in the agriculture production system and increased workload of women who bear the brunt of collecting water and managing household responsibilities, due to increased male out-migration (Tichagwa, 1994). With 78 percent of India's employed women working in agriculture (MOSPI, 2021), the impact on women is profound due to their reliance on climate-sensitive livelihoods and socio-economic status (Paul et al., 2019). Data from the India Human Development Survey-2 (IHDS) reveals that women, on an average, spend twice as much time collecting water compared to men (IHDS, 2020); this leads to irregular food consumption and adverse health impacts such as physical strain and mental stress. The coping mechanisms that women adopt during drought conditions, such as skipping meals, further elevate the risk of severe malnutrition (Algur et al., 2021).

Besides the significant repercussions of drought on various facets of women's health and well-being, studies indicate associations between drought and intimate partner violence (IPV) (Rai et al., 2021). While drought poses significant challenges to women's health and well-being, there are limited studies from a gendered perspective in the Indian context to highlight this. More empirical evidence is needed to understand the impact of drought on women's physical and mental health and well-being. More region-specific and time-use research is needed to provide a holistic understanding of the impact of drought on women. There is an urgent need for comprehensive strategies to mitigate the disproportionate effects of drought on women and build resilience within affected communities.

3.3.5. Differential Impact on women by urban and rural residence

Studies cover a range of climate change events in India such as extreme heat, air pollution, flood, water and climate stress vulnerability, but do not clearly differentiate between rural and urban residence in terms of women's health. Vulnerability is a function of exposure, sensitivity, and adaptation (Lee et al., 2023). Intersectionality with caste, class, tribe, age in the life cycle, occupation, geographical region will determine the extent of climate change effects. Each individual and geographical setting has unique functionality and some impact. There is a lack of explicit comparisons between rural and urban areas in terms of women's health. Children and elderly in urban areas experience adverse health effects due to extreme heat (Singh et al., 2019) and risk factors like lack of air conditioning, overcrowding, and poor housing quality (Ingole et al., 2021). In rural areas, the impact of extreme heat is different. Access to healthcare facilities, infrastructure, and awareness may vary and reliance on outdoor occupations like agriculture exposes individuals to direct heat (Southard and Randell, 2022). The sources of pollution, such as vehicular emissions and industrial activities, are more concentrated in urban areas (Nautiyal et al., 2007). While rural areas may not have the same level of industrial pollution, studies indicate that indoor air pollution from cooking practices contributes to health issues in rural areas (Maharana et al.,

2018). Rural women, particularly those relying on traditional cooking methods, might face health challenges due to indoor air pollution (Mohapatra et al., 2018). Those with poor infrastructure and planning face challenges in urban areas during extreme weather events like floods. Vulnerability in terms of water and climate stress in rural areas highlights the dependence of farmers on climate-regulated livelihood (Sam et al., 2017). Rural women might face distinct challenges related to water access, as they are directly involved in water arrangements for families (Tichagwa, 1994).

The multifaceted impact of climate change on health in India highlights the need for an intersectional approach that considers diverse factors such as caste, class, tribe, age, occupation and geography. Addressing the differential vulnerabilities between rural and urban areas, particularly concerning women and child health, requires urgent interventions that account for varying exposure, sensitivities, and adaptation capacities within this context. The differential impact of vulnerability factors is summarised in Table 3.1.

Table 3.1: Differential impacts of Climate Hazards on urban and rural women

Key Vulnerability factors	Urban Characteristics	Peri-Urban/ Rurban	Rural Characteristics
Exposure	• Higher air pollution levels due to vehicular and Industrial activities • Urban heat island effect • High Population density	Hardly captured	• Indoor air pollution due to cooking using biomass • Exposure to heat due to climate-sensitive livelihoods like agriculture. • High reliance on distant and inadequate drinking water sources.
Sensitivity - Individual health status	• Children vulnerable to respiratory problems due to vehicular pollution • Women residing in low-income areas are at heightened health risks from indoor air pollution, and limited access to reproductive healthcare and menstrual hygiene services. • Migrants and displaced, vulnerable to multiple adverse health impacts including psycho -social.		• Children vulnerable to respiratory problems from indoor air pollution • Women are prone to respiratory issues due to indoor air pollution. • Women are prone to mental stress due to water scarcity and climate-related disruptions. • Farmers and agricultural workers are vulnerable to crop losses.
Key adaptive Factors	• Higher prevalence of social isolation and limited access to services. • Higher burden on critical health infrastructure.		• High dependency on natural resources that are vulnerable to disruption from extreme events. • Limited resources and services to respond to extreme weather events and associated health burden. • Limited access for remote communities (Tribals).

Source: Study Team, Developed based on Anderson et.al (2016)

3.4. Insights from mapping and statistical analysis

From the above thematic review, it emerges that among hydromet events, droughts significantly impact people, economies, and ecosystems. They are more pervasive in affecting food production and water availability, often resulting in human suffering and loss of life (Crossman, 2018). Unlike sudden, immediate-impact events such as flash floods, drought is characterised as a slow-onset, long-duration event, which generally develops over an extended period and lacks obvious structural impacts (Sheffield and Wood, 2011). Numerous indicators are used to capture and quantify the onset, duration, extent, beginning and end of droughts (NDMC, 2012). It can be geographically extensive, affecting large areas regardless of geopolitical boundaries, and can exhibit complex spatial patterns. However, documentation of the impact of drought is complex. Its impact on health relies on the socio-economic environment, which can either enhance or weaken the affected population's resilience. Factors such as poor health, poverty, and conflict exacerbate the consequences of drought. Despite the challenges associated with assessing the health impacts of drought, it is imperative to try to do so to enhance preparedness, mitigation, adaptation, and response strategies; we have attempted to quantify the impact of drought on women's health and wellbeing. One of drought's most evident and widely recognised health impacts is its effect on nutrition, which consequently influences morbidity and mortality rates (UNEP, 2012).

Table 3.2

Impact of exposure to extreme hydro-met hazards on women-related indicators in India

	Drought	Flood	Cyclone
Women Underweight[1]	+6%	-10%	-7%
Girl Child Marriage[1]	+3%	NS	+10%
Intimate Partner Violence[1]	+26%	+7%	+27%
Miscarriage/Still Birth[2]	+6%	NS	+27%
Dropout from minimum recommended Antenatal Care[2,3]	+36%	+6%	+59%

Note: This table is derived from adjusted multivariate logistic regression analysis, and percentages describe the likelihood of decrease (-)/ increase(+) of an indicator if exposed to extreme hydro-met events, computed using odds ratio

Above results are significant at a 95 percent confidence interval, and NS=Not significant

Source: Study Team using CEEW and NFHS datasets 2015-16 and 2019-21

1 Adjusted for place of residence, social group, wealth status, household with sanitation facility, household with clean water, household with clean fuel, mass media exposure, women's education, number of household members, time

2 Adjusted for place of residence, social group, wealth status, household with sanitation facility, household with clean water, household with clean fuel, mass media exposure, mother's education, mother BMI, birth order, mother age at first birth, number of household members, time

3 only for the last birth

The impacts of drought on malnutrition and mortality are often indirect and complex. Droughts affect ecosystems, reducing food supplies, mainly crops and livestock. Consequently, this decline in food availability or quality diminishes nutrient intake, making individuals more vulnerable to illness and increasing the likelihood of mortality (Stanke et.al, 2013). Our findings reveal a six per cent higher likelihood of being underweight if a woman belongs to a drought-prone geography (Table 3.2.). This suggests that residing in regions susceptible to drought correlates with a modestly increased risk of women being underweight compared to areas less prone to drought. Studies have highlighted that in drought-prone regions, food intake often decreases in both quantity and frequency. A decline in food quality, dietary imbalance, and reduced consumption of essential items like milk and vegetables, leads to adverse health outcomes for women and children (Goh, 2012). Further, the literature also suggests that compared to men, women are more vulnerable to climate change and environmental degradation as they often constitute a higher proportion of the impoverished in their communities and rely heavily on local natural resources for their livelihoods, increasing their vulnerability to climate change (Arora-Jonsson, 2011; Abedin et al., 2013; Onwutuebe, 2019). In rural areas of developing countries, women primarily bear responsibilities such as ensuring water supply, cooking fuel, and food security. Consequently, they are disproportionately affected by drought (UN-ECOSOC, 2010), Women also secure fuel, fodder, and water for their homes, increasing their workload (Shah, 2007).

All these factors have devastating effects on the livelihoods and health of women and their children. Our analysis found that the likelihood of experiencing miscarriage or stillbirth is about six per cent higher in women if exposed to drought-prone regions compared to those who are not (Table 3.2.). This is possibly because drought conditions often lead to food and water shortages, inadequate healthcare infrastructure, and heightened stress levels among pregnant women. These factors can increase the risk of maternal complications, including miscarriage and stillbirth. Limited access to quality healthcare services, especially in rural and drought-affected areas, further exacerbates the risk of adverse pregnancy outcomes.

The odds of girl-child marriage are three per cent higher among families exposed to drought (Table 3.2). In regions affected by drought, families may face economic hardships due to crop failures and loss of livelihoods. Moreover, women shoulder an increased workload during these periods, working longer hours and taking on additional tasks. This added burden often forces girls to drop out of school to help with household responsibilities (Sahu, 2018; Zimmermann, 2011; Calow et al., 2002). In such circumstances, families may resort to marrying off their daughters at a younger age to reduce the financial burden and ensure their well-being. Additionally, limited access to education and social support systems in drought-affected areas may exacerbate the practice of early marriage. Therefore, it is crucial to acknowledge that droughts can significantly impact women's psycho-social well-being (Mahajan, 2014). Similar observations are seen for cyclones, as there is an increase in the likelihood of girl-child marriage by ten per cent in cyclone-exposed areas (Table 3.2).

Table 3.3

Impact of exposure to drought on women by place of residence in India – Select Indicators

	Urban	Rural
Women Underweight[1]	+9%	+5%
Girl Child Marriage[1]	NS	+5%
Intimate Partner Violence[1]	+41%	+19%
Miscarriage/Still Birth[2]	NS	+9%
Dropout from minimum recommended Antenatal Care[2,3]	+45%	+33%

Note:
This table is derived from adjusted multivariate logistic regression analysis, and percentages describes the likelihood of decrease(-)/ increase(+) of an indicator if exposed to extreme hydromet events, computed using odds ratio
Above results are significant at a 95 percent confidence interval, and NS=Not significant

Source: Study Team using CEEW and NFHS datasets 2015-16 and 2019-21

1 Adjusted for social group, wealth status, household with sanitation facility, household with clean water, household with clean fuel, mass media exposure, women's education, number of household members, time
2 Adjusted for social group, wealth status, household with sanitation facility, household with clean water, household with clean fuel, mass media exposure, mother's education, mother's BMI, birth order, mother age at first birth, number of household members, time
3 only for the last birth

Women exposed to drought have 26 per cent higher odds of experiencing intimate partner violence compared to those not exposed to drought (Table 3.2). Drought-induced stress and economic strains, resource scarcity, and heightened emotions in times of crisis may contribute to conflicts within households, resulting in a higher prevalence of intimate partner violence. Women exposed to drought have significantly higher odds of dropping out from minimum recommended antenatal care than those who are not, irrespective of whether they belong to the urban or rural areas of the drought-prone districts (Table 3.3). Specifically, the odds off dropping out from recommended antenatal visits are 36 per cent higher for women exposed to drought (Table 3.2).

Drought-related challenges such as reduced access to transportation, financial constraints, and prioritisation of immediate needs over healthcare may contribute to higher dropout rates from antenatal care. Additionally, disruptions in healthcare services and outreach programs during drought periods can further hinder pregnant women's ability to access and continue antenatal care services. Natural disasters and climate change exacerbate existing inequalities and discrimination, including gender-based ones, and can lead to new forms of discrimination (Sadia et.al, 2016). During emergencies, routine behaviours are altered drastically. Women who use contraception may not have access to contraceptive drugs or devices or may forget to take or use them, risking unplanned pregnancies and sexually transmitted diseases. In addition, delivery of prenatal care and delivery becomes challenging as the health system is overstretched, risking pregnancy complications and childbirth in unsafe conditions, increasing maternal and infant morbidity and mortality (Nour, 2011).

There is a significant decrease (-10 percent) in the likelihood of women being underweight when exposed to floods. Floods and cyclones may lead to a decrease in the likelihood of women being underweight due to increased access to relief aid and support services (Table 3.2.). It is likely that the impact of a cyclone and flood that occur in a relatively short period

with greater intensity are more visible and dramatic when compared to droughts whose onset is slow and remains relatively hidden.

It is possible that during flood or cyclone events, communities receive relief aid and support from government and non-governmental organisations, including food assistance programmes. This influx of aid may temporarily alleviate food insecurity and provide access to nutritious food, thereby reducing the risk of underweight status among women in flood or cyclone-affected areas. However, this could mask the mental stress that arise due to loss of lives, property and other assets which impact women's health and their livelihoods in different ways. But these dynamics require further research.

There is a significant increase (+7 percent) in the likelihood of intimate partner violence against women in flood-exposed areas and 27 per cent likelihood of increase in cyclone-exposed areas (Table 3.2). Rai et al., 2021 confirm that women residing in districts affected by cyclones face higher odds of experiencing emotional, physical, and sexual violence compared to those not exposed to cyclones. Disruptions to livelihoods, increased competition for dwindling resources, and heightened insecurities may intensify tensions within households, leading to a surge in incidents of domestic abuse.

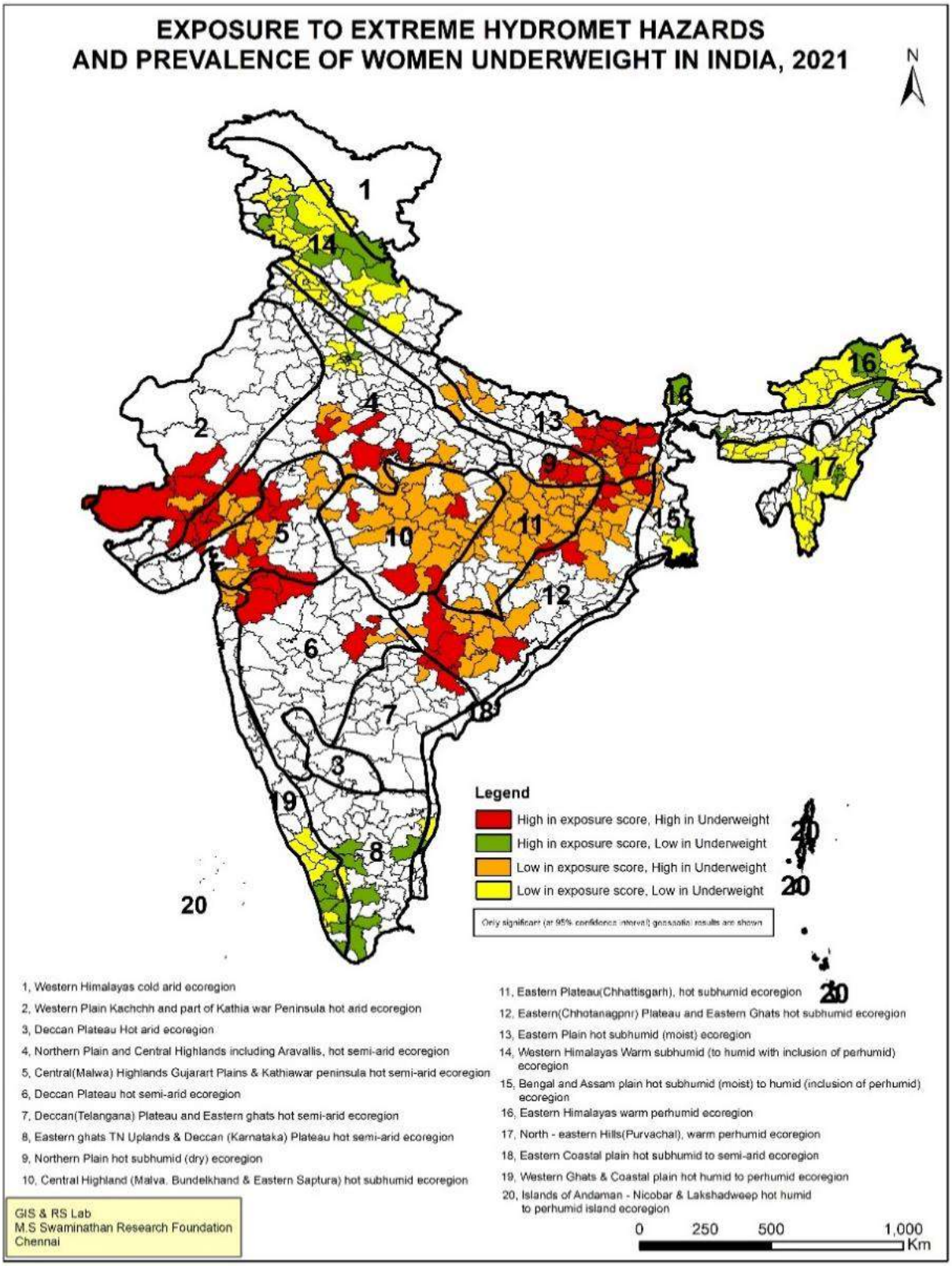
Floods and cyclones may disrupt healthcare services and infrastructure, leading to higher dropout rates from essential antenatal care. Displacement, damage to healthcare facilities, and transportation disruptions may hinder pregnant women's ability to access prenatal care services. Additionally, competing priorities, such as securing shelter and basic necessities, may lead to a deprioritisation of healthcare, resulting in increased dropout rates from antenatal care among flood or cyclone-affected populations. There is a significant increase (+6 percent) in the likelihood of women dropping out from minimum recommended ANC services when exposed to floods and a significant 59 per cent higher likelihood if exposed to cyclones (Table 3.2). The intensity of cyclones is always higher than that of flood in infrastructural damage, which could explain this difference. In addition, miscarriage or stillbirth is more likely to occur by 27 per cent if exposed to cyclones (Table 3.2). Cyclones can lead to displacement, lack of access to medical care, and exposure to unsanitary conditions, all of which can contribute to adverse pregnancy outcomes. Additionally, limited access to emergency obstetric care and prenatal services during and after cyclones may exacerbate risks for pregnant women.

The analysis of the implications of drought, flood and cyclone exposure on women's nutritional status, vulnerability to early marriage, intimate partner violence, pregnancy outcomes, and access to antenatal care highlights the urgent need for gender-responsive and climate-resilient strategies to safeguard women's health in disaster-prone regions.

The geospatial map of exposure to extreme hydromet hazards and prevalence of underweight women show that the following regions have high burden of the latter:

- Western Plain Kutch Peninsula hot arid ecoregion (AEZ-2),
- Nothern Plain and Central Highlands hot semi-arid eco region (AEZ-4),
- Central Highlands and Kathiawar Peninsula hot semi-arid ecoregion (AEZ-5),
- Deccan Plateau hot semi-arid ecoregion (AEZ-6),
- Nothern Plain hot subhumid (dry) ecoregion (AEZ-9),
- Central Highland (Malwa and Bundelkhand) hot subhumid (dry) ecoregion (AEZ-10),
- Eastern Plain hot subhumid (moist) ecoregion (AEZ-11),
- Eastern Plateau hot subhumid ecoregion (AEZ-12),
- Eastern Plain hot subhumid ecoregion (AEZ-13).

Map 3.1.: Map depicting the overlapping of extreme hydromet hazards and prevalence of underweight women

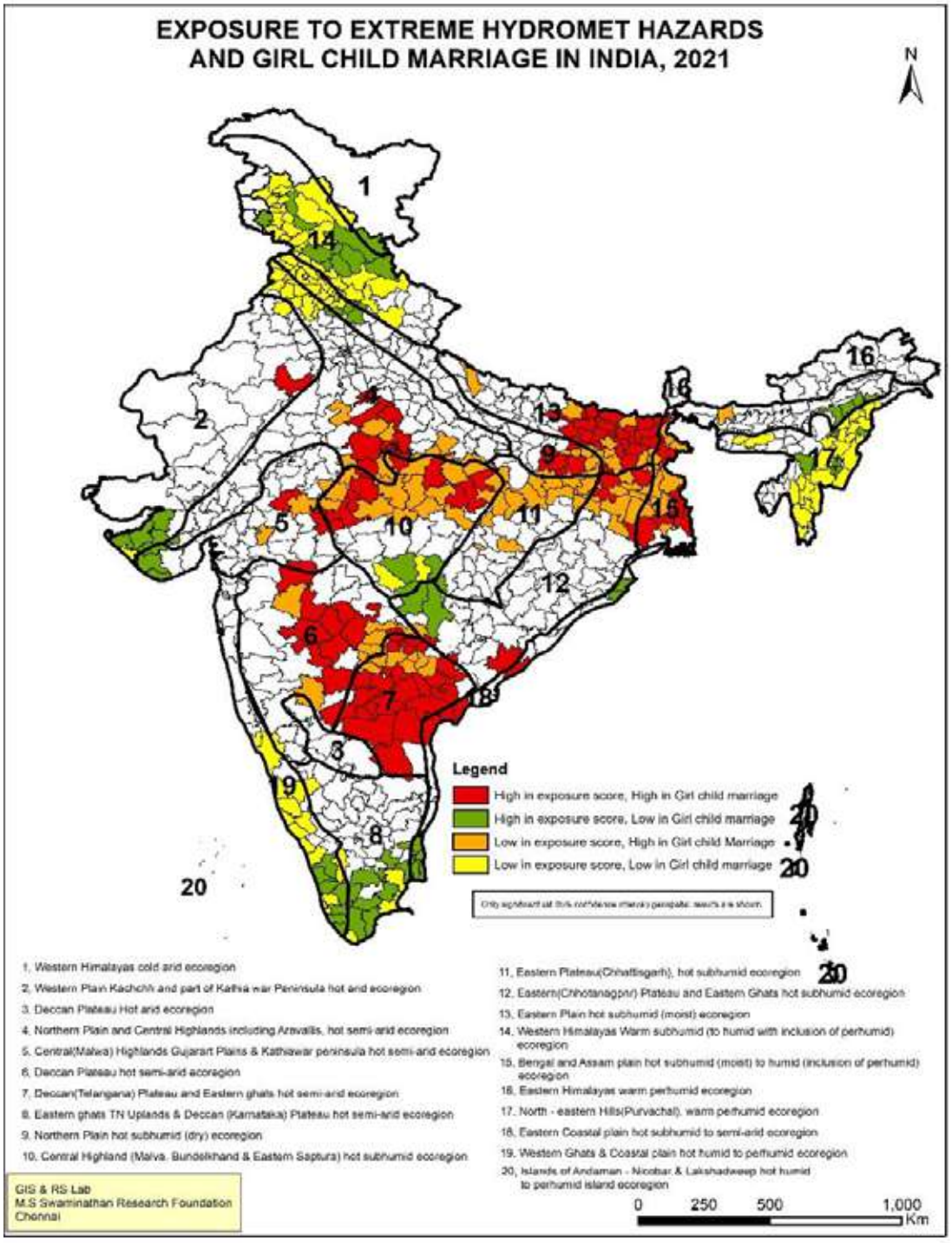


Source: Study Team using CEEW and NFHS datasets 2015-16 and 2019-21

Moreover, the southern part of AEZ-2, some parts of AEZ-4, AEZ-5, AEZ-6, the south-western part of AEZ-12, the eastern part of AEZ-9 and AEZ-13 are likely to be hot spots due to the

coexistence of high burden of underweight women as well as the high exposure score to extreme hydromet hazards. These regions need to be prioritised in the SAPCCs. Also, it can be clearly observed from map 3.1. That these coexistences of vulnerability transcend the state boundaries. In AEZ-2, both Gujarat and Rajasthan witness a coexistence of high exposure to extreme hydromet hazards as well as a high prevalence of underweight women. Similarly, in AEZ-12, parts of Telangana, Maharashtra and Chhattisgarh witness coexistence.

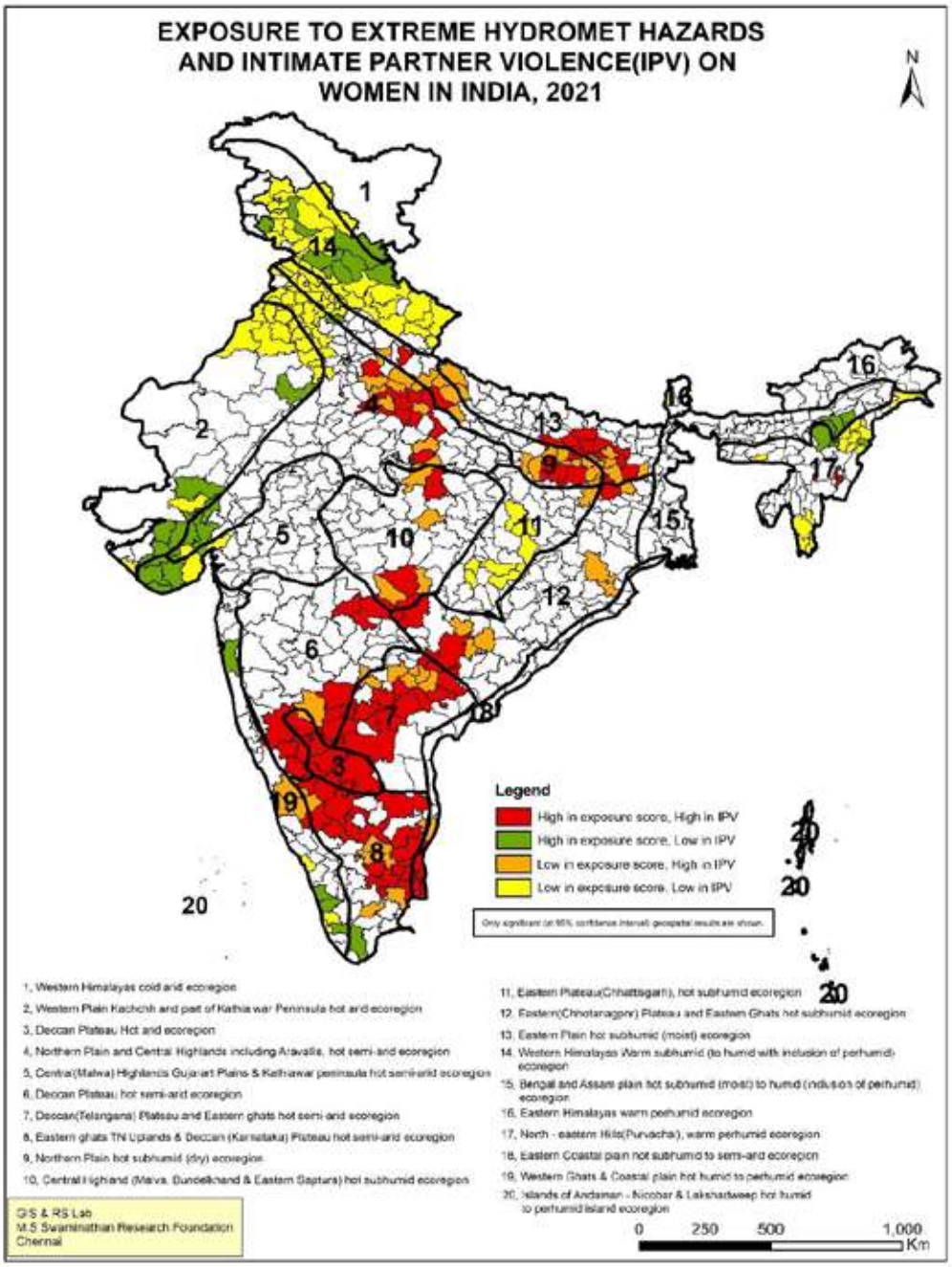
Map 3.2: Map depicting the overlapping of exposure to extreme hydromet hazards and girl child marriage.



Source: Study Team using CEEW and NFHS datasets 2015-16 and 2019-21

There is high prevalence of girl child marriage as well as high exposure score for extreme hydromet hazards in Deccan Plateau, a hot semi-arid ecoregion (AEZ-6), Deccan Plateau and Eastern Ghats, which are hot semi-arid ecoregion (AEZ-7) and Eastern Plain hot subhumid ecoregion (AEZ-13) These hotspots cover the states of Andhra Pradesh, Bihar, and parts of Maharashtra. Also, some parts in southern West Bengal, Madhya Pradesh, Uttar Pradesh and Telangana are also vulnerable since they have higher prevalence of girl-child marriage and high exposure scores for extreme hydromet hazards (Map 3.2.).

Map 3.3: Map depicting the overlapping of exposure to extreme hydromet hazards and prevalence of intimate partner violence (IPV) in India



Source: Study Team using CEEW and NFHS datasets 2015-16 and 2019-21

The hotspots of high intimate partner violence coupled with high exposure scores of extreme hydromet hazards are particularly clustered in the southern part of the country, including the states of Karnataka, Andhra Pradesh, Tamil Nadu and parts of Maharashtra. It covers Deccan Plateau Hot arid ecoregion (AEZ-3), Deccan Plateau hot semi-arid ecoregion (AEZ-6), Deccan Plateau and Eastern Ghats hot semi-arid ecoregion (AEZ-7), and Eastern Ghats (Tamil Nadu upland) and Deccan Plateau hot semi-arid ecoregion (AEZ-8). In northern India, parts of Bihar and Uttar Pradesh witness coexistence (Map 3.3)

In regions in India which are socio-economically more deprived, climate change is likely to exacerbate the already existing vulnerabilities, so there is a need for formulation of climate-sensitive plans to address women's health and socio-economic-related problems. For instance, we found that while both southern coastal and northern states have high vulnerability to exposure to hydromet hazards, women in northern states like Uttar Pradesh and Bihar, witness higher dropout from minimum recommended antenatal care services, possibly due to poor health infrastructure in these regions which could not bear the impact of climate change. The state of Bihar is a hotspot for almost all selected women-related indicators.

3.5. Impacts of climate change on women's mental health

The sixth assessment report of the Intergovernmental Panel on Climate Change (IPCC) acknowledges that climate change and disasters have adverse effects on the physical and mental health of the affected population (Lee et al., 2023). Women are prone to experiencing the disproportionate effects of climate change, such as gender-based violence, displacement, impact on family planning and reproductive health, disruption in feminine connection with nature, and various socioeconomic stressors, which contribute to adverse mental health consequences (Rothschild et al., 2022). The WHO (2023) reaffirms that mental health issues like anxiety, Post-Traumatic Stress Disorder (PTSD), and other long-term disorders are induced by displacement and disrupted social cohesion in response to climate change.

Manning and Clayton (2018) argue that women, children, marginalised communities, and indigenous populations bear an increased burden of mental health issues resulting from both acute and chronic climatic events. The effects of climate change differs by the characteristics of extreme climatic events, whether it is short term or long term; consequently, the impacts can be either direct or indirect (Cianconi et al., 2020). A systematic review of studies on the impact of climate change on mental health shows that globally, there are very limited studies capturing this aspect. Another global systematic review revealed that for every one-degree increase in temperature, there is a 2.2 percent likely increase in mental health-related mortality and a 0.9 per cent likely increase in morbidity (Liu et al., 2021). The incidence of affective and anxiety disorders, particularly PTSD, rises due to traumatic experiences from extreme weather events, while heat amplifies morbidity and mortality linked to mental illness, drought, food insecurity; climate-induced migration also poses significant risks to mental health (Walinski et al., 2023). Further, an empirical study in the USA found that there is an increase in suicide during extreme heat conditions (Parks et al., 2020). Bundo et al., 2021 also highlighted that there is an increase in psychiatric visits and hospitalisation in response to increased temperature in Switzerland. Gifford and Gifford (2016) pointed out that women are more vulnerable to the mental health impacts of climate change, and these impacts are not only confined to the

post-disaster period in the form of PTSD but cause eco-anxiety due to projected threats of climate.

In the Indian context, the case study conducted in the Himalayan state of Uttarakhand reveals that women are found to be more susceptible to mental health problems in response to the June 2013 floods due to the devastating impact on their livelihoods (Parida, 2015). This study further points out that the pre-existing socio-economic factors also increased the likelihood of witnessing mental health disorders among women. Socioeconomic vulnerability, long-term displacement, persistent material damage, and insurance-related problems are the main predictors of mental health after floods. A study on Kerala floods found two significant findings on the relation between climate change and mental health; firstly, women bear a greater burden of mental health problems like PTSD, anxiety and depression compared to men and secondly, these impacts on mental health are long lasting, affecting lives of women (Asim et al., 2022).

As a part of the country's overall disaster management strategy, the National Guidelines on Psycho-Social Support and Mental Health Services (PSSMHS) in Disaster were published in December 2009 for effective mental health service delivery to the population (NDMA, 2009). It does recognise women as one of the vulnerable groups; however, there is limited mention of a gendered perspective in the implementation of PSSMHS. Also, in the Indian context, there are only a few studies which document the differential impact of climate change and vulnerability on women, and there is a huge need to dive deeper into the invisible mental health implications on women's lives as it not only hinders their health but also may disrupt their families. The recognition of mental health issues of women needs urgent attention in India.

3.6. Conclusion

In the wake of a disaster, women face multiple challenges due to various social and cultural norms, household responsibilities and differential physiological needs. The implications are visible in terms of physical, reproductive and mental health. Also, it is not restricted to just these direct impacts on health. Instead, it poses significant challenges to women's overall well-being. However, there are very few studies providing insights into challenges to women's health and well-being, particularly in the context of different climatic events. Also, none of the existing literature has distinguished the impact on peri-urban women. Women are often considered as homogenous groups, but the challenges faced by them are not homogenous; they vary by social identities based on wealth status, place of residence, social group or religion. Our findings point to a major impact on women's nutritional status, increase in girl child marriages, disruption in access to maternal health care services, increased adverse pregnancy outcome and a significant increase in intimate partner violence (IPV). This scoping study emphasises the need for gender-specific considerations in policy responses, acknowledging vulnerabilities in various contexts. Combining qualitative and quantitative approaches and addressing socio-economic factors through an intersectional approach is essential for comprehensive understanding and targeted interventions in safeguarding women's well-being amidst climate change challenges.

CHAPTER 4: CLIMATE CHANGE IMPACT ON WOMEN'S LIVELIHOODS

4.1 Introduction

Climate change is expected to have adverse impacts on food production, livelihoods and socio-economic development on a global scale (Scheffers et al., 2016). At the same time, the long-term implications of climate change on weather patterns, natural ecosystems and freshwater supplies are weakening the resilience and adaptation capacities of the systems that sustain livelihoods and economies (Uddin et al., 2021). This is compounded by human activities such as population explosion, encroachment of agricultural, forest and community lands, increased waste generation and increased concentrations of greenhouse gases (GHGs) and pollutants in the atmosphere (Subramanian et al, 2023). Complex interactions between these effects have led to adverse visible and invisible consequences on livelihoods and food ecosystems in the country. However, there is a dearth of evidence exploring the links between climate variabilities and the complex interplay of factors sustaining livelihoods.

In developing countries, smallholder farming, fishing and pastoral communities dependent on natural resources for their livelihoods are among the most affected by climate change (Roy et al., 2024). Multiple risks and challenges induced by extreme climate events such as floods, cyclones, droughts, rising temperatures, and increasing rainfall variabilities pose significant threats to the lives and livelihood activities of local communities (Ateeq-Ur-Rehman et al., 2018; Hossain and Paul, 2019). Seventy percent of India's population resides in rural areas and relies heavily on climate-dependent agricultural activities. making these populations extremely susceptible to climate risks and shocks. The Economic Survey of India, 2018 found that extreme weather patterns impacted farm incomes by 15-18% on average and up to 20-25% for unirrigated areas (Ministry of Finance, 2018). Effects of climate change in India have resulted in shifts in agricultural cropping patterns, a loss of agricultural diversity, effects on livestock rearing, a decline in food production and increased reliance on external food sources exacerbating the vulnerability of small and marginal farmers (Sinha, 2007; Negi and Palni, 2010; Roy et al., 2014; Raj et al., 2022). Coastal ecosystems also bear the direct impact of uncertain and erratic climate changes primarily caused by anthropogenic changes, posing significant threats to coastal livelihoods (Subramanian et al., 2023). There is a significant influence of climate on the distribution, structure and ecology of forests (Gopalakrishnan et al., 2011). Forests have been considered an important source of food and livelihood by several indigenous and forest-dwelling communities in India. Climate variabilities can not only disturb the ecology of such regions but also have serious implications on communities dependent on forest-based livelihoods. The disruption of, and stress on, the agrarian-coastal-forest systems, as well as other factors such as freedom from poverty and personal aspirations, motivate the rural population to out-migrate to urban centers for work (Pattnaik et al., 2018; Mishra, 2020). A wide range of studies establishes the vulnerable and precarious conditions of these migrants in their destination (Singh, 2019; Rao et al., 2020).

The underlying vulnerability of communities dependent on natural ecosystems for their lives and livelihoods highlighted by high levels of poverty, food shortages, and the lack of social safety nets exacerbates the challenge of facing and adapting to climate events. At

the same time, lack of adaptation resources, poor governance, and lack of information and knowledge on mitigation and adaptation further magnify the systemic inequalities of vulnerable communities. Hence, the implications for people who are least equipped to adapt to the risks associated with climate change are extreme (Bunce et al., 2009). However, limited attention has been paid to exploring the impacts of climate change on the livelihoods and food security of vulnerable population groups in India, and studies accounting for contextual challenges are close to negligible. In the context where multiple climate risks interact with already existing socioeconomic differences to intensify and sustain vulnerability, assessing the vulnerability to, and implications of, climate change on people and systems is a critical need to design appropriate adaptation measures (Singh et al., 2016).

Vulnerability to climate change is deeply influenced by the intersection of gender, socio-economic status, age, location, livelihoods, and capacity to adapt (Rao et al., 2019).Research on the gender-differentiated impacts of climate change underscores the disproportionate impact on women, particularly poor women with lower access to material and natural resources that further limit their capacity to sustain and strengthen their livelihoods (Singh, 2023). At the same time, having less access to, and control of, resources as compared to men, women are more susceptible to shocks and threats (Rao, 2017). Women in India are largely engaged in informal and traditional livelihoods such as agriculture, forest-based activities, fisheries, tea plantations, and informal labour in the urban areas, the sectors that face significant threats from the complex interplay of climate change and human activities. As a result of climate hazards, the productive and reproductive workload on the farm and in households of women and girls increases, leading to their exclusion from opportunities like education and a reduction in their equal participation in more formal employment activities (Singh et al., 2013). A FAO study found women-headed households experienced more income losses than male-headed households due to heat stress and floods (FAO, 2024). In India, drought-affected regions impose a disproportionate burden on women, given their primary role in securing household resources and adhering to traditional gender roles (Kher et al., 2018). Additionally, women not only bear a higher cost of the shock in terms of employment losses during drought for instance, but are also unable to cope with these negative effects; they are not able to diversify to the less risky, higher return, non-farm work given their restricted mobility and gendered norms around home production responsibility and childcare (Afridi et al., 2021).

Knowledge gaps exist in documenting the vulnerability of women's lives and livelihoods to changing and uncertain climate across various agroecological zones in India (Yadav and Lal, 2018), despite clear linkages between climate change and women's vulnerabilities especially in rural livelihoods and food security (Patel et al., 2020). At the same time, adequate attention has not been paid to the heterogeneity of "women" as a group and the differentiated experiences and vulnerabilities of diverse categories of women such as older women, younger women, informal workers, farmers, agricultural labours, "left-behind" by migrant husband, non-binary individuals and Dalit women. This chapter explores the existing literature on the impacts of climate variabilities on women at the various intersections. Additionally, it aims to map the link between climate variabilities and the diverse categories of women, particularly in terms of their involvement in livelihood activities. The findings and implications from this study can act as critical inputs for further research to bridge knowledge gaps, and, to design contextual adaptation pathways.

4.2 Conceptual framework

This chapter adopts the conceptual considerations and the framework illustrated and described in Chapter 2 (Figures 2.2 and 2.3) to explore the impacts of climate hazards on women engaged in various livelihoods in India. The study adopts an intersectional lens to explore the literature to document the impacts of sudden and slow onset climate hazards on the lives and livelihoods of women, especially from the marginal and vulnerable populations across four broad domains of livelihoods like agriculture, forest-based, coastal, and off-farm or informal wage work. Additionally, the chapter aims to document evidence on livelihood vulnerabilities engendered by climate change, considering the structural inequalities and the intersecting axes of marginalisation across agroecological zones in India. The study also recognises that climate change is one of numerous stressors acting upon people's livelihoods and that people's capacity to achieve food security and sustain livelihoods, and adaptation to climate events is influenced by various economic, institutional, and social conditions.

4.3 Women are at the core of agriculture systems, yet are invisible from the climate-livelihoods nexus

Communities dependent on rainfed agriculture are extremely vulnerable due to limited resources and infrastructure, and lack of opportunities to scale and diversify especially in the context of climate induced rainfall variabilities. Indian agriculture is impacted by temperature extremes, rainfall variabilities and droughts, thereby having implications for agricultural productivity, incomes and livelihoods (Takeshima et al., 2022). Extreme weather events can erode the various forms of capital or assets in the households necessary to sustain livelihoods – erosion in the productive value of land, decline in labour productivity due to adverse health impacts (Somanathan et al., 2021), effect on natural resources capital, such as water and energy sources (e.g., fuelwood) (Takeshima et al., 2022), hamper education and other opportunities to build livelihoods in the future.

Impacts of climate change on agricultural systems have been widely researched. A systematic review conducted by Baraj et al., (2024) found a total of 572 research articles pertaining to climate change, resilience, adaptation and sustainability of agriculture in India being published between 1994 and 2022. There also exists ample evidence on the impact of climate events on women's health and wellbeing across certain agroecological zones. However, the relationship between climate, women and agricultural systems has received minimal attention (Pattnaik and Lahiri-Dutt, 2023). Moreover, analysing the impacts at the intersections of various marginalised identities of women, as well as across agro-ecological contexts is largely neglected. Research is also concentrated in specific agroecological zones, often referred to as agroclimatic regions, underscoring the urgency of intensive research and intervention in more vulnerable areas (Baraj et al., 2024). For instance, according to the CEEW's (2019) analysis while the north-eastern and eastern zones of the country are highly exposed to extreme floods, the western and central zones are more vulnerable to drought-like conditions, and some eastern zones are exposed to both floods and droughts, in which case, the required strategies for adaptation and resilience-building ought to be designed contextually, based on the experiences of farmers. However, top-down approaches to adaptation and a lack of systemic initiative to

understand differential vulnerabilities poses significant risks to poor farming communities in the context of worsening climate events.

Agriculture is the most important livelihood for women in rural India. However, women disproportionately experience hunger and food insecurity due to socio-economic inequalities and gender roles that limit their access to livelihoods assets. At the same time, disruption in agricultural systems exacerbates the burden and invisibility of their roles in productive and (social) reproductive activities. Migration, primarily of the male members, becomes an alternative pathway for households to cope with climate stressors and other inequalities further shifting the gender dynamics in agricultural households. Evidence from Koraput in Odisha found that women perform almost the same amount of agricultural work during the peak seasons as men, if not managing farming entirely, when men migrate (Rao and Raju, 2020).

Studies assessing the impact of climate change on agriculture systems need to be more contextual and gender-transformative so that the adaptation pathways are equitable. Simultaneously, various aspects of agricultural systems (agriculture value chains) that go beyond the categories of food production should also be studied. For instance, studies on assessing food production provide initial estimates into one aspect of food availability, but they are not designed to address the other aspects of food security, namely food access and food utilization. Aspects that impact women the most such as ways of/barriers to accessing the food, diet diversity and intra-household distribution of food, are left unexplored.

4.4 Gendered dimensions of climate-induced migration

Although it is challenging to disaggregate the influence of climate change from other environmental, demographic, political and social factors, the IPCC had cautioned in 1990 itself that the greatest impact of climate change may be on human migration (Uddin et al., 2021). In India, migration remains a key livelihood strategy to diversify incomes and manage risk (Deshingkar, 2016; Singh, 2019), especially in the context of increasing climate variability (Jha et al., 2018; Singh et al., 2018). 37 per cent of population in India are internal migrants (De, 2019). Several studies in India examine how extreme events like droughts, floods, and erratic rainfall dampen agricultural livelihoods and intensify instances of rural out-migration (Dallman and Millock, 2017; Hari et al., 2021), fewer studies examine the differential benefits and barriers between women and men, to moving (Singh, 2024).

Migration from rural to urban areas is determined by multiple intersecting factors, including the lack of local livelihoods, poverty, lack of access to social protection and lack of opportunities exacerbated by extreme hazards. Due to the disruption of agriculture and livelihood systems caused by long-term social and environmental stressors, individual members of poor households, particularly men, migrate to urban centers or to more irrigated lands to earn cash income to sustain the essential needs of households (Lei and Desai, 2021). The impact of male migration on women who stay back in the households are primarily two-fold in the literature, also evidenced in India. First, opportunities for increased participation in agriculture and household related decisions and activities, asset accumulation and purchase and consumption of diversified foods through remittances, are found to have positive impacts on women's self-confidence (Patel and Giri, 2019; Mendola, 2012). There are also negative impacts on women in the form of loneliness and increase in

the work burden as they have to manage both household duties and agricultural tasks (Singh and Basu, 2020). Male out-migration dampens health expenditure of 'left-behind'/staying women, leading to negative health outcomes (Lei and Desai, 2021). Evidence finds higher incidences of food insecurity in 'left-behind women' due to their increasing role in agriculture amidst the growing agrarian distress (Choithani, 2020).

The number of Indian women migrating for work is rising (Mazumdar et al., 2013). Evidence on female migration induced by climate change indicate that their experiences are a mix of gains and losses, given their specific social group, low educational attainment, and engagement in low-paying unskilled jobs at the destination (Patel and Giri, 2019). Hence, to map the impact of climate change on migrant workers, especially women migrants, it is important to understand the vulnerability context of women in the place of origin, the socio-cultural norms and inequalities, and the challenges faced by them at the destination. However, there is a dearth of studies aiming to explore the various levels of vulnerabilities faced by female migrants/informal workers in urban centers or the stay-behind women in rural areas, across social groups. For instance, caste and social identities play an important role in determining the experiences of the migrant workers either at origin or at the destination. At the same time, understanding migration and its impact on women in binaries either as positive or negative (or as in rural or urban areas) fail to depict the interacting and intersecting nature of realities on the ground and at the household level, and hardly any study captures these dynamics. For instance, families (including women and children) that migrate to peri-urban and urban centers for work end up residing in unorganised settlements and urban slums with inadequate access to essential services, inadequate housing and safety, exposing them to gender-based violence and other precarious living conditions (Bhagat, 2017). Informal workers are also extremely vulnerable to increasing temperatures and extreme weather events causing physical harm and ill health thereby reducing the overall human capital and wellbeing (Dodman et al., 2023).

Migrant women are typically engaged in low-skilled or unskilled roles in the informal sector, have limited access to financial and health services, and face issues of work-place discrimination, and higher work burdens as they move (Rajan and Sumeetha, 2019). These unique groups of women are largely neglected in the research on climate change implications and adaptation. Hence, while migration is considered as a coping and adaptation strategy to deal with climate induced agricultural losses and local livelihoods disruption, Singh and Basu (2020) establish that migrant households keep moving in and out of vulnerability because the act of migration does not allow people to move out of structural inequalities and existing social structures and norms. This underscores the importance of addressing the normative limiting structures especially in the context of women, to improve their experiences and wellbeing. A critical step to that extent is to map the contextual inequalities and vulnerabilities and the differential impacts of climate variabilities and bridge the existing knowledge gaps on the above discussed areas of inquiry. It is important to establish a link between the implications of climate events on women's health, their access to a healthy life and nutritious diet and their capacity to build and sustain livelihoods. In addition, it is important to understand the ways in which changing livelihood patterns, including migration, change health and nutrition access and outcomes for women, both being key knowledge gaps persisting in the climate change implications evidence base.

4.5 Women at the forefront of sustaining forest-based livelihoods as well as facing shocks and stressors to the biodiversity.

Twenty-six per cent of the villages in India were classified as forest-fringe villages by the Forest Survey of India (2019). Forests fulfil significant socio-cultural, and livelihood needs (Prateek and Punia, 2023). However, there is a lack of assessment about the proportional contribution of forests to the livelihood basket of the households of dependent communities and the varied ways in which external shocks and stressors impact that reliance (Saalu et al., 2019; Jagger et al., 2022). Research has shown a failure in the socio-economic surveys across the world in capturing the full contribution of forest and environmental income in rural livelihoods (Bakkegaard et al., 2017).

Forests-based livelihoods and Non-Timber Forest Products (NTFPs) have always been particularly integral to indigenous or tribal communities living in the proximity of biodiversity-rich forests in India. Women are primarily involved in collecting the NTFPs for consumption and as a source of income (Prema, 2002). Fuel, fodder, food and medicine from the forest are used for the community's energy requirements, livelihoods, as well as consumption in the households. In states with significant tribal population such as Madhya Pradesh, Chhattisgarh and Jharkhand, returns from selling forest produces are a significant source of income for the communities. For instance, Sal (Shorea robusta) seeds fetch the highest price in the market, followed by Chard (Beta vulgaris), Tendu (Diospyros melanoxylon) leaves and Mahua (Madhuca longifolia) flowers in these states (PRADAN and Ford Foundation, 2022).

Global assessments have found climate change is a threat to the survival of forest species and impact forest ecosystems at large, thus reducing the ability of forest-dependent people to meet their basic needs of food and other necessities which can worsen existing inequalities (Obeng et al., 2011). Prolonged drought, forest fires caused by high temperatures, erratic rainfall patterns and variability in the rainfall intensity are known to directly impact the forest ecosystems and create scarcity of resources. A study in Jharkhand reveals a significant decline in lac (Kerria lacca) yield as well as deterioration of quality of NTFPs attributed to rising maximum temperatures (Magry et al., 2023). States like Himachal Pradesh, Madhya Pradesh, Uttarakhand, Mizoram and Odisha are seeing an increasing number of forest fires that are only expected to increase, fueled by relentlessly rising atmospheric temperatures (Barik and Roy, 2023). The decreasing forest cover and events such as forest-fires have also led to a rise in human-animal conflict, even in villages located far from the forests (PRADAN, 2022), particularly affecting women and young children who are engaged in forest produce collection and aggregation. Additionally, climate stresses can impact the demand and market prices of forest produce as seen with the falling prices of lac, mahua and tamarind, key forest products. This can directly impact not only the access to, and ability of, women and men to obtain indispensable forest resources (Singh et al., 2013), but also reduce women's participation in, and contribution to, households' livelihoods basket.

However, implications of loss of forests on vulnerable communities, especially women, are hardly captured. Though evidence attributes a complex set of factors including various human activities as well as climate change to the depletion of forests (Chakraborty et al., 2018; Jharia et al., 2019), systematic areas of inquiry need to be developed to establish link between forests, women and climate change impacts.

4.6 Neglected identities of, and implications on, women in the coastal livelihood ecosystem.

Climate change manifested in terms of rising sea levels, increasing frequency of storms, cyclones and flooding have negative effects on coastal ecosystems including deprivation of natural habitats, loss in biodiversity and impacts on livelihoods of dependent communities (Singh et al., 2017). The evidence from the IPCC Special Report on Oceans and Cryosphere (SROCC) highlights that the warming of the ocean has already affected marine ecosystems (Prakash et al., 2022), severely altering their functioning including mangroves and causing dramatic impacts on associated socio-economic systems (Kriegl et al., 2022).

Population groups dependent on marine ecosystems for their livelihoods are at extreme risks of slow-onset and sudden climatic events. Research on fishers in the west coast of India has observed that while on one hand, changes in rainfall patterns have affected fish breeding and have caused a significant decline in fish catch, on the other, industrial development and blocking of coastline has restricted fishing communities' access to marine resources, thereby hampering their livelihoods (Mehta et al., 2019). These communities face several other challenges including occupational uncertainty, damage of equipment and frequent relocation of residence, pushing them to take distress-driven pathways of migrating to informal sector in urban and peri-urban areas.

Women are central to the fish value chain and their historical contribution has been immense, yet, they are often assigned the most unstable and poorly paid positions, thus making their position precarious (Prakash et al., 2022). Climate crises thus have direct consequences on the food security and livelihoods of the fisher-people, and to the wellbeing of women and having negative implications for gender relations (ibid). However relatively less attention has been paid to a gendered analysis of coastal livelihoods and the specific experiences, opportunities, and constraints women face to sustain their livelihoods. While the lack of attention to gendered analysis of adaptation and gender-disaggregated data makes it difficult for women in overall livelihoods ecosystems, it is worse for coastal women. Moreover, fisher communities in India, particularly women are positioned within the axes of religion, caste, gender, age, and poverty and thus their experiences of vulnerabilities need to be mapped as such. Amidst significant knowledge gaps in documenting the complex link between climate events and its impact on coastal women farmers, it becomes critical to examine gendered livelihood challenges, strategies, adaptation, and resilience to natural hazards amongst the coastal communities.

4.7 Conclusion

A widely acknowledged definition of livelihood was proposed by Chambers and Conway in 1992: "A livelihood comprises the capabilities, assets (stores, resources, claims and access) and activities required for a means of living; A sustainable livelihood is one which can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels and in the short and long term." This definition foregrounds multiple vulnerabilities that are a part of the lives and livelihoods of rural people which are exacerbated by extreme events, further influencing their capacities of drawing on different types of livelihood assets, opportunities

and strategies to achieve desired livelihood outcome. Succeeding research also recognised the role of gendered labour and access, and how those influence livelihoods, experiences and outcomes for women. Thus, multidimensional climate vulnerabilities faced by rural people call for multifaceted policies and programmes. Such programmes should take into account the vulnerable rural and migrating population groups engaged in both on-farm and off-farm activities and address their specific constraints to build their resilience and adaptation to risks and stressors.

The literature on climate change and livelihoods in India exhibits knowledge gaps in documenting the vulnerabilities of specific population groups, particularly various groups of women. Women are often considered a homogenous population group restricting the research, programmes and policies to understand intersectionalities and develop unique and adequate adaptation and coping strategies. As a result, the interconnection between women's health and livelihoods and ways in which one domain impacts the other is not adequately researched. The previous chapter details the multifaceted impacts of climate events on women's health laying the foundation to also study the climate change-livelihoods-women's health nexus across the various agroecological zones.

This chapter has two important limitations. First, it does not examine the differences in the impact of climate change on women's engagement in agriculture, informal labour work, forestry or coastal livelihoods. Despite a lack of evidence, understanding gender differences across livelihood pathways and how those interact with climate events is a key area of inquiry for developing adaptation programs and policies. Second, this chapter only studied climate change impacts on women engaged in four broad ecosystems. Other ecosystems such as deserts, mountains and mangroves, that face significant threat from climate events need exploration and in-depth analysis in terms of women's vulnerabilities, opportunities and possible adaptation strategies.

CHAPTER 5: SUSCEPTIBILITY OF CHILDREN TO CLIMATE EVENT

How are the health, education, and overall wellbeing of children impacted by ***climate change***

5.1 Introduction

The climate crisis is overturning the lives of millions of children around the world. Almost every child (any person under 18) on Earth is now exposed to at least one major climate hazard, from floods and heatwaves to pollution and drought (UNICEF, 2021). The United Nations Children's Fund (UNICEF) estimates that 1 billion children, amounting to almost half of all children on Earth, are at 'extremely high risk' to climate impacts. Children's bodies and minds are particularly vulnerable to, and disproportionately affected by, the impacts of climate change effects such as pollution, heat, deadly diseases and extreme weather, with some estimates suggesting up to 88 percent of the global burden of disease falling upon children (Sheffield and Landrigan, 2011; Perera, 2017; UNICEF, 2023b). Children drink more water, eat more food, and breathe more air pound-for-pound of body weight compared to adults, putting them at a greater exposure risk (Landrigan et al., 2004). Hence, a combination of physiological vulnerability and the risk of exposure puts children at a higher risk as compared to adults (Singh et al., 2021). Stress from extreme weather events is also found to contribute to neurodevelopmental and mental health problems in children (Perera, 2017). A child born in 2020 faces 6.8 times more heatwaves, 2.6 times more drought, 2.8 times more crop failure, and 2.8 times more river floods than a person born in 1960 (Ryan et.al, 2021). According to the World Health Organization (WHO), in 2030, there could be an additional 77,000–131,000 deaths among children under 5 years of age, in the absence of mitigation strategies (Bhutta et al., 2019). COVID-19 and its intersection with climate change have intensified the climate crisis and the risk to children's health and wellbeing and increased the complexity of addressing climate change-induced challenges.

These far-reaching implications of climate change on children have the potential to challenge the very essence of children's right to good health, education, nutrition and overall survival and wellbeing, as described in the Convention on the Rights of the Child in the UN Sustainable Development Goals (UN General Assembly, 1989; UNICEF, 2023a). Climate change implications represent intergenerational inequity or one generation's commitment (or the lack thereof) towards the health and wellbeing of future generations. A lack of action on mitigating climate change, impacts in general, and for children particularly, undermines children's rights to a clean environment to live in, clear air to breathe, water to drink, food to eat, and to learn and play. At the same time, children's rights to be heard, to participate in decision-making, and to exercise their voice and agency, which is critical to their potential capacity to respond and adapt to climate change impacts are neglected in the global and national mitigation strategies (UNICEF, 2021). The voices and rights of children from the more vulnerable countries are further unheard and unrecognised.

Inequity is deeply interwoven into climate crisis concerns. Children in low-income and developing countries are in a more precarious situation. A growing body of evidence suggests that the world's most disadvantaged and disempowered people are also the most vulnerable to the health impacts of climate change with low capacities to adapt and

recover from recurring climate-induced shocks (Watts et al., 2018a; Kagawa, 2022). Limited social safety nets, fragile healthcare systems, and weak systemic linkages magnify the challenges for underprivileged communities, making it harder for them to adapt or respond to climate change. In such geographies, disasters like floods and droughts further exacerbated by climate change pose immediate risks to children's lives and health and intensify the scarcity of resources (Arpin et al., 2021). Conflicts and disputes arising because of the lack of resources can lead to displacement and separation of children from their homes and families and cause disruptions to their education. Overall wellbeing and development. At the same time, climate change impacts people differently based on various determinants such as geographical location, age, sex and socioeconomic conditions and further impacts how they cope with the effects. For instance, during extreme weather events and displacement, girl children lose their education first, to help support their families in times of crisis (Castañeda et al., 2020; UNICEF, 2021). Climate change is thus aggravating existing injustices and producing new ones. By exacerbating the vulnerabilities of children and other populations at risk, climate change can substantially impede development and possibly even reverse the improvements made in child survival and wellbeing during recent decades (UNICEF, 2015).

Despite children's unique vulnerability and the recognition of the adverse implications of climate change on child health and wellbeing, a systematic approach and investigation focusing solely on children has been lacking. Children are largely ignored in the response to climate change (Bunyavanich et al., 2003; Sheffield and Landrigan, 2011; Arpin et al., 2021; Helldén et al., 2021). In the 2023 Synthesis Report of the IPCC Sixth Assessment Report, the word "children" is referred to only two times. Evidence presents an accelerated momentum for studying the health effects of climate change only in the past few years (Helldén et al., 2021). In 2021, for the first time, UNICEF laid out the risks and threats of climate change to children when it released the Children's Climate Risk Index (CCRI). CCRI ranks countries based on children's exposure to climate and environmental shocks such as cyclones and heatwaves6, and their vulnerability to those shocks based on their access to essential services (UNICEF, 2021). While these efforts towards understanding and strengthening climate change response, mitigation and adaptation have been recognised, it is essential to generate context-specific understanding and develop systematic and inclusive pathways. This will incorporate children's voices and perspectives in urgent climate action, to ensure that all, including the most vulnerable, have a livable future (UNICEF, 2023a).

Children at risk of the impacts of climate changein India

India is one of the most vulnerable countries in the world to the adverse impacts of climate change. According to the Global Climate Risk Index that analyses quantified impacts of extreme weather events, India was the seventh (out of 180 countries) most climate-affected country in the world in 2019, both in terms of fatalities (2,267 people) as well as the economic losses (66,182 million US$) (Eckstein et al., 2021). According to the CCRI of 2021 released by UNICEF, India is ranked 26th out of 163 countries, making it one of the countries where children face serious vulnerability to the consequences of climate change (UNICEF, 2021). The CCRI data has foregrounded that children in India are among the most 'at-risk' for the impacts of climate change. It pointed to the serious deprivations faced by children due to the intensifying effect that climate and environmental shocks have on existing inadequate access to essential services such as water and sanitation, healthcare and education, and overall wellbeing (UNICEF, 2021).

India's average temperature has risen by around 0.7°C during 1901–2018. This temperature rise is largely on account of greenhouse gases-induced warming, compounded by anthropogenic activities, such as fossil fuel consumption and land use and land cover changes caused by industrialisation (Krishnan et al., 2020). Children are the most affected by climate change disasters that they are least responsible for causing. Limited to negligible emphasis is provided in the policy frameworks for understanding the overall impact of climate change on children's lives and mitigation strategies for addressing natural disasters (PwC and SC, 2015). In this scenario, it becomes vitally important to understand the link between climate variabilities and related effects, especially on the various aspects of children's lives (Hanna and Oliva, 2016). This task is further hampered by the fact that it is hard to disentangle climate effects from other characteristics that coexist with climate.

Understanding the effects of climate change on children is a challenging task. A detailed assessment of differential vulnerabilities and specific and contextual needs of children needs to be mapped. Children are not a homogenous population group, even within a specific social or economic category. However, most of the literature treats them so. The existing data and studies are hardly disaggregated by age and gender, rendering the long-term needs of children invisible (PwC and SC, 2015). In this scenario, the interests and rights of children with special needs and protection are completely overlooked. Understanding where and how children are uniquely vulnerable to this crisis is crucial to building our resilience and effectively addressing climate change. A range of research methods are needed to further the understanding of vulnerable subpopulations and geographical regions and articulate the costs and benefits of mitigation and adaptation for addressing risks.

5.2 Conceptual framework

Recognising the UNICEF'S CCRI, which found 1 billion children in the world at extremely high risk of the impacts of climate change, this chapter adopts and builds on the CCRI framework to explore the exposure of children to multiple climate and environmental shocks and stress across agroecologies in India. The purpose of adopting the CCRI model is that it represents a balanced view of the different sectors involved in the well-being of children, focusing on aspects that could lead to, or exacerbate, child deprivation in the context of climate-related and environmental shocks and stresses (UNICEF, 2021). Understanding the vulnerability and exposure to hazards, and thus risks, that children face due to climate change is key to understanding how to better protect them.

The conceptual framework in Figure 5.1, building on the overall framework of the study described in Chapter 2, illustrates the two pillars (exposure to climate and environmental shocks and stresses, and child vulnerability) of CCRI and its different components. At the same time, the framework adds a third pillar underlining the elements that the CCRI misses: the socio-economic inequities and inequalities influencing the impacts of climate change on children from varied contexts. This is based on the assumption that implications of climate events are driven by multiple factors, acting in combination with each other which cannot be homogenised. This chapter aims to establish a more holistic and interrelated framework for understanding the impacts of climate change events on the various aspects of children's lives.

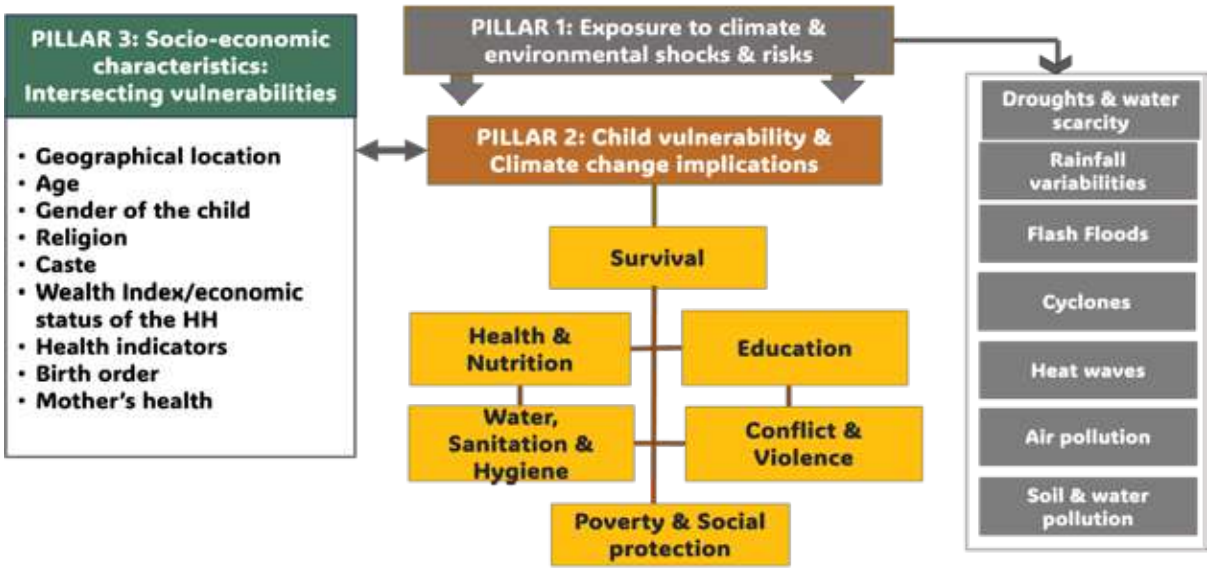


Figure 5.1: Conceptual framework adopted in the chapter to assess climate change implications on children (adapted from CCRI-UNICEF, 2021)

5.3 Climate change impacts on children's survival

According to UNDP, women and children are 14 times more likely than men to die in a disaster. The direct effects of climate change evidenced by changing weather patterns such as heatwaves, windstorms, and flooding, are associated with childhood morbidity and mortality (Garcia and Sheehan, 2016). The burden is predominantly on children under 5 years of age, partly because of their small physical size, cognitive and physiological vulnerability and their dependence on caregivers for protection (Bennett and Friel, 2014). Climate change may be particularly dangerous for children in developing countries due to high birth rates and high ratios of children to adults (Hanna and Oliva, 2016). At the same time, in poor communities, the major factors for child mortality are infections and parasitic diseases, which can increase due to climate change (ibid).

Thermal extremes manifested through heat waves increase the rate of death and illness, especially among infants and young children ((Dutta et al., 2020), Kakkad et al., 2014; Bennett and Friel, 2014; van Oldenborgh et al., 2018; Yadav et al., 2023). Children tend to spend more time outdoors, playing and doing other physical activities, putting them at increased risk of dehydration and heat stroke. At the same time, children from low-resource households and from communities living in geographies that offer limited modes of respite such as regular electricity supply for cooling, regular water supply or dense vegetation find themselves to be more at-risk.

Limited research exists on the effects of high ambient temperatures on infants and young children. In India, most of this limited evidence is generated from small-scale studies, which though useful, represent skewed geographical distribution and methodological weaknesses (Ingole et al., 2017; Dimitrova et al., 2021; deSouza et al., 2022). A study investigating the effects of temperature extremes and diurnal temperature variations on mortality in the city of Varanasi in Uttar Pradesh during 2009-2016, found children (≤ 4 years) suffering the maximum number of deaths compared to other age groups (Singh et al., 2019). Similarly, Ingole et al., (2012) found children (≤ 5 years) highly susceptible to, and

facing increased mortality, due to the high (and cold) temperatures in the Vadu block of Pune district, Maharashtra. In Delhi, Hajat et al. (2005) found a high proportion (48 percent) of heat–related deaths between 1991–1994 occurring in children younger than 15 years and demonstrated more sustained risks for children. Underlying limitations in all these studies are a) the challenge of absolute attributability: studies considering ambient temperatures and heat waves as an "all-cause" risk factor for mortality without considering other factors are analytically and methodologically inadequate; and b) due to the smaller scale of these studies (some blocks/districts of a state), the data and results may not be representative of the state or the agroecological regions.

Children can get injured, killed, or displaced in sudden disaster events such as floods and cyclones, and at the same time suffer from disruptions in access to essential services for survival, protection, health and wellbeing. Sea-level rise due to global climate warming has made coastal storm effects increasingly dangerous for inhabitants living around the coast, especially for children who have a high susceptibility to death from drowning (Perera, 2017). In five major natural disasters in India from 2000-2016, around 17,671 children lost their lives and in 2019, ten million children were reportedly in the path of tropical Cyclone Fani in India (UNICEF, 2021). Floods and tropical cyclones can also cause diarrhoeal illness due to contaminated water, and the disruption of access to medical care further worsens the situation (Kousky, 2016). Children's underdeveloped immune systems can hardly resist infections and they can get dangerously dehydrated very quickly. In India, diarrhoeal diseases are linked to high child mortality which stands at approximately 300,000 deaths per year (Kagawa, 2022). Such an outbreak superimposed on socio-economic disadvantage and poverty can make the situation more precarious for children and other vulnerable groups. There is limited evidence on the direct effect of the different kinds of floods on children's mortality in India. Data from Rajya Sabha indicate that deaths due to cyclonic storms have increased between 2019 and 2021 (GOI, 2022), however, efforts need to be made to understand the complexities and factors behind the same to develop appropriate mitigation pathways, especially for different vulnerable groups such as children.

Long-term exposure of children to anthropogenic changes such as poor air quality and pollution adversely affects their health and contributes to higher mortality (UNICEF, 2015). According to the State of Global Air (2020) report, more than 116,000 infants in India died within a month of birth due to outdoor and indoor air pollution. Though evidence establishes that air pollution together with climate events can magnify the harm to children (Perera, 2018), making this a critical area of inquiry and intervention, no explicit linkages of either air pollution with health or climate change with air pollution have been made. One study finds a robust association between PM 2.5 and infant mortality largely through neonatal mortality (deSouza et al., 2022).

5.4 Climate change impacts on children's health and nutrition

Establishing causal pathways or attributability among the complex environmental threats and climate change events on one hand and child health on the other remains a constraint. As India is already facing climate change-related challenges, further studies exploring and addressing the association between climate variability and related health and nutrition impacts, to improve future policies, programmes and research are necessary (Sheffield and Landrigan, 2011; Mall et al., 2017; Singh et al., 2019; Singh et al., 2021). As far as climate change-related health impacts on children are concerned, the studies are at a preliminary stage and empirical research quantifying the impacts of various climate events on child health is scarce (Singh et al., 2021). Moreover, various socio-economic factors impacting health and nutrition thereby magnifying children's susceptibility to, and risk of, facing the adverse impacts from extreme events are not considered in measurements. Although there is a slight overall improvement in nutrition indicators such as stunting, wasting and underweight for children as per the NFHS-5 (2019-21), the trend is not uniform across districts and the figures are still worrying. (IIPS and ICF, 2021). Though the scale and extent of risk climate change can pose to these growth indicators have not been clearly established, studies have conceded that climate change could further slowdown or reverse improvements in health indicators (Muttarak and Dimitrova, 2019; Dimitrova and Bora, 2020). Table 5.3 lists the key empirical studies conducted in India attributing various climate-related hazards and the health and nutrition of children.

Children's metabolism, especially in the embryonic and foetal life and in the first few months after birth, is slower, making them more susceptible to adverse effects of extreme climate events. Evidence suggests a strong relationship between in-utero conditions and the overall development of a child after birth. – In-utero exposure to adverse environments may negatively affect the health and educational attainment of children in later stages of their lives (Banerjee et al. 2010; Kumar et al., 2014). There is growing literature on the "foetal origins" hypothesis introduced by David Barker, who argued that inadequate nutrition in utero triggers chronic, degenerative conditions in adult life. (Almond and Currie, 2011). Exposure during these periods can cause devastating damage that can cause low levels of human capital accumulation and has been found to have no counterpart in adult life (Berkman et al., 2002; Kumar et al., 2014).

The exposures and impacts of extreme climate events on the lives of children are heavier, differential and rapidly changing, and it is pertinent to identify and understand the critical periods of susceptibility in children's lifespan to be able to build resilience and adaptation (Carroquino et al., 2013). This section presents the evidence and potential areas of major exposures associated with climate events, building upon the categorisation of the potential association of climate change and child health done by Bunyavanich et al., (2003): a) environmental change such as air pollution, b) climatic change such as thermal extremes and weather disasters such as floods, cyclones and droughts, and, c) long-term ecological changes such as availability of food and nutrition, and emerging infectious diseases.

a. Air pollution and other respiratory problems pose serious threats to respiratory diseases in children and to their overall wellbeing

Twenty-two out of the 30 most polluted cities in the world are in India (IQAir, 2020). The major contributors to air pollution in India are household burning emissions, coal combustion (in power plants), agricultural burning and transport (Singh et al., 2019). Fossil-fuel combustion by-products involving a myriad of toxic air pollutants and carbon dioxide (CO2) are the world's most significant threat to children's health (Perera, 2017). Various indoor air pollutants are associated with respiratory disorders in children, and these pollutants include particles, gases, vapours, allergens, and moulds (Landrigan et al., 2004). According to a rough estimate, if the pollution levels in India were reduced eight-fold (based on WHO recommended standards), the status of stunted and severely stunted children would decrease by 10.4 and 5.17 percentage points, respectively (Ibid).

Though a large share of studies establishing causal links between air pollution and child health have focused on developed countries, macro studies and a few context-specific micro-studies in India help us in improving our understanding of the same. Air pollution negatively affects the health of children throughout their life cycle starting from their fetal origin. Singh et al., (2019b) suggest that exposure to air pollution during the first trimester increases both stunting (height-for-age) and wasting (weight-for-age) for children aged below five years. Outdoor and indoor air pollution are positively associated with upper and lower respiratory tract infections in children (Chauhan et al., 2005). Siddique et al (2011) found a high prevalence of upper (running and stuffy nose, sinusitis, sore throat) and lower (wheezing, wet cough, dry cough, phlegm, shortness of breath) respiratory symptoms among school-age children, and the risk of severe acute respiratory infections (ARIs) in very young children and the elderly in Delhi due to high level of ambient air pollution. Ambient air pollution levels are also associated with asthma and other respiratory morbidity in children (Landringan, 2004). As far as the health risk from particulate matter (PM_{10}) pollution is concerned, it is high for some susceptible groups such as children and elderly and those with diseases of the heart and lungs (Siddique et al., 2011). Exposure to airborne fine particulates ($PM_{2.5}$) has also been linked to adverse neonatal conditions in India (Balakrishnan et al., 2019).

Synergies between air pollution and climate change can magnify the harm to children including cognitive and behavioral development, respiratory illness, and other chronic diseases—all of which may be "seeded" in utero and affect health and functioning immediately and over the life course. By impairing children's health, ability to learn, and potential to contribute to society, pollution, and climate change cause children to become less resilient and the communities they live in to become less equitable. At the same time, complex and poor socio-economic factors can increase children's susceptibility to respiratory diseases caused by air pollutants. Low socioeconomic status is associated with caste, religion, poverty, education, large family size, crowded living conditions, poorer access to medical care, nutritional deficits, and exposure to environmental pollutants, including outdoor and indoor air pollution and stressful living conditions (Siddique et al., 2011; deSouza et al., 2023). Children affected by malnutrition are likely to be more vulnerable to the neurotoxic effects of air pollution; and children born with low birth weight or preterm because of air pollution will be at greater risk of malnutrition or infectious disease (Perera, 2017). Similarly, the effect of air pollution exposure during pregnancy on the risk of preterm birth is likely to be magnified by the concurrent experience of extreme temperatures, food insecurity and stress due to climate change.

b. Climate hazards such as thermal extremes and weather disasters such as floods, cyclones and droughts have immediate and long-lasting health impacts on children

Thermal extremes manifested as heat waves are intervals of abnormally hot and humid weather and have been shown to impact human health substantially. Understanding how heat waves affect health is the key to preparing vulnerable communities such as children to respond. Children remain the most vulnerable to heat waves, which expose them to heat strokes and burns and more long-term effects of air pollution magnified by the rise in temperature (UNICEF, 2021). Research in this area is relatively inadequate, particularly in India. Moreover, a consistent definition of a heat wave from a children's health perspective which identifies the best measure of children's exposure to heat waves is missing (Xu et al., 2014).

Children may be more susceptible to heat waves due to their high metabolic rate (Bunyavanich et al., 2003), and less developed thermoregulatory systems, allowing greater heat and cold transfer between the environment and the body (Xu et al., 2014). Spending more time outdoors and participating in more vigorous physical activity than adults expose them to outdoor heat. At the same time, infants and children up to 5 years of age cannot take care of themselves and rely on others to regulate their environments and provide adequate liquids as a respite from heat waves (Xu et al., 2014). In urban areas specifically, there is increased risk of heat waves exacerbating the problem of urban heat islands – a phenomenon where urban areas become hotter because of more heat absorbing and retaining surfaces, incident solar radiation and low vegetation (Li and Bou-Zeid, 2013). Kakkad and Barzaga (2014). An example of heat-related illness in infants occurred during the 2010 heat wave in Ahmedabad in Gujarat when there was an increase in admissions in the neonatal intensive care unit (NICU) with a particularly noteworthy surge when the maternity ward remained in the top-floor of a non-air-conditioned hospital. From 2013-2022, the total number of heatwave days experienced annually by children in India under the age of one was 43 percent greater than the equivalent demographic from 1986-2005 (Sharma, 2023). Children experience a greater risk of diseases or conditions due to exposure to heat waves including respiratory disease, renal disease, and electrolyte imbalance (Nitschke et al., 2011). School-age children are also more susceptible to gastroenteritis due to temperature exposure since children in this age group are more likely to be involved in outdoor activities (Lam, 2007).

Several other factors shape the impacts of heat waves. For instance, a study done in a peri-urban region of Telangana found that people living in houses with lower ceiling height and asbestos roofing sheets might be more vulnerable to heat (Milà et al., 2020), thereby making children of such households more at-risk. Similarly, children from different socio-economic geographies and age groups would have different levels of adaptability to heat waves. Intensifying cold is also a constraint for poor children as they do not have warm clothes and schools in marginalised areas don't have the facilities to keep children warm (Kagawa, 2022). Data gaps exists in understanding the differential factors behind children's vulnerability to heat waves and more robust and systematic methods are needed to measure children's exposure to heat waves.

Rainfall shocks, especially floods and periods of drought affect maternal and children's health through a) income and food shocks, and b) diseases and infections. In rural India,

disasters such as floods and droughts may cause significant income shocks due to crop and livestock damage thereby limiting their expenditure on food and health.

In India, there are context-specific studies that have established clear links between flood exposure and negative child health outcomes during different childhood stages. For instance, Dimitrova and Bora (2020) observe that in India exposure to excessive monsoon rainfall in utero and during the first year after birth is associated with an increased risk of undernutrition and stunting among children under the age of five. Rodriguez-Llanes et al (2016) and Muttarark and Dimitrova (2019) reported high rates of diarrhoeal diseases and childhood undernutrition among flooded communities in rural eastern India and Kerala coastal regions, respectively. In the Bahraich district of Uttar Pradesh, Joshi et al (2011) also found similar results and identified 6-17 months age group children to be most vulnerable. The study also highlighted that preexisting low health indicators such as anaemia formed a significant risk factor in children. Singh et al. (2021) in their study in Varanasi, UP, reported that the burden of infectious diseases due to climate variabilities and shocks remains high among children, especially under-5s. Temperature rise, extreme and changing precipitation, and drought conditions are conducive to pathogen growth and spread, hence it is anticipated that diarrhoeal illnesses will only magnify (USAID, 2017). Extrapolating past climate change episodes could mean a 13% increase in childhood diarrhoea incidence rates in the northern states of India by 2040 (Moors et al., 2013). Children may also be exposed to a high risk of water-borne diseases such as malaria and dengue fever and other infections like conjunctivitis due to standing water and open defecation (Kagawa, 2022). Many other socio-cultural impacts of disasters such as floods lack systematic inquiry. For instance, in flood shelters, people share the space with many unknown people putting children, especially girls at particular risk of abuse, distress and other kinds of physical and mental violence. Kar et al. (2007) reported post-traumatic symptoms in many children and adolescents one year after the 1999 super-cyclone hit Odisha.

Kumar et al. (2014) found that exposure to drought in utero (in the first trimester) increases the child's probability of being underweight and severely underweight by 1.7 and 2.1 per cent respectively. Existing evidence also establishes attributability between drought conditions and undernutrition (stunting, wasting and underweight) in infants and children under 5 years of age (Shaw et al., 2020). Other systematic reviews in India such as Phalkey et al. (2015) found an association between droughts and childhood stunting. Algur et al. (2021) reported effects not only on the nutrition levels of children but also a considerable increase in the burden of work for women and children due to droughts.

There are a few empirical studies establishing linkages between drought exposure and child health outcomes across agroecological zones. For instance, Singh et al (2006) found a high prevalence of wasting, vitamin A and B complex deficiencies and anaemia, along with dietary deficits of energy and protein in preschool children aged 0-5 years in drought-affected desert areas of western Rajasthan; Mahapatra et al. (2000) revealed the widespread prevalence of malnutrition in the form of wasting, stunting and underweight in over one-fourth to half under-5 children in Kalahandi, Odisha. In addition to nutrition, a field observation study from the Deccan plateau of southern India has shown droughts to result in psychosocial illness and stress in children due to feeling neglected and overlooked regarding food, medication and sanitation (Reddy et al., 2021).

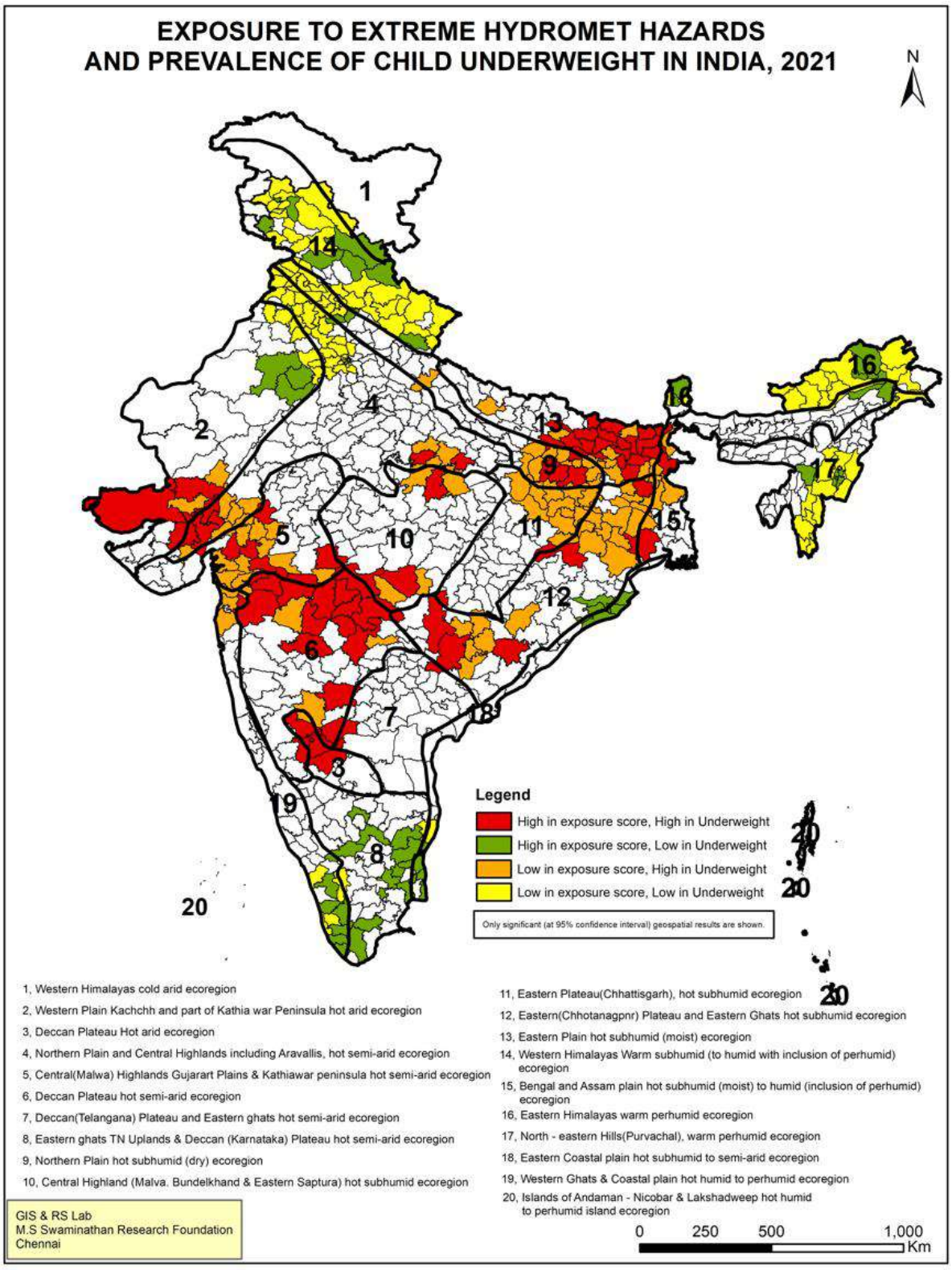
These impacts exacerbate the already existing inequalities or unfair norms discriminating against the girl child (Datar et al., 2013). For instance, there is wide agreement among scholars that Indian families prefer to invest more in boys' nutrition than girls' (Aurino, 2017). In the context of sharp differences in nutrition levels of males and females in the country, a girl child who is being discriminated against in matters of nutritional choices is more likely to be at risk during a drought.

On the contrary, during floods, Kumar et al (2014) found boys and children from the low castes more susceptible to rainfall shocks highlighting the importance of heterogenous socio-economic factors in understanding the effects of disasters. Hence, natural disasters can widen existing inequalities, perpetuate poverty and have long-lasting implications on children's lives. More agroecologically context-specific studies as well as large-scale studies are needed in India to contribute to the understanding of immediate and long-term impacts of climate change disasters on children's health.

5.5 Insights from mapping and statistical analysis underscoring differential vulnerabilities

The geospatial analysis of exposure to extreme hydromet hazards and prevalence of underweight children show that the southern part of Western Plain Kutch peninsula hot arid ecoregion (AEZ-2), north-western part of Deccan Plateau hot arid ecoregion (AEZ-3), northern part of Deccan Plateau hot semi-arid ecoregion (AEZ-6) and eastern part of Eastern plain hot subhumid ecoregion (AEZ-13) are major hotspots where a high percentage of underweight children coexists with high exposure score of extreme hydromet hazards.(Map 5.1 red zones)

Figure 5.2: Map depicting exposure to extreme hydromet hazards and prevalence of underweight children.

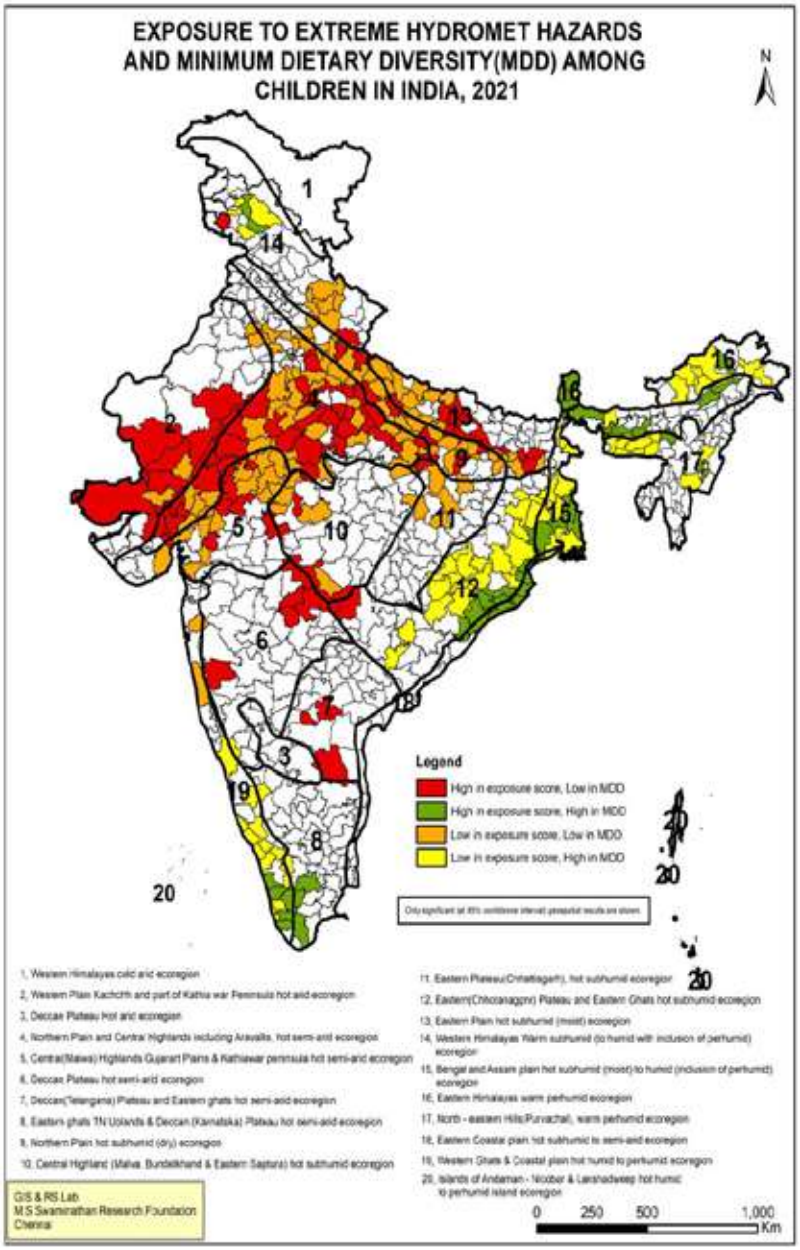


Source: Study Team using CEEW and NFHS datasets 2015-16 and 2019-21

In contrast, the green zones on the map show areas with high exposure score to extreme hydromet hazards in the southern states like Kerala (AEZ-19), Tamil Nadu (AEZ-8) and coastal parts of Odisha (AEZ-18), some parts of AEZ-2, AEZ-14 and AEZ-16, but lower prevalence of underweight children. This is most likely due to better health systems and

better programmatic implementation.

Figure 5.3: Map depicting the exposure to extreme hydromet hazards and prevalence of minimum dietary diversity among children in India.



Source: *Study Team using CEEW and NFHS datasets 2015-16 and 2019-21*

Major hotspots where low minimum dietary diversity coexists with high exposure scores to extreme hydromet hazards include the Western Plain Kutch peninsula hot arid ecoregion (AEZ-2) and the Northern Plain and Central Highlands hot semiarid ecoregion (AEZ-4). Some parts of the Deccan Plateau hot semi-arid ecoregion (AEZ-6) and the Deccan Plateau and Eastern Ghats hot semiarid ecoregion (AEZ-7) also witness this coexistence (map 5.2). These findings underscore the vulnerability of arid and semi-arid ecoregions in terms of child nutritional indicators due to exposure to droughts. Similar patterns are observed through regression analysis, highlighting the consistency and reliability of the findings across different analytical approaches.

Table 5.1
Impact of exposure to extreme hydromet hazards on selected indicators among children in India

	Drought	Flood	Cyclone
Child Underweight [1]	+10%	-6%	NS
Minimum Dietary Diversity[1,2]	-28%	+16%	NS
Under-5 child deaths[3]	+6%	NS	+13%
Diarrhoea among children[1,2]	+20%	+14%	+24%
Child Immunisation[2,4]	-18%	-9%	NS
ICDS utilisation for children[2,5]	NS	-25%	-25%

Note:
This table is derived from adjusted multivariate logistic regression analysis and percentages describe the likelihood of decrease (-) / increase (+) of an indicator if exposed to extreme hydro met events, computed using odds ratio
Above results are significant at 95 percent confidence interval (we can say that results hold true for 95 out of 100 attempts), and NS=Not significant

Source: CEEW and NFHS

1 Adjusted for Place of Residence, Sex of Child, Social Group, wealth status, household with sanitation facility, household with clean water, household with clean fuel, mass media exposure, mother's education, mother BMI, birth order, mother age at first birth, child current age, number of household members, ICDS, time
2 only for the last birth in five years preceding the survey
3 Adjusted for Place of Residence, Sex of Child, Social Group, wealth status, household with sanitation facility, household with clean water, household with clean fuel, mass media exposure, mother's education, mother BMI, birth order, mother age at first birth, number of household member, time
4 Adjusted for Place of Residence, Sex of Child, Social Group, wealth status, household with sanitation facility, household with clean water, household with clean fuel, mass media exposure, mother's education, mother BMI, birth order, mother age at first birth, ICDS, number of household member, time
5 Adjusted for Place of Residence, Sex of Child, Social Group, wealth status, household with sanitation facility, household with clean water, household with clean fuel, mass media exposure, mother's education, mother BMI, birth order, mother age at first birth, child current age, number of household member, time

In congruence with the existing literature, our findings reveal that the percentage of underweight children is likely to increase by 10% if exposed to drought (Table 5.1). Similarly, our analysis shows a 28 percent reduction in minimum dietary diversity if exposed to drought but a 16 percent increase if exposed to flood (Table 5.1). Droughts often lead to crop failures, water scarcity, and decreased agricultural productivity, resulting in food shortages and limited access to nutritious and diverse foods. As a result, children in drought-affected areas are more likely to experience higher rates of underweight status and reduced diet diversity causing malnutrition including deficiencies in macronutrients and micronutrients. At the same time, though floods can disrupt food distribution networks and damage crops, they may also bring relief through humanitarian aid and support. Increased access to food aid including diverse food items and nutritional supplements and relief efforts during and after floods may improve nutritional status among children in flood-affected regions. However, this improvement may not be sustained since all relief

measures are provided for a short duration when people are displaced and withdrawn once they are rehabilitated.

Under-five deaths are likely to increase by 6% if families are exposed to drought and 13% if exposed to cyclones (Table 5.1). This can be attributed to various factors, including disruptions to healthcare services, food insecurity, and heightened vulnerability to waterborne diseases. Droughts can also reduce access to clean water, sanitation facilities, and healthcare services, increasing the risk of diarrhoeal diseases, malnutrition, and other health complications among young children. Additionally, floods and cyclones can cause widespread destruction of infrastructure, displacement, and drowning, exacerbating existing health vulnerabilities and mortality risks among children.

Diarrhoea among children is likely to increase by 20 percent if exposed to drought, 14 percent if exposed to flood, and 24 percent if exposed to a cyclone (Table 5.1). Damage to infrastructure and disruption of access to health centers and delivery of immunisation services are affected, making children more susceptible to preventable diseases. Our findings show that child immunisation is likely to decrease by 18 percent if exposed to drought and 9 percent if exposed to flood (Table 5.1). Furthermore, ICDS utilisation is also likely to decline by 25 percent if exposed to flood and cyclone (Table 5.1). Post-disaster recovery efforts may prioritise immediate relief and reconstruction activities over long-term development programs, further exacerbating the challenges in ICDS utilisation among affected communities.

Table 5.3:
Characteristics empirical studies investigating impact of climate change on child-specific health risks

Climate change & child-specific health risks	Agro-ecological zone (AEZ)	Objectives and sample size	Findings	Usefulness and gaps of the study	Authors
Various environmental variables	AEZ: **9**; Northern plain hot subhumid (dry) ecoregion; Varanasi, Uttar Pradesh	▪ Association of maximum temperature, relative humidity, absolute humidity, rainfall, wind speed, and solar radiation with prevalent infectious diseases examined between 2017-2020. ▪ 461 children under 16-years-of-age	▪ The burden on child morbidity and mortality pertaining to infectious diseases remains high among children, especially in under 5 age groups; is significantly associated with climatic parameters. ▪ High percentage of children with poor nutritional status based on socioeconomic status	▪ Provides locally constructed disease burden estimates to design contextual mitigation and adaptation pathways. ▪ Low Attributability: Climate variables contributed a small part of the disease proportion; other non-independent observations were not considered. ▪ Need for nutritional analysis	Singh et al., 2021.
Heat Waves	AEZ **7**: Deccan Plateau & Eastern Ghats hot semi-arid ecoregion	▪ Quantify the association between ambient fixed site & personal air temperature exposure. ▪ Identify additional predictors of personal exposure to air temp. Based on housing assessment, GPS, remote sensing, wearable camera data. ▪ 50 adults monitored in up to six non-consecutive 24 h sessions in peri-urban south India.	▪ Additional factors to be considered in epidemiological studies e.g. Altitude. ▪ Other factors representing differential exposure should be explored based on fixed-site monitors including housing materials and dimensions; occupation; socioeconomic factors; mobility etc.	▪ The study included a large range of objectively measured predictors including individual and household characteristics, mobility, activities, and greenspace. ▪ Low accuracy of personal temperature measurements	Milà et al., 2020

	AEZ: **4**; Northern plain and central highlands hot semi-arid ecoregion (Ahmedabad, Gujarat)	▪ Comparison of neonatal morbidity in a non-air-conditioned hospital during the 2010 heat wave in Ahmedabad to morbidity in the prior & subsequent years. ▪ Neonatal intensive care unit (NICU) admissions for heat were the outcome of interest	▪ Significant increase in neonatal intensive care unit (NICU) admissions for heat-related illness during heat waves, with a noteworthy surge when the maternity ward remained on the top-floor of non-air-conditioned hospital.	▪ Lack of descriptive information on non-heat-related cases limited examination of individual-level risk factors ▪ Factors such as birth weight, socio-economic status, delivery mode, breast/ formula feeds that contribute to vulnerability are ignored.	Kakkad et al., 2014
Floods and Cyclones	AEZ: **15**; Eastern Plain hot subhumid ecoregion (Bahraich, Uttar Pradesh)	▪ Long-term impacts of recurrent floods on diarrhoea among under-five children in UP. ▪ Two-stage stratified cluster sampling. ▪ 400 children in each flood-exposed and unexposed stratum. Children of age 6-59 months.	▪ Lower age groups (6-17 months) associated with high prevalence of diarrhoea; Economic condition of the households was associated with diarrhoea prevalence. Anaemia is a significant risk factor for diarrhoea among children	▪ Makes the case for an analytical approach to flood-related disaster prevention cutting across sectoral boundaries. ▪ Association between economic conditions and diarrhea cases ignore various other complex sociocultural factors	Joshi et al., 2011
	AEZ: **17**; Eastern Himalayas Warm Perhumid Ecoregion (Jagatsingh pur district, Odisha)	▪ The relationship between exposure to floods and malnutrition in children aged 6-59 months is examined. ▪ Population-based survey of children in flooded & non-flooded regions, one year after f2008 & 2006 floods ▪ Anthropometric measurements on 879 children, parental and household level variables	▪ Children in flooded households were more likely stunted and wasted as compared with those in non-flooded ones. ▪ Low-resource or subsistence farming rural households, long-lasting adverse impacts on the nutritional levels of children was more prevalent.	▪ Nutritional deficiencies may have been concomitant, depending on the socio-economic status and nutrition levels of mothers. ▪ Findings are contextual to a very particular setting and cannot be extrapolated to other populations.	Rodriguez-Llanes et al., 2016.

		collected through face-to-face interviews.			
	AEZ: **20**: Western Ghats & Coastal plain hot humid to perhumid ecoregion (Kerala, India)	▪ Potential impacts of floods on childhood development ▪ Based on the Demographic and Health Survey (NFHS-4) data for India in 2015–2016. Standardised Precipitation and Evapotranspiration Index (SPEI) is used to identify flood events/	▪ Abnormally wet conditions in Kerala increased the likelihood of undernutrition for children aged under 5 as measured by stunting and wasting. ▪ Critical age for stunting from exposure to floods is in infancy. ▪ Girls are more vulnerable than boys, and children of illiterate mothers are more vulnerable in terms of their vulnerability to stunting during floods.	▪ Presents the danger of short-term and long-term consequences of floods on children and proposes intervention at the crucial period of flood exposure of children and reverse the course of undernutrition.	Muttarak and Dimitrova, 2019
Air pollution	AEZ 4: Northern plain and central highlands hot semi-arid ecoregion (Delhi)	▪ Prevalence of respiratory symptoms was determined through a structured respiratory symptomology questionnaire and personal interviews, ▪ Study carried out in Delhi and findings compared with rural West Bengal & Uttarakhand ▪ Air quality data collected from central and State Pollution control boards and also obtained by direct measurements using portable aerosol monitor ▪ Sample:16,164 children aged between 6 and 17 years	▪ Statistically significant association between PM10 level in Delhi's air and prevalence of lower respiratory tract symptoms. ▪ 32% of children in Delhi suffered from respiratory problems in contrast to 18% of rural children ▪ Higher prevalence of respiratory symptoms among school-age children of Delhi, in girls than boys, and, in children from households with poor socio-economic situations.	▪ Findings from this study can serve as reference data for future monitoring studies of urban air pollution on children's health. ▪ Conducts differential analysis age-wise, sex-wise and rural-urban-wise.	Siddique et al., 2011

Droughts & water scarcity	AEZ **2**: Western plain Kutch peninsula hot arid ecoregion	▪ Assesses the impact of drought on the nutritional status of pre-school children aged 0–5 years from a rural population in W. Rajasthan. ▪ 914 children in 24 villages: nutritional status assessed by anthropometry, dietary intake, and clinical signs of nutritional deficiency.	▪ High prevalence of wasting (greater than the WHO cut-off point of 15 percent) ▪ Vitamin A and B complex deficiencies and anaemia, along with dietary deficits of energy and protein were observed to be higher than in non-desert areas.	▪ The study attributes children's low nutrition and health indicators to the near failure of the monsoon for three consecutive years (due to reduced harvests & decline in the food availability and accessibility in the community)	Singh et al., 2006

c. Long-term ecological changes such as the availability of food and emerging infectious diseases affect children's resilience and adaptability to climate risks.

In India, exposure of children to extreme weather events is associated with low nutritional outcomes including a greater likelihood of children facing issues of stunting and underweight (Datar et al., 2013). The extent and scale of extreme events on morbidity, physical growth and immunisations are considerably huge (ibid). India has one of the highest rates of childhood undernutrition in the world with slow improvement over the years (UNICEF et.al, 2023).

Extreme weather, as well as average temperature and rainfall changes, have an impact on food production and consumption patterns, both in terms of quantity and quality. Food insecurity and undernutrition in developing countries, such as India are primarily a matter of access (UNICEF, 2014). Climate change's potential impact on food prices and fluctuations is likely to intensify the perils of access, especially for poorer households. About 70 percent of the Indian working population rely on agriculture directly or indirectly for their sustenance and changes in seasonality in regions with erratic and heavy rainfall, and droughts can negatively affect household income due to reduction in agricultural yields. In the absence of risk-sharing and consumption smoothing, loss of harvest appears to be a severe shock to the rural household incomes and consequently to the health and nutritional status of family members, particularly of pregnant mothers. For developing countries, there is enough evidence to confirm that family income does affect the nutritional status of children (Jensen, 2000; Banerjee et al., 2010; Kumar et al., 2014). Climate change is likely to reduce agricultural production and affect more than 30 percent of the farmers in developing countries who are already food insecure (Lobell et al., 2008). Hence, climate change may worsen malnutrition by adversely affecting agricultural yield and worsen the situation in areas with low socio-economic indicators and already existing food and nutrition insecurity.

Aguayo and Menon (2016), and Likhar and Patil (2022) posit that malnutrition during the first 1000 days causes stunting of the brain and body, with associated reduced metabolic, immune, neurodevelopmental and cognitive function in children and subsequent decreased ability to grow, learn and be economically productive. Consequentially, children's capacity to fight against diseases and infections remains underdeveloped. Childhood ailments such as diarrhoea, malaria and infectious diseases that are considered most climate-sensitive are associated with malnutrition (Patz et al., 2007). At the same time, maternal health plays a key role in determining not only foetal growth, birth weight and infant mortality (WHO, 2016), but also influences offspring's risk of contracting non-communicable diseases (Pullar et al., 2019). This is particularly the case in low and middle-income countries such as India where the double burden of malnutrition poses major health challenges among the adult population (WHO, 2014; Dutta et al., 2019). According to NFHS-5, in India, 52.2 percent of pregnant women aged 15-49 years are anaemic (IIPS and ICF, 2021) putting them and their fetus at risk.

Malnutrition in childhood has been linked with the socio-economic outcomes and overall development of children (Kanjilal et al., 2010). Several interacting factors such as poverty, low levels of literacy of mothers, high anaemia among women/mothers, son preference, and birth order, can lead to adverse impacts on children and hence make them more

susceptible and vulnerable. For instance, Jayachandran and Pande (2017) reveal that Indian parents invest less in subsequent children, hence, children born second, tend to be shorter than the first-borns, and so forth. These observations on the existing evidence present the need for a heterogeneous and differential lens while making climate adaptation and resilience plans. Existing poor health and nutrition situation can increase disaster risk for children, hamper recovery and, if not addressed in the emergency response, leave children more vulnerable to future shocks.

5.5 Climate change implications on Water, Sanitation, and Hygiene (WASH) related threats to children

In rural India, groundwater is the source of water for multiple uses, and in urban areas, surface water is the primary source of water purified in treatment plants. India is the largest user of groundwater in the world, extracting over a quarter of the global groundwater (World Bank, 2012). Groundwater level in India is decreasing due to the continuous extraction of water for agriculture, industry and for domestic purposes, without adequate recharge measures (Dangar, 2021). NITI Aayog published a report in 2018 titled "Composite Water Management Index "which indicated that India was undergoing the worst water crisis in its history manifested through the fact that nearly 600 million people were facing high to extreme water stress and about 200,000 people were losing their lives every year due to inadequate access to safe water.

Climate hazards such as floods and cyclones can damage water sources and sanitation structures and contaminate the water supply, while droughts can cause water sources to dry up thereby leading to scarcity and increasing the demand for clean water. For example, flash floods due to the Amphan cyclone in West Bengal destroyed the WASH infrastructure and contaminated water sources, and people lost access to safe drinking water and sanitation facilities (IRC and Water for People, 2021). Droughts and less water can not only inhibit good sanitation and hygiene practices but also reduce the possibility of production, availability and consumption of nutritious food by children (UNICEF, 2023b). Livelihoods and household finances are pushed under prolonged distress as a result of the economic impacts of droughts (Algur et al., 2021). Water scarcity and climate change-induced erratic rainfall can also lead to disruption of agriculture-related livelihoods in rural areas thereby acting as drivers for migration of individual household members or the whole family to relocate to other regions. Children in these regions will also grow into adults who will be forced to migrate from their origin to seek work. Relocation and displacement driven by distress are known to impact children in multiple ways and expose them to further vulnerabilities and risks. The complex interplay of urbanisation and the increasing number of disasters affecting more people leads to the concentration of the growing population in urban centres. Urbanisation leads to the establishment of slums or informal settlements on flood plains or steep slopes, under bridges or on sites closer to industrial waste, that continue to lack basic sanitary facilities and access to essentials such as safe drinking water, healthcare, and housing needs (NIUA, 2016). The urban poor, including the children, concentrated in these poverty pockets are exposed to landslides, rise in sea levels, flooding and other hazards, and are at particularly high risk (PwC and SC, 2015).

Children in developing countries such as India face a triple burden of WASH-related threats, namely limited access to WASH services, the burden of WASH-related diseases among children under 5 years of age, and the increasing vulnerability from climate-related threats

(UNICEF, 2023b). The consequences of unsafe WASH can have precarious impacts on children, hamper their fundamental needs of good nutrition, health, education and safety, and put them at a greater risk of morbidity and mortality (IRC and Water for People, 2021; UNICEF, 2023b). While safe water is essential to life itself, proper sanitation and hygiene prevent the spread of disease and infection and ensure human dignity, without which most basic needs of life are left unmet early on in life for children (UNICEF, 2023b). A study conducted to document the impact of climate change on children in Uttarakhand, Madhya Pradesh and West Bengal found that up to 90 percent of the respondents saw a negative impact of climate crises on drinking water (PwC and SC, 2015). During heavy rainfall in monsoons, in urban areas, municipal water sources are contaminated as they are mixed with faeces flushed by surface water (Bunyavanich et al., 2003), thereby increasing diarrhoea cases due to the consumption of infected water or food (Singh et al., 2021). A survey conducted by Caritas India in the flood-affected areas of Assam observed damage to existing sanitation structures and that the latrines were not suitable for the children, elderly, and people with disabilities (Relief Web, 2018). Inadequate access to drinking water or water for handwashing, and sanitation facilities in schools and educational institutes adversely impacts children's health and learning (UNICEF, 2023b). According to the Ministry of Education's statistics in India, for 2019-20, 94% of schools have functional drinking water, and 90% have functional hand washing facilities. However, in relation to climate change implications, water availability at school is one of the key concerns (Kagawa, 2022). Studies have outlined the role of simple measures such as washing hands with soap in reducing the scale of diarrhoeal illness by up to 30 percent (Ejemot-Nwadiaro et al., 2021).

The disproportionate burden of disasters on girl children and young girls' access to safe and reliable WASH facilities highlight the inequalities in capabilities and opportunities for coping with risks (Cutter, 2017). Children from migrating households who reside in temporary/make-shift housings are another population groups at high risk of WASH related challenges. However, a detailed examination of differential and diverse challenges and capacities across the agroecological zones of the country is lacking. A few small-scale micro-level studies provide insights into these issues. For example, a study conducted by Bhattacharjee (2019) in Assam brings out the cultural and logistical barriers faced by adolescent girls and women in maintaining menstrual hygiene needs during floods. Shortage of water can cause children to spend less time at school or even drop out of school and spend time fetching water from sources that are farther away. Some studies have shown the gendered impacts of such events where girls are forced to drop out of schools and travel long distances to collect water, enduring the physical burden and exposure to safety risks (Singh and Singh, 2015; Yadav and Lal, 2018). Heat stress can further put these children and young girls (and boys) at risk. At the same time, in schools, a shortage of water, particularly for girls, impacts their attendance and performance (UNICEF, 2020).

Hence, climate change, as well as human factors, are increasingly hampering children's right to safe water and sanitation. This is compounded by the absence of data correlating the impacts of extreme climate events on the living conditions and built environment on one hand to children's growth and development on the other. Inadequate living conditions are one of the most prevalent violations of children's rights (NIUA, 2016). The factors causing the lack of safe drinking water, sanitation and hygiene services are complex and often interrelated and are magnified by climate change events, population growth, urbanisation and migration, conflicts and socio-economic vulnerabilities. Though the provision of basic facilities has improved, and open defecation has significantly decreased in India, the

sustenance has been slow, which may be reversed if the exposure to climate change and its adverse impacts especially on vulnerable groups such as children are not considered (Shome, 2023). It is, therefore, crucial to understand the risks posed by climate change, its implications on drinking water and sanitation services, and therefore on human health, especially of the most vulnerable populations that are often the least resilient to deal with the effects of climate change.

5.6 Climate change implications on children's education

Education is critical for the socio-economic and holistic development of children. On the one hand, it can expand learning, skills, and employment opportunities, and improve living standards, on the other, it can contribute to gender equality and promote social mobility. However, access to education remains a critical impediment for children across the globe. UNESCO reported that in 2016, one in five children or 263 million school-aged children remained out of school, globally. While India has been successful in getting children into school7, many children lack basic skills (ASER, 2019). According to the 2019 ASER report, there was a decline in the nationwide education indicators between 2008 and 2018 (Balakrishnan and Tsaneva, 2021).

Climate hazards can impact the education of children in several different ways. Fast-onset hazards such as floods, landslides and cyclones might cut the area off from the outer world, and adversely impact children's education by destroying the infrastructure and learning facilities. One of the potential disruptions for children during and after extreme climate events involves access to schools because these may be destroyed, the roads may be flooded or damaged, or children displaced or relocated (Gibbs et al., 2019). In May 2019 when the state of Odisha was hit by cyclone Fani, 19% or 5735 elementary and secondary schools were reported damaged (Kagawa, 2022). In India, frequent floods and droughts are found to impact school attendance, especially for children studying at the primary level (Plan International, 2015). In the 2018 torrential rains in Kerala, 2.5 million children were affected including students losing their uniforms, school bags and textbooks (Kagawa, 2022). These effects can leave children temporarily unable to attend schools and regular exposure to such events can make this disruption permanent.

Further disadvantaged are girls, whose likelihood of missing school and education opportunities is higher during climate events, like droughts, as they have to travel longer distances to collect water or are even married off at an early age to potentially secure the girl's future. In this scenario, irregular attendance, or absence of primary education will not only generate and deepen inequalities in children's development but also have long-lasting consequences for children's present and future employment and overall wellbeing (Filho et al., 2023). At the same time, when a particular area is cut off due to extreme events, the teachers who travel to that region to teach the children can no longer reach the place. With the absence of proper teaching staff, the educational ecosystem of a place can collapse. Alternatives such as remote learning and teaching opportunities can also widen the gap due to differential access. A study done by the Azim Premji Foundation in 2021 found that 60 percent of school children in India cannot access online learning opportunities, mainly due to a lack of internet access, lack of equipment needed to connect from home or digital skills to find and use educational content dependent on technology.

School closures have been found to bring a major disruption in the lives of children and youth, affecting their socio-emotional development and well-being, as well as their social life and relationships (UNESCO, 2021). School closures also threaten decades of progress made towards gender equality, placing many girls at heightened exposure to gender-based violence, sexual exploitation, adolescent pregnancy and forced (child) marriage (UNFPA-UNICEF, 2021). As an indirect threat to disruption in educational attainment, subsequent social disruption adds to the trauma of the actual extreme event and gives rise to anxiety in children for years afterwards, obstructing their physical, emotional, cognitive, and social stages of development (Gibbs et al., 2019).

Health setbacks in children such as stunting, caused by hunger and malnutrition have been in part attributed to climate change and can adversely impact children's performance in school. Studies find that both low birthweight and early childhood undernutrition are associated with poorer cognitive development and lower educational attainment later in life (Mal-Ed Network Investigators, 2018; Sania et al., 2019). Shah and Steinberg (2017) assess the effect of rainfall variability in India on human capital accumulation and find that children's exposure to droughts in utero or between birth and age four has adverse effects on their literacy and numeracy skills. They are more likely to repeat a grade and are less likely to ever enroll in school. Disruption of access and availability of health services, especially in rural and remote areas during disasters, also hampers human capital development. In addition, the limited availability of resources in the household due to the disruption of livelihoods further restricts spending on the health of all household members as well as the education of children.

Disruption of livelihoods induced by climate change events can also negatively affect educational outcomes. In rural areas, flooding has been shown to have serious impacts on crop productivity and hence household income (Rodriguez-Llanes et al., 2016). This leads to challenges for children at multiple levels. If households are unable to pay school fees, children are automatically pulled out of school. At the same time, children are drawn to participate in income generation activities to support livelihood activities and enhance household income during school ages. It is important to note that girl children have to leave school to support their mothers to manage the increased burden caused by the loss of livelihoods, especially based on agriculture in rural areas. Droughts and erratic rainfall cause women already working as cultivators/producers and agricultural labourers to work harder to secure income and resources for their families. According to the figure provided by the Child Labour in India Statistics 2019, 10.1 million children are engaged as labourers in India. Another important consequence of loss of livelihoods is the migration of individual members or all members of the household in search of safe and secure housing and livelihoods. Migration can lead to displacement of children in many ways thereby restricting their access to education opportunities (Abeygunawardena et al., 2010).

5.7 Climate change implications on conflicts and violence faced by children.

One of the many levels by which disasters impact human beings is the burgeoning psychological cost of living through material, social and personal losses, and injuries. Children are developing emotionally, as their brains continue to grow throughout adolescence. They can experience direct, indirect and overarching effects on their mental health as a result of major storms, fires, and other extreme events that are expected to

increase with a changing climate. Children have been clearly identified as a high-risk group for post-traumatic stress disorder and studies have documented such symptoms in children after natural disasters (Kumara et al., 2016). A study done in Bihar, Kerala and Odisha by UNICEF found that 70 per cent of Indian youth (14-24 years of age) were anxious about climate change and its implications for the future (Kagawa, 2022).

A growing body of research has found that hotter temperatures and reduced rainfall are linked to increases in conflict at all scales (Akresh, 2016). Water scarcity is another driver of conflict, as communities and entire populations compete for shrinking water resources. Conflict, in turn, puts more strain on food and water supplies. Aggravated situations of vulnerability due to the loss of income and livelihood may force families to leave their homes in search of reliable water supplies and livelihood opportunities. In addition to directly exposing children to trauma and violence, conflict can break families, displace children, interrupt their schooling, and cut off their access to food and healthcare further exacerbating their trauma (Hanna and Olivia, 2016). Migrants often move to urban areas and towns, which puts even more pressure on already strained services in these areas, especially during disasters. At the same time, migration makes children and families more vulnerable to health and safety threats (Naylor, 2021). Young children depend on others for their safety and in turn become more susceptible to physical and sexual abuse, further elevating their levels of anxiety (Silverman and Weems, 2014). The inability to make sense of the new surroundings and the lack of support can lead to a decreased ability to cope and increase children's vulnerability (UNICEF, 2006).

Climate variabilities and their link to conflict have gendered implications which find scant evidence in the literature. Economic stress from climate shocks; for example, rainfall shocks are found to contribute to domestic violence and deaths during disputes over dowries in India (Sekhri and Storeygard, 2011). Corno et al., (2020) found an increase in child marriage rates in India due to rainfall shocks. While the prevalence of child marriage has declined over the last decade, an estimated 1.5 million girls under 18 are married off every year (Kagawa, 2022). In the aftermath of Cyclone Fani in Odisha and Cyclone Amphan in the Sundarbans region of West Bengal, adolescent girls from the most marginalised communities were found to be at an elevated risk of forced marriage (UNFPA-UNICEF, 2021). Child marriage has been considered an act of gender-based violence and has been observed in many communities in different countries and regions as a means of coping by securing funds and assets in the event of a disaster or extreme event (UNFCCC, 2022). Pulling girl children out of schools during droughts and other extreme events to fetch water and manage household responsibilities reinforces gender inequality.

The aftermath of disasters such as floods and cyclones, and the process of recovery to normal can also put children and families at risk. Gender and caste have a role to play in terms of access to relief materials, access to privacy in shelters and toilets in the relief shelters (Krishna et al., 2018). In a global context, displaced children, particularly girls, face a heightened risk of gender-based violence, trafficking, disruptions in education, and premature entry into the workforce (Uddin et al., 2021).

5.8 Conclusion

Children are particularly vulnerable to the effects of climate change and are disproportionately affected by the impacts of disasters, environmental degradation and climate crises through extreme weather events, pollution, and deadly diseases. Recent disasters such as BHUJ, Chennai floods, flash floods in Jammu and Kashmir, and Odisha cyclones have established that children are among the hardest hit during a disaster. Yet the research on disaster risk and programmes around disaster risk reduction in rural and urban areas do not delve into the risks faced by children, especially from the more poor and vulnerable sections. Although no single extreme weather event, such as floods, droughts, wildfires, or hurricanes and cyclones, can be attributed directly to climate change, human-induced climate change is contributing to the frequency and severity of such events. Future research should also determine if the burden of climate change on children is gender, age and socioeconomic status specific and what inequities exist. Understanding and quantifying associations between climate variability, crop yields, and childhood undernutrition, ideally at both the macro and the micro levels, is necessary. Documenting these associations systematically over the next years, even "with associated uncertainties," may help generate more realistic estimates for the future and therefore should be done. In terms of programmatic interventions, children should also be enabled to play an active role in mitigation and adaptation strategies. Unless we act forcefully right now, our children and theirs will inherit an unsustainable world, lacking the essential ecological resources and social stability to support them.

CHAPTER 6: KNOWLEDGE GAPS IN UNDERSTANDING THE IMPACT OF CLIMATE CHANGE ON WOMEN AND CHILDREN

Scope for future research

The magnitude and pattern of impacts of climate change depend on the characteristics of the extreme event in a particular geography, the extent of exposure to the event, the susceptibility of the population, and the ability of the population or natural system to cope with and recover from the event. Climate change presents a multifaceted challenge to the health, well-being and livelihoods of women and children in India. This scoping review on the impacts of climate change on women and children, based on literature reviews, stakeholder consultations, and data analysis, revealed that there is a need for a deeper and more holistic understanding of climate change and its impacts, in order to ameliorate the adverse impacts of climate change and fulfil the sustainable development goals. Wide gaps exist globally and nationally at the conceptual, policy formulation and action levels. This chapter explores critical research/knowledge gaps concerning the impacts of climate change on women's health and livelihoods, as well as children's health and education, emphasising the urgent need for further investigation and evidence-based interventions.

Gaps in Conceptualising and Measuring Climate Change

- Climate change cannot be addressed as a single, overarching issue; it encompasses multiple components requiring distinct attention, e.g biodiversity loss, excess heat or flooding, air pollution, poor soil health, and water availability and quality. The interactions among these elements result in diverse unintended consequences, highlighting the necessity for a multifaceted approach.
- Keeping in mind the diverse geography of India and the non-uniform impact of climate change across regions, research is needed to establish local-level thresholds for each climate event, based on biological effects, instead of adopting a uniform definition. For example, a temperature of 40 degrees Celsius in Chennai is likely to have a different impact on human health compared to the same temperature in Delhi because of humidity and other factors. Research on defining thresholds for specific events, particularly for heat, at the local level, possibly at agroecological zone (AEZ) levels, is essential for better predicting the impact of climatic events in each region.
- Extreme events generally do not occur in isolation in a given area and can coexist with others. So, simultaneity or consecutive occurrence of the events need to be accounted for. For example, a flood might occur during a heat wave or with rising temperatures. Similarly, the temperature might decrease after a few days of intense rain, followed by high humidity and temperatures.

Gaps in Identifying vulnerable population segments and pathways

- Each climatic hazard induces a different set of vulnerabilities based on the sensitivity of various population groups. This sensitivity-specific climate vulnerability assessment is urgently needed to identify groups more susceptible to certain climate events in different regions, and to protect them.
- The literature covers social, economic, and other determinants of health, such as access to healthcare, education quality, resource availability, transportation options, social capacity, and cultural norms, which impact vulnerability. However, prioritising research on how climatic events or climate change affect these factors, including impacts on community services, livelihoods, and social capital - such as economic resources, infrastructure, service access, and social networks - is crucial for designing more effective intervention strategies. So, there is a need for research on how climate change affects each pathway of health, well-being, livelihood and education to develop and establish a gender sensitive framework on the impact of climate change.

- The differential impact of climate change on women and children in rural and urban areas is hardly captured in the existing research. Studies exclusively focussing on peri-urban India are needed.
- Urban populations should be studied as something other than a homogenous group. Climatic hazards in urban slums, peri-urban areas and coastal areas pose differential threats to women and children, varying by housing, occupation and other factors. Future research is needed to map vulnerable communities within cities and districts to target them specifically with interventions.
- Surveys show that scheduled caste and tribes often have worse health indicators. However, few studies have deep dived into the heterogeneities within Scheduled Castes (SC) and Scheduled Tribes (ST). Women and children of each sub-caste or tribal group may face the impacts of climate change differently, and develop mitigation and adaptation strategies based on their unique situation and indigenous knowledge, which needs to be captured through further research.
- Studies encompassing the challenges faced by migrant or displaced families are limited. There is a need to understand the impact on migration dynamics, migrants' health, livelihood and well-being, as well as the impact on left-back women and children in villages.

Data Gaps

- Each agroecological zone witnesses different implications of climate change due to various pre-existing socio-cultural and geographical factors. However, agroecological region-specific studies are limited, and agroecological subzones are yet to be studied. There is a vast scope of context-specific research at the agroecological subzone level.
- Deaths attributed to climate hazards are difficult to quantify and poorly recorded. Improved cause-of-death data will help to understand the impact of climate change on lives, which is currently under-estimated.
- Longitudinal studies are necessary to elucidate the complex relationships between different elements of climate change and their health impacts on women and children.
- There has not been enough attention on mental health issues of women and children in existing studies, though this is a crucial aspect in the wellbeing of women and children. There is a considerable need to understand the invisible effects of climate change on mental health (both short-term and long-term). Long-term mental health impacts especially are not well quantified.

Implementation Gaps

- Research is needed to assess the implementation of policies and plans for addressing the impact of climate change so that gaps can be identified and addressed.
- More research is needed at the micro-level, like a block or a gram-panchayat, keeping in mind the specificities of the agro-ecosystem. However, this is lacking as we found that the state/country is generally treated as a single homogenous unit, often leading to inappropriate policies and actions.
- There is a need for research on various adaptation strategies across agroecological zones, including the use of new technologies to improve resilience and address the gaps in implementation.

Gaps in identifying impact on women

- Extreme weather events can exacerbate existing gender inequalities and vulnerabilities, leading to increased risks of intimate partner violence, early marriage, and mental health issues among women. However, it is not uniform across all groups of women, so there is a need to investigate the social and economic dimensions of climate impact on women and their resilience and adaptation strategies through an intersectional approach across the life stages.
- Comprehensive longitudinal studies are needed to understand women's specific health impacts in different occupations and to develop targeted interventions to mitigate heat and other occupation related health risks.
- While the association between air pollution and cardiovascular health is recognised, gender-specific impacts, such as those on women's respiratory and reproductive health, still need to be explored.
- Women play a crucial role in agricultural production and food security, yet they often face barriers to accessing resources and technologies. Climate change can disrupt women's livelihoods and income-generating activities, particularly in vulnerable communities dependent on natural resources. Further research is needed on the specific impacts of climate change on women's income generation, economic empowerment, and livelihood diversification strategies, including their knowledge, skills, and decision-making processes.

Gaps in identifying impact on children

- Childhood is a period of rapid growth, with each phase being distinct regarding the five domains of development namely, physical, cognitive, mental, emotional and social. Levels of exposure and vulnerabilities vary across each stage. Further the situation of children also varies according to gender and socio-economic status. So, children should not be treated as a homogenous entity. Future research should explore whether the burden of climate change on children varies depending on gender, age, and socioeconomic status. Understanding these nuances is crucial as it allows us to identify and address existing inequities.
- There is a need to identify and prioritise climate-related diseases in different geographical regions that threaten children's health. This could involve assessing the prevalence and distribution of diseases such as vector-borne illnesses, waterborne diseases, and respiratory infections.
- Research should focus on identifying specific populations of children most susceptible to climate-related diseases, including those living in rural areas and urban slums. Understanding the socioeconomic factors contributing to vulnerability can inform targeted interventions to protect vulnerable children. This can be undertaken through an intersectionality approach.
- While much of the focus has been on infectious diseases, including respiratory infections, there is a need to explore the broader health impacts of climate change on children, including malnutrition, mental health disorders, neurological, cognitive and other chronic illnesses exacerbated by air pollution.
- There is a lack of studies measuring the permanent and temporary school dropout rates attributable to different climatic hazards, as well as how learning is impacted in prolonged and simultaneous climate hazards.
- The limited evidence on the impact of climatic events such as hydromet disasters, high ambient temperatures and air pollution on children is generated from small-scale studies with skewed geographical distribution and methodological weaknesses. Generating context-specific understanding and developing systematic and inclusive pathways to incorporate children’s voices and perspectives in urgent climate action is essential.

Documenting these associations systematically over the coming years is imperative. This longitudinal approach will enable us to track changes over time, identify trends, and refine our understanding of the long-term implications of climate change on women and children. Filling these research and data gaps will generate more realistic estimates and help in updating our existing knowledge base, for future planning and policy development.

CHAPTER 7: SUMMARY OF FINDINGS AND RECOMMENDATIONS

Findings	Recommendations
The National Action Plan on Climate Change acknowledges gender as a driver of vulnerability and provides states with a national articulation of the gendered impacts of climate change. However, most State Action plans for Climate change (SAPCC) do not operationalise these elements adequately and evenly. There are no detailed and contextual climate adaptation plans at district, city or Panchayat level.	▪ The ongoing review of SAPCCs in India could be a way to mainstream a gender-transformational approach in sub-national climate action. A framework to do this can be developed by an expert group and lessons can be learnt from states that have incorporated gender in their planning. Budgetary allocation, coordination and monitoring and evaluation of these plans will be needed. Also, given the nature of the crisis, new governance structures and mechanisms, including a nodal coordinating body might be needed at central and state levels. ▪ The targets for all current schemes for women and children should be enhanced and allocations increased to speed up the achievement of development goals. Coordinated and well-publicised moves to ensure such accelerated development would send a powerful message on adaptation both domestically and internationally. Such schemes would include, inter alia, nutrition and nutrition support, direct benefit transfers and income-generating opportunities. ▪ There needs to be a stronger focus on action on protecting children from impacts of climate change in SAPCCs ▪ Detailed multi-sectoral assessments are needed at sub-district/municipal ward level for climate hazards, risks and vulnerabilities and adaptation measures should prioritise the most vulnerable communities ▪ Gram Panchayat development plans should address local hazards (droughts, floods etc) and have a Climate Action Plan.
Governance and Finance are major constraints in the implementation of action plans. Because climate mitigation and adaptation need an all of government response, it is critical to have high level leadership and coordination across ministries. Capacity of officials at different levels of government in addressing the gendered impact of climate hazards is limited	▪ Leadership for climate action (mitigation and adaptation) should be at the highest level of government (Prime Minister, Chief Ministers) – a national advisory council should be chaired by the Prime Minister and State advisory councils by respective chief ministers. ▪ The National Action Plan on Climate Change (NAPCC) and National Action Plan on Climate Change and Human Health (NAPCCHH) and the corresponding state action plans should be designed in a manner that promotes synergy between climate change adaptation and health system strengthening efforts. ▪ Efforts from the private sector can be leveraged and linked with government initiatives around gender-responsive climate action ▪ Adequate resources and funding for Panchayati Raj Institutions and local urban bodies, as well as capacity building, for action on climate adaptation, are urgently needed. ▪ The Finance Commission may consider how best to ensure climate financing is a part of all relevant ministerial budgets, and the accountability mechanisms for the same.

With projected annual temperatures in India rising by 1.7 to 2.2 °C by 2030, the number of people exposed to extremely high temperatures is rising. This can result in more acute events (e.g. heat stroke, heat exhaustion) and increased chronic disease risk. People at extremes of age and with underlying diseases are more vulnerable Health and educational facilities are not climate resilient	▪ A consistent definition of a heat wave, including night temperatures and ambient humidity, needs to be jointly developed by IMD and health ministry, contextualised for different regions of India, from a women and children's health perspective. ▪ Comprehensive heat mitigation plans at the local level in coordination with Gram Panchayats/local urban bodies should be developed, with short, medium and longer-term actions. This would include, for example, increasing area under tree cover and restoring water bodies as these will bring changes in the micro-climate ▪ Cities need to keep urban heat island effects in mind while planning and designing housing and urban infrastructure. Blue-green spaces and architectural designs and materials that are locally climate appropriate are urgent needs in cities. ▪ Heat impact mitigation should be prioritized in SAPCCHHs, with a special focus on pregnant women and young children. This should include ensuring maternity and newborn wards are located in cooler parts of the health facility, as well as facilities to treat heat stroke and heat exhaustion at all levels of the health system ▪ Health facilities, schools and Anganwadis in places prone to heat waves should modify infrastructure, ensure good ventilation and cooling ▪ Development of early warning system and interagency coordination to minimize mortality and morbidity due to heat waves ▪ Decentralised decision-making regarding work timings (including MGNREGA) and adequate shade, cooling, water and medical facilities in all work places. ▪ Improve the thermal performance of public infrastructure, including schools and Anganwadis, by retrofitting them with energy-efficient materials and design elements ▪ Consider an insurance program that prevents exposure to extreme weather events and thus avoids severe health impacts.
Pregnant women experience disproportionately higher health risks from the impacts of prolonged heat exposure. This is resulting in adverse reproductive outcomes including preterm delivery, gestational hypertension and pre-eclampsia. Many informal women workers cannot avoid exposure to extreme heat, because of their situation	▪ Train health workers (doctors. ASHAs, ANMs, Anganwadi workers) in dealing with heat related morbidity, especially in pregnant women and young children – prevention and management ▪ Leverage Accredited social health activists (ASHAs), Auxiliary nurse midwives (ANMs) and Anganwadi workers to generate awareness among mothers and pregnant women on the adverse effects of extreme climatic events, preparedness, measures to reduce exposure and widely disseminate information on weather related forecasts, including through use of digital technology. ▪ Ensure a supportive workplace environment, particularly addressing specific needs related to comfort, hydration, and hygiene to safeguard the health of pregnant women in both outdoor and indoor work

	▪ Build a climate-resilient health system and healthcare infrastructure, with special focus on maternal and newborn wards to prevent temperature extremes.
Climate change is increasing the frequency of certain diseases, including heat related, pollution related, water-borne and vector-borne diseases. Women and girls are disproportionately affected.	▪ Review the Pradhan Mantri Jan Arogya Yojana (PMJAY) and ensure the benefit packages can cope/align with a potential increasing number of hospitalizations related to climate-sensitive diseases. Additionally, the existing service package offered through Health and Wellness Centres (HWCs) can be expanded to include climate-sensitive illnesses such as heat and air pollution-related illnesses. ▪ Behaviour change communication strategies can be designed with specific focus on prevention of climate sensitive illnesses and targeted towards women and children. These communication strategies will need to be designed and rooted in agroecosystem specific contexts. ▪ Improve surveillance and develop AI-based tools to detect, prevent, and treat vector-borne diseases and forecast by triangulating environmental data with epidemiological data ▪ Certain districts and blocks identified to be vulnerable to climate change and having poor health indicators need to be prioritised for immediate action.
Studies are increasingly showing a direct correlation between natural disasters and gender-based violence. Women are particularly vulnerable to sexual and physical abuse if they are members of underrepresented social groups as well as groups with a low asset base such as landless, agricultural labour.	▪ Provision of gender clinics, hotlines and helplines for women in areas impacted by extreme weather events. ▪ Establish gender-sensitive emergency shelters during natural hazards, with special attention to women's safety, sanitation and menstrual hygiene. ▪ These clinics and shelters have to be made easily accessible and affordable to all those in need. ▪ Problem of the 'perpetrator' needs to be addressed by providing counselling and financial support to men to re-establish their livelihood, retain their dignity and not resort to gender based violence. ▪ School based interventions to address regressive social norms and promote gender equality.
Continued exposure to poor air quality leads to disproportionately poor health outcomes for women and children. Both ambient and indoor air pollution are key problems and cooking in poorly ventilated spaces compounds the problem	▪ Ensure the availability of clean cooking fuel for poor and vulnerable households, by addressing current gaps in implementation of the Ujjwala scheme. ▪ Ensure proper ventilation especially in urban, low-income houses. ▪ Accelerate action to improve ambient air quality, especially in cities – set targets and monitor contribution of different sectors to PM2.5
Women as First Responders: Many health care workers at the primary care level are	▪ ASHA/AWWs acting as Frontline/first responders should be supported and compensated fairly to

women (CHOs, ANMs, ASHAs and Anganwadi workers). Their capacity needs to be built, so that they can detect and respond to climate related illnesses or distress. They may also be impacted themselves and need physical support or psychological counselling. Further, women in communities bear the brunt of caregiving responsibilities and these get more difficult when there are natural disasters.	acknowledge their contributions to maintaining health and wellbeing in the community ▪ Leverage technology, including Artificial Intelligence, and other digital solutions to provide both early warning of climate hazards as well as real time advice on how and where to seek help and care. ▪ Strengthen early childhood care and education (crèches plus Anganwadi), to ensure optimal physical and cognitive development of young children ▪ Women's traditional knowledge and ways of responding to crisis should be leveraged by ensuring that they have a seat at the decision-making table. ▪ Recognise women's leadership role in climate resilience efforts as climate warriors. ▪ Ensure committees at all levels addressing climate adaptation have gender and geographic balance.
Exposure to Climate hazards, especially if repeated, has significant short term and long-term effects on mental health. Children and adolescents are developing eco-anxiety	▪ The district mental health program needs to be strengthened with a streamlined referral and management system. ▪ Mental health interventions need to be "nested" in all climate change interventions ▪ Establishment of Women Councils at local level for Mental Health Support to women and children ▪ School based mental health interventions to be prioritized
Livelihoods especially of rural, agricultural women, and informal workers, are increasingly being threatened by sudden weather events and slow onset natural disasters, especially drought. Extreme weather events and subsequent changes in water cycle patterns severely impact access to safe drinking water which increases the vulnerability of women and children in multiple dimensions (drudgery, reduced participation in productive work, malnutrition-related health impacts etc). Migration is a frequent response to climate change, both sudden and gradual.	▪ Providing appropriate tools and technologies to agricultural communities, particularly women engaged in labour intensive work ▪ Investing in climate-resilient farming and supporting women in transitioning to climate resilient livelihoods ▪ Implementation of micro-level weather forecasting and agro-met advisory systems to benefit women engaged in agrarian activities ▪ Strengthening infrastructure for local food storage and transportation as coping mechanism to alterations in weather patterns. ▪ Dedicate resources to incentivise women's participation in healthy food production and ensure that rural families have access to affordable, nutritious food. ▪ Consider expanding the PDS to provide more nutritious cereals (millets) and legumes ▪ In coastal areas, empower fisher women to develop a blue food economy – can address nutrition needs as well as strengthen livelihoods.

There is a nexus between food, water, livelihood and climate change.	Building resilience of women across urban and rural India necessitates a multi-disciplinary approach. It is necessary to support communities, with special focus on reaching women and children, in adaptation by enhancing infrastructure, diversifying livelihoods and promoting sustainable resource management. ▪ A coordinated and multi-faceted approach is required involving all the relevant departments/Ministries including Rural Development, Housing and Urban Affairs, Jal Shakti, Agriculture and Famers' Welfare, Environment, Forests and Climate Change, Labour, etc. to have targeted strategies for each agroecological zone in the country. ▪ Ministry of Women and Child Development may periodically convene inter-ministerial and inter-departmental consultations to i) sensitise departments/ministries to specific gender concerns in climate resilience and adaptation, ii) review progress in relation to enhanced climate resilience, iii) undertake joint studies for building climate resilience with other departments/ministries, including monitoring and evaluation of gender-specific and child-centric enhancement of resilience initiatives. ▪ Ensure access to safe drinking water by augmenting the supply side of water resources at the local level. ▪ Mobile health clinics and resource centres need to be established for addressing migrant worker health and livelihood issues in Indian cities which are major migrant destinations ▪ SHGS both rural and urban can play a major role in the processes of creating climate change awareness, mitigation and adaptation. They need to be provided resources and training for this purpose.
Children's education is disrupted by extreme weather events Child nutrition is negatively impacted by exposure to repeated drought Cognitive ability may be affected by extreme heat	▪ Adopting climate-sensitive curriculum in schools to empower children with the right kind of knowledge, and coping mechanisms ▪ Climate resilient school infrastructure should be developed to protect children from the impact of extreme events like heat waves, flooding etc ▪ Given the right resources and training, children can become environmental champions and bring about positive change in their communities.
Research on the impacts of climate change on women and children is scant. Further, a lot of data are not disaggregated by sex and age and are not sufficient to address intersectionality, given the multifaceted implications of climate change	▪ Climate induced vulnerabilities, and adaptive capacity needs to be assessed by age and sex and mapped across agroecological zones ▪ Better recording and reporting mechanisms (health information systems, cause of death reporting) to accurately capture climate-related health impacts, is needed ▪ Longitudinal studies should be conducted to establish the linkage between climate change, climate-sensitive health, livelihood, and socio-economic indicators

	▪ Time use studies to acknowledge and account for the time and effort women dedicate to household responsibilities could inform policies.
There are significant gaps in the implementation of laws and policies that enhance gender equity	▪ Gender focal point in each ministry/department ▪ Gender based budgeting ▪ Need for more research to understand the gendered impacts of climate change and to develop and test solutions. ▪ While this report focuses on women and children, other vulnerable groups like the elderly and disabled also need attention. ▪ Invest in targeted solutions for climate migrants, skilling and behaviour change in young men, and enable green jobs for women. ▪ There is a need to blend traditional knowledge and modern science to address this existential threat.

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APPENDIX I

Table 1: Description of the list of indicators selected for final analysis in this scoping study

Indicators	Definition	Data Source	Control/Adjusted Variables #
Exposure Score	Exposure scores are developed using district-level profiling of India's extreme climate events, including cyclones, floods, and droughts and their associated events through a pentad decadal spatio-temporal analysis of change in frequency and intensity. A higher score represents more vulnerability to climate change in response to higher changes in the frequency and intensity of hydromet hazards in that district. Only the hazards considered fulfil at least one of the following criteria: i) 10 or more people reported killed; ii) 100 or more people reported affected; iii) declaration of a state of emergency; iv) call for international assistance. The data for district-level profiling is taken from the Indian Meteorological Department (IMD), EM-DAT, World Meteorological Organisation (WMO) and PIB reports.	CEEW, 2021 based on 1970-2019 records	An independent variable
Exposure to drought	Droughts are defined as "an extended period of unusually low precipitation that produces a shortage of water, and operationally, it is defined as the degree of precipitation reduction that constitutes a drought, that varies by locality, climate and environmental sector" (EMDAT 2015). Drought is a recurring event. Droughts in India are categorised into three subtypes: i) meteorological drought, ii) hydrological drought, and iii) agricultural drought. Drought, described as a slow-onset process, is usually not associated with any other major climatic events apart from famines and heat waves. In this study, drought is defined in terms of meteorological definition which states that the deviation from normal rainfall for an extended period in a district is considered as drought.	CEEW based on records of 2010-19	An independent variable

Exposure to flood	Floods are defined as “a general term for the overflow of water from a stream channel onto normally dry land in the floodplain (riverine flooding), higher-than-normal levels along the coast and in lakes or reservoirs (coastal flooding) as well as ponding of water at or near the point where the rain fell (flash floods)” (EM-DAT 2015). The associated events considered in this study are i) landslides, ii) extreme rainfall, iii) hailstorms, iv) thunderstorms, and v) cloud bursts.	CEEW based on records of 2010-19	An independent variable
Exposure to cyclone	A cyclone is defined as a tropical storm originating over tropical or subtropical waters. Cyclones are characterised by a warm-core, non-frontal x-scale disturbance with a low-pressure centre, spiral rain bands, and strong winds. A cyclonic storm formed due to a monsoon depression may lead to extreme rainfall/hailstorms/floods/thunderstorms .	CEEW based on records of 2010-19	An independent variable
Women underweight	Percentage of women aged 15-49 years who have a Body Mass Index lower than 18.5 kg/m^2. Body Mass Index refers to a person's weight in kilograms divided by their height squared in meters. In NFHS, women’s height and weight are measured by the surveyor.	NFHS, 2015-16 and 2019-21	Place of Residence, Social Group, wealth status, a household with sanitation facility, household with clean water, household with clean fuel, mass media exposure, women’s education, number of household member, time
Girl Child Marriage	Percentage of ever-married women aged 15-49 years who got married before attaining the age of 18 years.	NFHS, 2015-16 and 2019-21	Place of Residence, Social Group, wealth status, household with sanitation facility, household with clean water, household with clean fuel, mass media exposure, women’s education, number of household member, time

Intimate Partner Violence (IPV)	Percentage of ever-married women aged 18-49 years who experienced any kind of violence committed by their current and former husbands. Physical Violence involves pushing, shaking, or throwing something at her; slapping, twisting her arm or pulling her hair; punching her; kicking her, dragging her, or beating her up; trying to choke her or burn her on purpose; or threaten or attack her with any weapon. Sexual violence includes physically forcing her to have sexual intercourse even when she does not want to. Emotional violence includes saying or doing something to humiliate her in front of others, threatening to hurt or harm her or someone close to her; insulting her or making her feel bad about herself.	NFHS, 2015-16 and 2019-21	Place of Residence, Social Group, wealth status, household with sanitation facility, household with clean water, household with clean fuel, mass media exposure, women's education, number of household member, time
Miscarriage/ Still Birth	Percentage of women aged 15-49 years whose pregnancies ended in a non-live birth (miscarriage or stillbirth) in the five years preceding the survey	NFHS, 2015-16 and 2019-21	Place of Residence, Social Group, wealth status, household with sanitation facility, household with clean water, household with clean fuel, mass media exposure, mother's education, mother BMI, birth order, mother age at first birth, number of household member, time
Dropout from minimum recommended antenatal care	Percentage of women aged 15-49 years who received timely initiation of antenatal care (ANC), i.e. within the first trimester (0-3 months), but didn't receive sufficient recommended ANC visits i.e. at least four visits, for her most recent live birth in the five years preceding the survey.	NFHS, 2015-16 and 2019-21	Place of Residence, Social Group, wealth status, household with sanitation facility, household with clean water, household with clean fuel, mass media exposure, mother's education, mother BMI, birth order, mother age at first birth, number of household member, time
Child Underweight	Percentage of living children under the age of five years whose weight-for-age Z-score is below minus two standard deviations (-2 SD) from the median of the reference population are classified	NFHS, 2015-16 and 2019-21	Place of Residence, Sex of Child, Social Group, wealth status, household with sanitation facility, household

	as underweight. It considers both acute and chronic undernutrition.		with clean water, household with clean fuel, mass media exposure, mother's education, mother BMI, birth order, mother age at first birth, child current age, number of household member, ICDS, time
Minimum Dietary Diversity	Percentage of the youngest living children aged 6-23 months who receive foods from five or more of the food groups during the previous day of the interview based on their breastfeeding status: (i) breast milk; (ii) infant formula, milk other than breast milk, cheese or yogurt or other milk products; (iii) foods made from grains or roots, including porridge or gruel, fortified baby food made from grains; (iv) vitamin A-rich fruits and vegetables; (v) other fruits and vegetables; (vi) eggs; (vii) meat, poultry, fish, shellfish, or organ meats; (viii) beans, peas, lentils, or nuts	NFHS, 2015-16 and 2019-21	Place of Residence, Sex of Child, Social Group, wealth status, household with sanitation facility, household with clean water, household with clean fuel, mass media exposure, mother's education, mother BMI, birth order, mother age at first birth, child current age, number of household member, ICDS, time
Under-five child deaths	Percentage of live births in the five-year period preceding the survey who died before completing the five-years age.	NFHS, 2015-16 and 2019-21	Place of Residence, Sex of Child, Social Group, wealth status, household with sanitation facility, household with clean water, household with clean fuel, mass media exposure, mother's education, mother BMI, birth order, mother age at first birth, number of household member, time
Diarrhoea among children	Percentage of youngest children under age five years with diarrhoea in the two weeks before the survey.	NFHS, 2015-16 and 2019-21	Place of Residence, Sex of Child, Social Group, wealth status, household with sanitation facility, household with clean water, household with clean fuel, mass media exposure, mother's education,

			mother BMI, birth order, mother age at first birth, child current age, number of household member, ICDS, time
Child immunisation	Percentage of youngest living children age 12-23 months who received specific vaccines at any time before the survey either according to a vaccination card or the mother's report. To have received all basic vaccinations, a child must receive at least: one dose of BCG vaccine; three doses of DPT vaccine; three doses of polio vaccine; one dose of measles vaccine	NFHS, 2015-16 and 2019-21	Place of Residence, Sex of Child, Social Group, wealth status, household with sanitation facility, household with clean water, household with clean fuel, mass media exposure, mother's education, mother BMI, birth order, mother age at first birth, ICDS, number of household member, time
ICDS utilisation for children	Percentage of youngest living children aged 0-59 months who received any service (food supplements, immunisations, health check-ups, went pre-school, weighted and counselling received) from an anganwadi centre (AWC) in the 12 months preceding the survey	NFHS, 2015-16 and 2019-21	Place of Residence, Sex of Child, Social Group, wealth status, a household with sanitation facility, a household with clean water, a household with clean fuel, mass media exposure, mother's education, mother BMI, birth order, mother age at first birth, child current age, number of a household member, time

 # There are various confounding variables which may affect the women and child-related indicators. In this study, while applying the multivariate analysis, we have controlled/ adjusted the model for those variables. This means that when the effect of listed adjusted variables is constant then how much the women and child-related indicators are affected by climate-related indicators.

APPENDIX II

ADDITIONAL MATERIALS

Case Studies

1. GARBH-Ini Cohort Study: Insights into Environmental Exposures and Pregnancy Outcomes

Contributed by: Sreevatsan Raghavan, Translational Health Science and Technology Institute,
(An Autonomous Institute of Dept. of Biotechnology, Min. of Science and Technology, Govt of India)

Research and evidence show that there are significant global public health impacts on small and vulnerable newborns, particularly those born preterm or growth-restricted, exacerbated by environmental factors such as air pollution and extreme heat. In regions like Gurugram, India, located amidst the Himalayas and the Aravali range, susceptibility to high levels of air pollution is further compounded by meteorological characteristics, notably ambient temperature. An emerging hypothesis suggests that pregnant women from low- and middle-income backgrounds, especially those in tropical climates like Gurugram, are disproportionately affected by climate change, with extreme heat linked to a spectrum of adverse outcomes including preterm birth, fetal growth restriction, stillbirth, and preeclampsia. Thus, there is a critical need to research and generate evidence on the complex interactions between heat, air pollution, and pregnancy outcomes to inform targeted interventions and mitigate health risks for vulnerable populations.

GARBH - Ini: The Interdisciplinary Group for Advanced Research on Birth

The Interdisciplinary Group for Advanced Research on Birth Outcomes—Department of Biotechnology India Initiative (GARBH-Ini) addresses this challenge, with the objective of studying the association of ambient air pollution with adverse pregnancy outcomes amongst pregnant mothers residing in Gurugram. With 11400 women enrolled during their pregnancy before 20 weeks of gestation, with the objectives of developing an epidemiological understanding to develop personalized prediction tools using AI, and discover biomarkers for customized clinical decision-making. A pivotal achievement of the study was the establishment of an extensive biobank integrated with clinical data, enabling the identification of unique trends and risk factors associated with adverse pregnancy outcomes. The preliminary findings from the study suggest a non-linear relationship between ambient PM2.5 concentration and outcomes like preterm birth and fetal growth restriction. The exposure levels exceeding 110 mcg/mL of PM2.5 during the first and third trimesters significantly increase the risk of preterm birth and smaller than average babies at gestation respectively.

Way Forward

GARBH-Ini is collaborating with the George Institute, University of Oxford, Imperial College, London, IIT Delhi, Sri Ramachandra Institute of Higher Education and Research, Pondicherry Institute of Medical Sciences and Chattisgarh Institute of Medical Sciences supported by the Wellcome Trust, UK to investigate the epidemiological association between exposure to environmental heat and pregnancy outcomes. This research involves determining the effects of heat exposure on pathways and biomarkers associated with adverse outcomes such as preterm birth, stillbirth, preeclampsia, and fetal growth restriction. Additionally, efforts are directed towards producing a comprehensive description of the association between heat and fetal heart rate, circulating trophoblast-derived stress, placental angiogenic markers, maternal and uteroplacental fetal circulations, and human lactation. By gaining insights into heat adaptations among women during the antenatal period, particularly in marginalized communities, GARBH-Ini aims to develop targeted interventions to mitigate the effects of air pollution and heat on pregnancy outcomes. By addressing these challenges and leveraging emerging evidence, GARBH-Ini aims to derive actionable insights to mitigate the adverse effects of air pollution and heat on pregnancy outcomes.

2. Air pollution and Climate change – A case study on household air pollution

Contributed by: Poornima Prabhakaran, Centre for Chronic Disease Control, India; Trivedi School of Biosciences, Ashoka University

India is among the countries with the highest morbidity and mortality due to air pollution, with both ambient and household air pollution contributing about 1.7 million deaths annually, (Fig.1) with household air pollution alone causing around 370,000 deaths each year(1). The sources of air pollution—such as industrial activities, transportation, and fossil fuel combustion in power generation—also drive climate change by emitting greenhouse gases and pollutants like CO2, particulate matter, and heavy metals. Tackling these common sources can yield substantial health co-benefits by reducing both air pollution and climate change impacts.

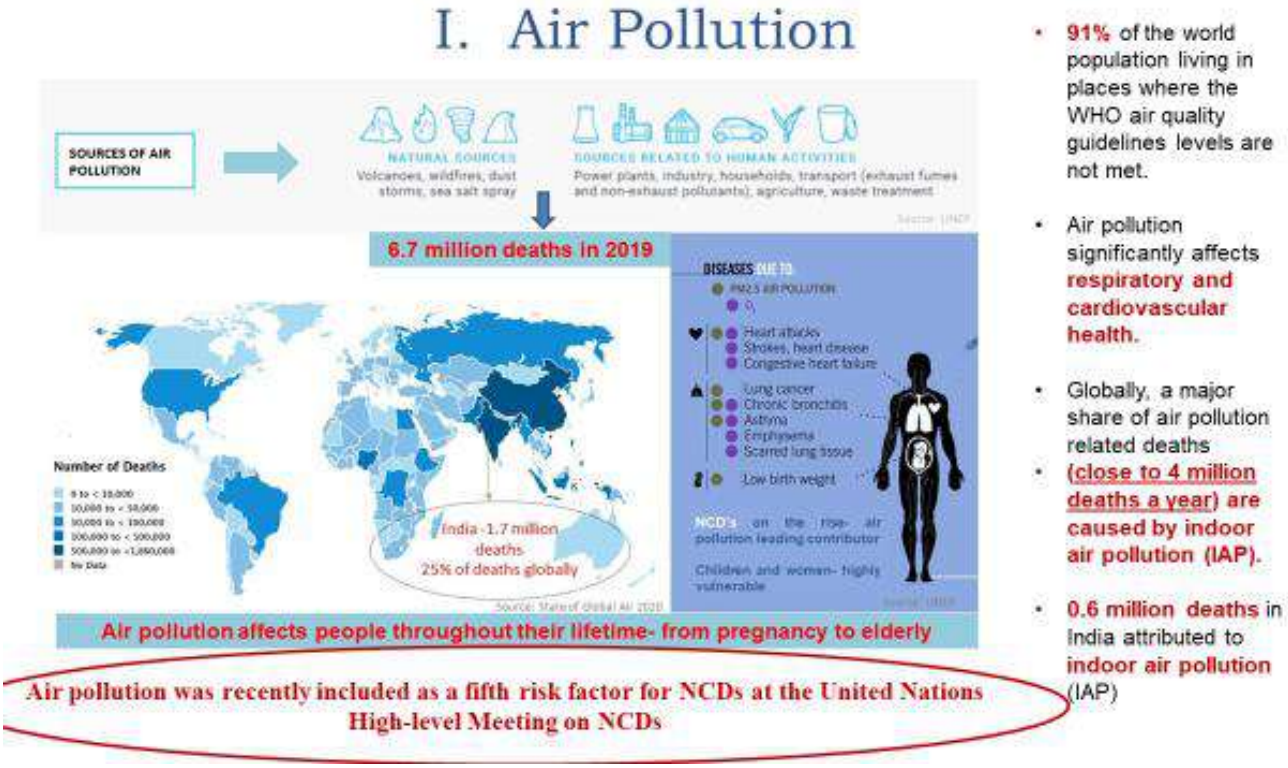

Fig.1. Air pollution - the fifth risk factor for non-communicable diseases with indoor air pollution contributing to morbidity and mortality

Household air pollution from the burning of unclean fuels, biomass, wood, agricultural residue, etc for cooking, heating and lighting purposes is common in large tracts of rural India where women, often the sole caregivers of children, are the ones tasked with these responsibilities. Other sources of household air pollution include the burning of mosquito coils, incense sticks and smoking of beedis and cigarettes. (Figs 2 and 3)

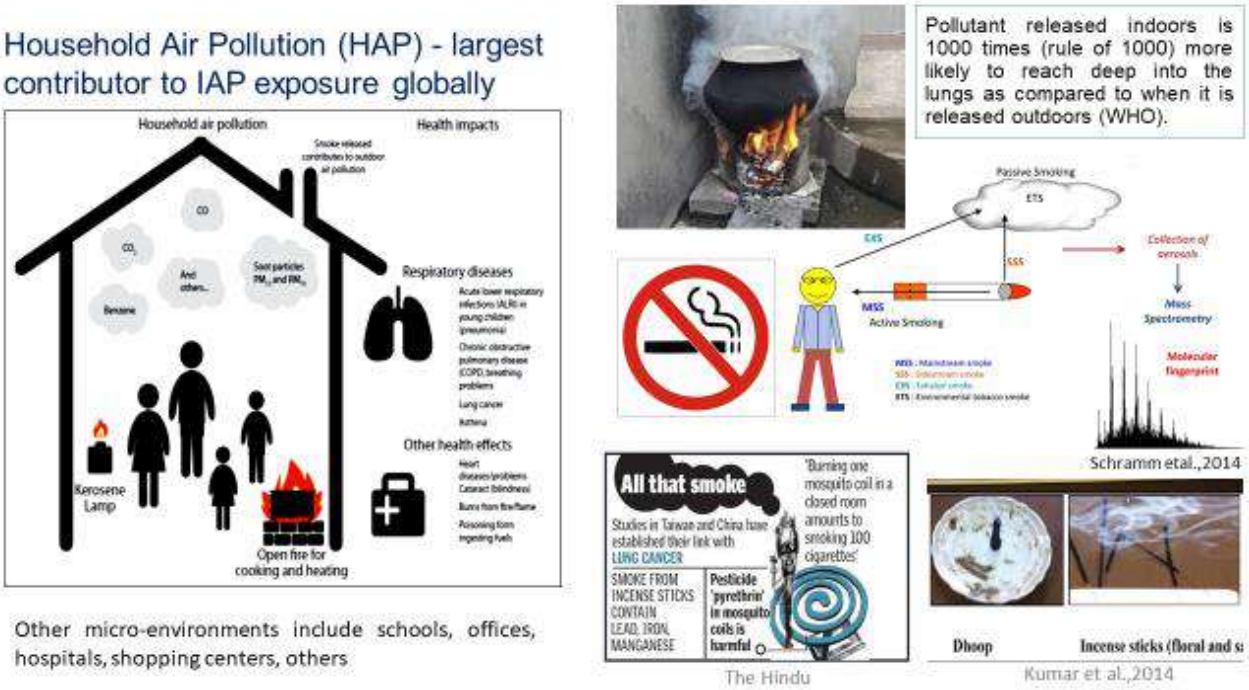

Fig. 2. Household air pollution –sources and potential impacts

Fig.3. Rural woman using a traditional cookstove ("chulha")

Poor housing with inadequately ventilated rooms exposes vulnerable groups, especially women and children who spend significant time indoors, to high levels of pollutants. The need for women to collect firewood, often from distant locations, adds risk and social impacts, such as young girls missing school to help with chores. This activity also contributes to deforestation and biodiversity loss, exacerbating climate change. Thus, household air pollution has broad health, social, economic, and environmental consequences, with particularly severe impacts on women and children. *However, while ambient air pollution in India is under regulatory purview and efforts to attain National Ambient Air Quality Standards are underway, there are no stated guidelines or standards for indoor or household air pollution in many parts of the world, including in India.*

Research in India on household air pollution has primarily examined cooking fuel types, practices, and health impacts, focusing mainly on rural women. Fewer studies have explored the impacts of household air pollution on human health, with gender differences mostly unaddressed.

In 2019-2020, a study by the Centre for Chronic Disease Control, New Delhi, aimed to document adult exposure to air pollution in urban Delhi. A sub-sample of 100 adults from the CARRS Study (2), comprising 43 men and 57 women aged 30-60 years, was selected. These participants, from various urban settings including slums, JJ clusters and non-slum areas, represented around 40 occupations such as drivers, metalsmiths, textile workers, flower sellers, and office assistants. (Fig.4)

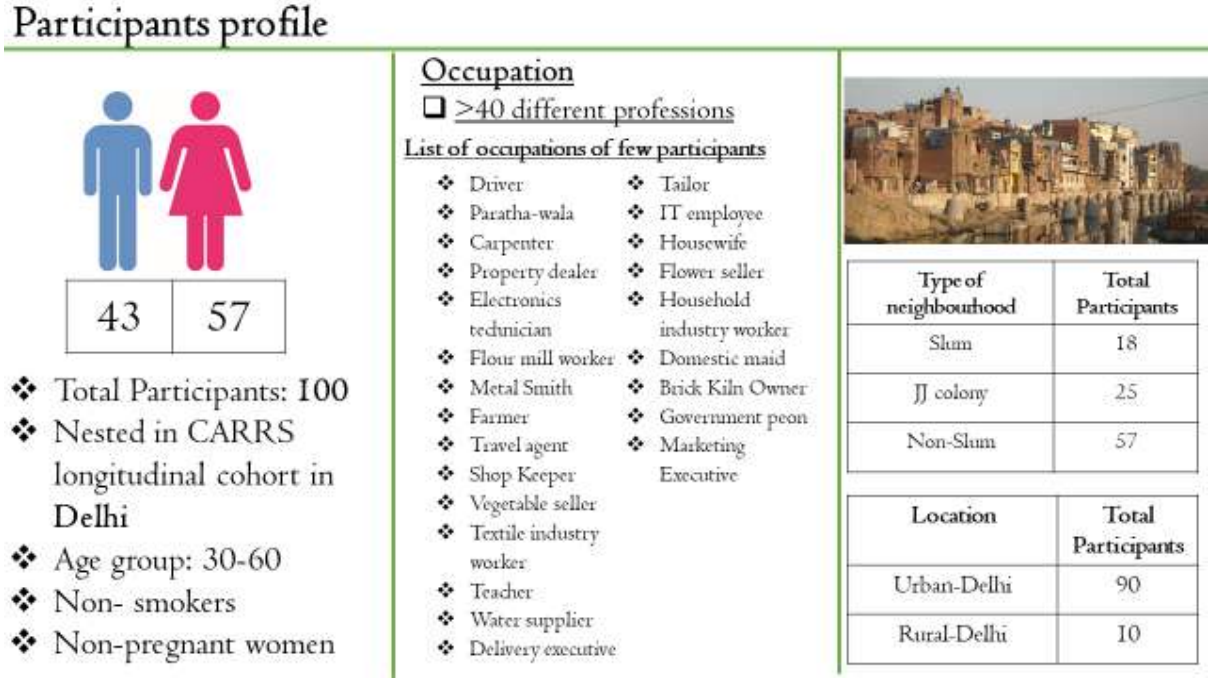

Figure 4: Participants' profile for personal exposure to air pollution assessment study

Participants in the study were equipped with personal exposure monitors and GPS-enabled activity trackers, carried in backpacks for 24 hours to measure their exposure to particulate matter, black carbon, heavy metals, and gaseous pollutants throughout various daily activities such as resting, travelling, and cooking. The monitors provided a detailed 24-hour profile of each individual's exposure to particulate pollution. (Fig.5)

The study highlighted significant gendered differences in exposure levels, particularly noting that women, often indoors, faced higher levels of particulate matter than their spouses who spent more time outdoors, indicating increased health risks from pollutants in enclosed spaces. (Fig.6-B).

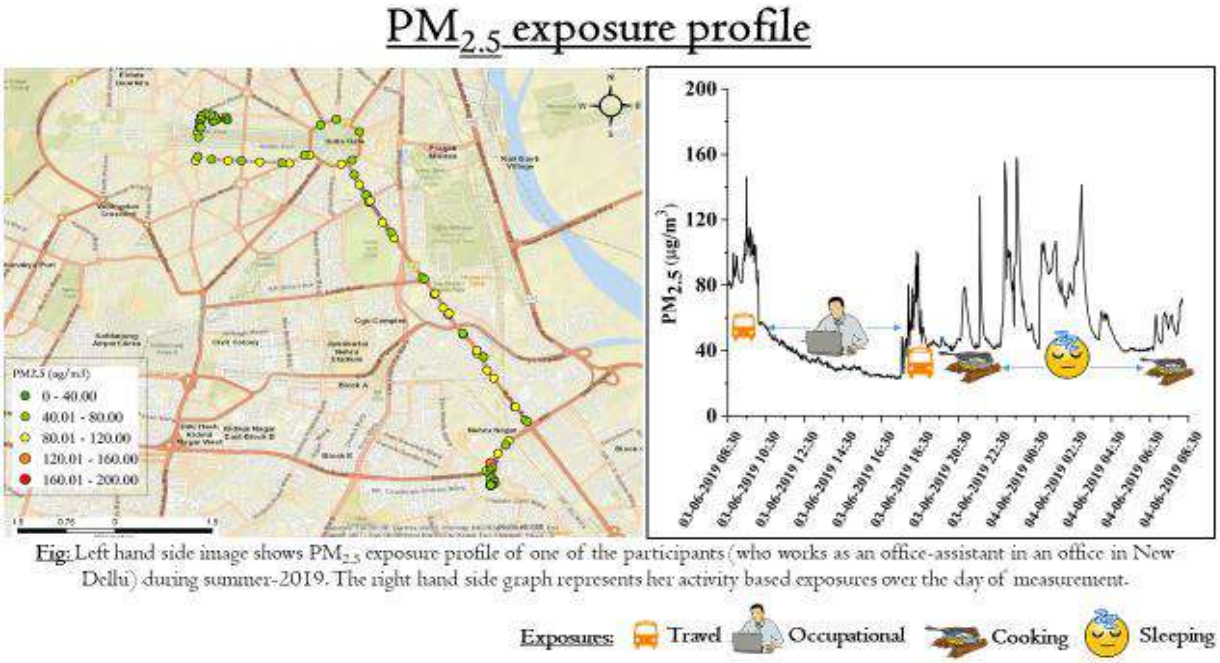

Fig: Left hand side image shows $PM_{2.5}$ exposure profile of one of the participants (who works as an office-assistant in an office in New Delhi) during summer-2019. The right hand side graph represents her activity based exposures over the day of measurement.

Figure 5: Example of PM 2.5 exposure profile for a female participant.

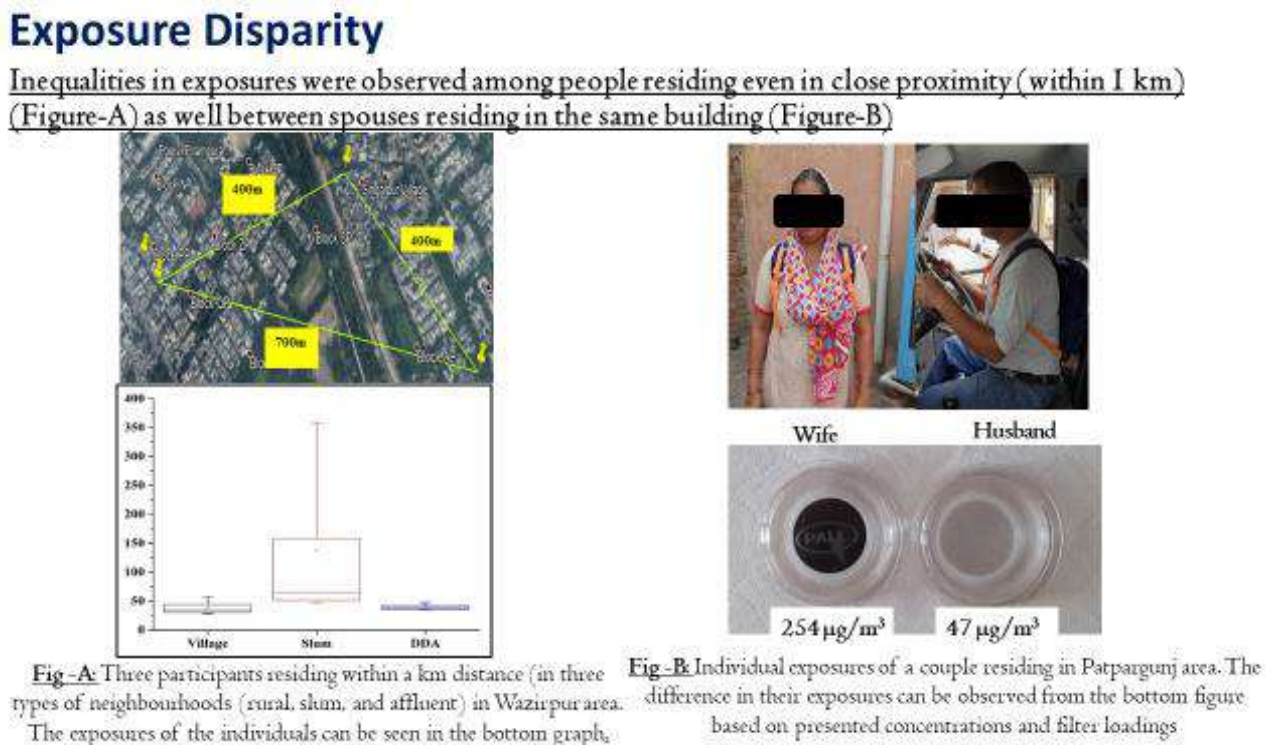

Fig -A: Three participants residing within a km distance (in three types of neighbourhoods (rural, slum, and affluent) in Wazirpur area. The exposures of the individuals can be seen in the bottom graph.

Fig -B: Individual exposures of a couple residing in Patparganj area. The difference in their exposures can be observed from the bottom figure based on presented concentrations and filter loadings

Figure 6: Exposure disparity – a gendered lens

The study suggests that women, particularly from lower socio-economic backgrounds living in informal settlements with inadequate housing, face heightened vulnerabilities to indoor air pollution compared to men, even in urban environments like Delhi. This is compounded by the city's already high levels of ambient air pollution, resulting in significant exposure to toxic pollutants. As primary caregivers, women often share their environment with small children, including infants and toddlers, exposing them to similar high levels of pollutants from a young age. This exposure to particulate and gaseous pollutants can adversely affect children's growth, cognitive development and their future health and economic potential.

Current Programs - Launched in 2016, the Pradhan Mantri Ujjwala Yojana (3) aims to provide LPG cylinders to below-poverty-line households, with women as the primary beneficiaries, to transition from unclean cooking fuels. However, sustainability, accessibility, and affordability issues have hindered its success. An in-depth analysis suggests that adopting new cooking fuels requires targeted behavior change communication to women about the health benefits of cleaner fuels. Additionally, resistance to abandoning traditional "chulhas," often due to beliefs that food tastes better when cooked on them, poses a further challenge to the program's effectiveness.

Future areas of intervention and recommendations:

1. **Research**: A research study that helps to document the gender differences in the health effects of air pollution on women in both rural and urban settings must be conducted to facilitate a baseline evaluation of the current status of health effects of air pollution on women and children.
2. **Strengthening existing programs**: The PMUY programme requires a thorough qualitative review to pinpoint gaps in LPG usage and retention. Results should improve accessibility and sustainability, and alternatives like solar energy should be explored.
3. **Behaviour-change communication:** Specific behaviour-change communication programmes should raise awareness among both women and men about the health impacts of unclean cooking fuels on families. Addressing men's preferences for food cooked on traditional chulhas is crucial for transitioning to cleaner fuels.
4. **Communication and Awareness-building**: Information, education, and communication (IEC) materials in all local languages on air pollution's health impacts on women and children should be widely disseminated. Resources are available on the National Centre for Disease Control website under the NPCCHH section (4), with translations in many regional languages.
5. **Inter-ministerial Women-centric Rehabilitation programs**: Collaboration between the ministries of health, women and child development, housing, and rural development is essential to improve housing infrastructure. This includes better natural lighting, ventilation, clean cooking fuels, and enhanced water and sanitation facilities, specifically aimed at elevating women from poor housing conditions, unhygienic environments, and limited access to clean fuels and essential services.
6. **Indoor air pollution standards and guidelines:** The development and implementation of guidelines for indoor air quality is urgent and imperative. An inter-ministerial task force involving representatives from health, environment, energy, agriculture, housing and urban affairs, rural development and the women

and child development ministries must come together to work on this given the wide-ranging implications across sectors.

Acknowledgements

Research study – Mr Kishore Madhipatla- Research Fellow and team at Centre for Chronic Disease Control; Content and graphics – Personal Communication – Dr D. Prabhakaran, Executive Director, Centre for Chronic Disease Control, Dr Jyothi Menon and Mr Kishore Madhipatla.

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4. National Program for Climate Change and Human Health- https://ncdc.mohfw.gov.in/national-programme-on-climate-change-human-health/

3. National Programme on Climate Change and Human Health

Contributed by: National Programme on Climate Change and Human Health Team, National Centre for Disease Control, Delhi

India was the 7th most affected country due to climate change in 2019. This impact was evident in terms of both, the human toll with 2,267 lives lost, and the economic damage, which accounted for 66,182 million US$ Purchasing power parities (PPPs)[4]. Further, climate change unequally affects the population, with women and children being among the most vulnerable groups. Indian children ranked 26th for most "at-risk" to the impacts of climate change.[5] This highlights the significant impacts of climate change on the nation's geographical, economic and human capital.

The WHO Health and Climate Change global survey report of 2021 states that over three-quarters of the surveyed countries (77%) have developed or are currently developing national health and climate change plans or strategies, and 85% of ministries of health have a focal point on climate change and health (footnote 2) to develop sustainable and robust action plans for specific climate-related events.

National Programme on Climate Change and Human Health (NPCCHH): Mission and Objectives

In 2019, India aligned with global counterparts in inaugurating a health initiative under the auspices of the Prime Minister's Climate Change Council (PMCCC), upholding the political will to bolster healthcare infrastructure and executing population-level health adaptation measures. The National Action Plan on Climate Change and Human Health (NAPCCHH) is the operational framework through which the National Programme on Climate Change and Human Health (NPCCHH) directs its efforts. NPCCHH is a tiered organisation serving as a national mechanism to address health impacts due to climate change in the country since its inception. The NPCCHH works through the general health architecture of the country and has reached the district level.

The goal of the National Programme on Climate Change and Human Health is to reduce morbidity, mortality, injuries, and health vulnerability to climate variability and extreme weather events (EWE). To achieve this goal, the key objectives identified are as follows:

- Awareness generation
- Capacity building of the health workforce
- Health sector preparedness
- Intersectoral coordination
- Steering research with the Indian Council of Medical Research.

The programme has **identified 17 climate-sensitive diseases for action** and drafted specific National Health Adaptation Plans on these subjects. The priority areas identified by NPCCHH are air pollution-related illnesses, extreme heat-related illnesses, extreme weather events, green and climate-resilient health infrastructure, climate change and vector-borne diseases, and water and health issues.

Seasonal advisories are released as a part of awareness generation (for air pollution in August, heat waves in February, floods in June, and cold wave in December); information, education and communication materials are developed and disseminated with a special

[4] **GLOBAL CLIMATE RISK INDEX 2021**

[5] **Boutin G, Escudero P, Ganesh V, Hereward M, Ann Naylor K, Otmacic V, et al. Overall Leadership and Guidance: Gautam Narasimhan (Climate, Energy, Environment & Disaster Risk Reduction) and Toby Wicks (Data Use).**

focus on the vulnerable groups such as women, children and elderly. Sensitisation workshops and webinars are also conducted involving Panchayat Raj Institutions (PRI), Village Health and Sanitation Committee (VHNSC), Jan Arogya Samiti, School Health and urban local bodies to spread awareness regarding the impact on health due to climate change. Observation of important Health days like World Environment Day, International Day for Clean Air for Blue Skies, International Day for Disaster Risk Reduction, World Water Day, and World Health Day etc. with the participation of peripheral health workers (ASHAs, ANMs, etc.) and the community, especially school children, also contributes toward generating awareness.

Achieving this vision also requires a **knowledgeable workforce** that works effectively and has competent skills. In NPCCHH, capacity building involves assessing health vulnerability needs, developing health issue-specific technical content, and conducting tiered training sessions. These documents are developed with support from centres of excellence (CoEs) and UN partner agencies like WHO and UNICEF, each with a targeted approach for vulnerable populations, including women and children. Apart from this, regular publications are released in the form of Handbooks and Newsletters, which highlight the latest updates from the world on climate change and its continued impact on human health. To emphasise the importance of climate change on health for future generation doctors, the medical curriculum is currently being updated to include the topic.

Recognising the diverse regional impacts of climate change, NPCCHH has proactively encouraged states and districts to formulate action plans **tailored to localised circumstances**, thereby advancing targeted implementation strategies.

The programme also focuses on **green and climate-resilient measures to be adopted across all healthcare facilities.** These include measures like solarisation (for renewable energy), rainwater harvesting, conducting energy audits and replacing all light fixtures with LEDs. Climate resilient methods are also being implemented in health facility infrastructure with cool/ green roofs.

Integrated surveillance of heat-related illnesses in all states with daily summer-time temperature records from the India Meteorology Department has been a mechanism to monitor the incidence of suspected heatstroke cases and deaths. **Sentinel surveillance of acute respiratory illnesses** from tertiary care health facilities integrated with daily ambient air pollution records provided by the Central Pollution Control Board has been an effort to track the health impact of air pollution.

Way Forward:

NPCCHH is a tailor-made programme that acknowledges regional climate variations and is envisioning the development of district action plans and task forces for tailored healthcare solutions. Building on successful pilots in select facilities, NPCCHH is also directing all states to conduct energy audits through local administrations,as an initial step towards establishing green and climate-resilient healthcare facilities for improving healthcare access, especially for women and children.

Emphasising prevention rather than the cure, the program is working on enhancing early warning systems for extreme weather events, focusing on gender-disaggregated data for targeted adaptation plans. Furthermore, efforts are underway to enhance awareness of the impact of climate change on human health through the development of interactive health courses tailored for medical professionals.

NPCCHH thus remains committed to adopting a comprehensive approach that encompasses various aspects of human health and strives to achieve a sustainable balance between environmental integrity and public health.

"The Earth has enough resources to meet people's needs, but will never have enough to satisfy people's greed."

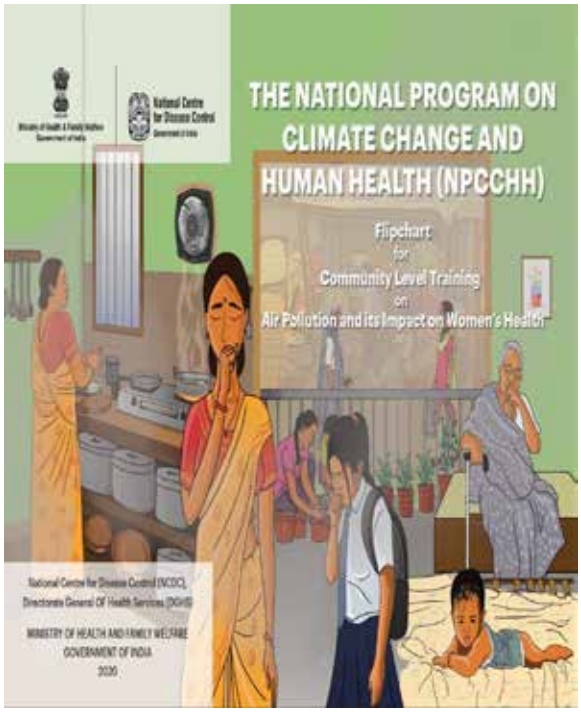

***Figure 1**: IEC and Training modules developed for children and women*

1. Boutin G, Escudero P, Ganesh V, Hereward M, Ann Naylor K, Otmacic V, et al. Overall Leadership and Guidance: Gautam Narasimhan (Climate, Energy, Environment & Disaster Risk Reduction) and Toby Wicks (Data Use).
2. GLOBAL CLIMATE RISK INDEX 2021.

4. Bridging governance and data gaps for climate impacts

Contributed by: Bhargav Krishna, DrPH, Fellow and Coordinator - Environmental Governance at Policy, Sustainable Futures Collaborative

Context

India has positioned itself as a global leader and norm-setter on climate change through significant global initiatives like the International Solar Alliance, and national goals to move towards a renewable energy-led energy system by 2030. However, the rising frequency and intensity of climate-induced extremities such as heat waves, storm surges, forest fires, urban floods, etc. in the coming years will hamper India's efforts to meet health, social and developmental goals including the urgent need to pull millions out of poverty.

The framework for action on climate currently functions in parallel with existing programs on health and development. Laid out primarily in State action plans on climate change (SAPCCs) and implemented by State environment departments, climate action strategies at the state-level make no mention of health except as a normative goal and with no linkages with health sector programs and policies. On the flip side, health sector and health-adjacent programming such as through the National Health Mission of the Ministry of Health and Family Welfare or the Integrated Child Development Scheme of the Ministry of Women and Child Development do not embed climate-relevant messaging or action in any way.

Adapting to a changing climate will require not just successful small-scale actions, but systemic transformations that mainstream climate concerns across sectors. This is only possible with State intervention aided by appropriate governance structures.[6] While India has seen some success with responding to issues such as storm surges in coastal areas, building systemic resilience (including of the health system) will require an all-of-society approach that is built on foundational scientific evidence, leveraging public finance effectively, and decentralising planning and action to State and local levels to meet contextual needs.[7]

The structural transformation necessary to promote systemic resilience hinges on identifying upstream policy levers that when activated can:

- Drive localised planning and implementation
- Unlock financing from existing and new streams of public funding at union and state level
- Diffuse solutions that are contextual to local needs including agro-ecology

The example of heat waves and India's evolving policy can help unpack what appropriate governance frameworks to mainstream localised adaptation strategies look like.

[6] Pillai, A.V., N. K. dubash, and P. Bhatia. 2021. "unlocking climate action in Indian federalism". Policy Brief, initiative for Climate, energy, and environment. New Delhi: Centre for Policy Research. July 2021.

[7] Aditya Valiathan Pillai, and Tamanna Dalal. 2024. "Adaptation and Resilience: Building systems that allow India to adapt to multiple and increasingly severe climate impacts." SFC Perspectives. Sustainable Futures Collaborative, New Delhi.

Heat waves and India's evolving policy response

India is experiencing more frequent and intense heat waves that start earlier in the year and stay longer, with multi-day hot day and night events increasing significantly. Climate projections indicate a two to four-fold increase in heat waves by 2050. Extreme heat is already contributing to excess all-cause mortality in India with a recent study across 10 cities in different agro-ecological zones estimating a 14.7% increase in daily mortality associated with heat wave conditions, contributing to over 1100 deaths annually.[8] Heat waves and extreme heat are also likely to exacerbate the spread of vector-borne diseases, render working conditions unbearable especially for outdoor workers, and decrease labour productivity and associated economic growth.

Union and State governments have approached the issue of extreme heat through the development of Heat Action Plans (HAPs) at State, district or city levels. These HAPs outline strategies to be employed by governments to prepare for, manage and learn from heat waves. They primarily comprise a series of discrete actions with the most common interventions being those focused on infrastructure (e.g., ensuring availability of water and cooling centres), information dissemination (e.g., early warning systems or sensitizing vulnerable groups), or leveraging nature-based solutions (e.g., increasing urban green cover). Analysis of 37 of these HAPs in 2022[9] revealed that while most had a good mix of short and long-term solutions to address heat, HAPs could be strengthened substantially in several ways by:

1. Contextualising the heat hazard to local conditions by setting local temperature thresholds and integrating future climate projections (only 10 of 37 HAPs had local thresholds)
2. Better identifying and targeting vulnerable groups such as women, children, outdoor workers, etc. (only 2 HAPs conducted vulnerability assessments)
3. Identifying earmarked funding for heat solutions (only 2 HAPs considered any financing at all)

In addition, the study also identified the need for firm legal grounding for heat action, and the need for more cross-sectoral capacity building, consultation and evaluation of implementation efficacy.

Subsequent work has focused on identifying pathways to finance already identified HAP solutions through existing central sector schemes (CSS). Early analysis suggests that 18 of the 72 CSSs reviewed had direct linkages to HAP solutions, and 7 of these 18 could unlock finances for two-thirds of HAP solutions.[10] This information made available to district-level bureaucrats could prove hugely beneficial in implementing contextual solutions backed by financing. Utilisation of the funds for multiple objectives, particularly at the district or local level, is also indicative of the co-benefits approach to climate action, integrating climate considerations into existing program delivery methods.

Developing locally tailored adaptation strategies hinges on establishing foundational evidence regarding the health impacts of climate events. While some studies have examined the effects of heat waves and high temperatures on mortality, further research is imperative to understand impacts across various health conditions, particularly among

[8] De Bont, J., Nori-Sarma, A., Stafoggia, M., Banerjee, T., Ingole, V., Jaganathan, S., Mandal, S., Rajiva, A., Krishna, B., Kloog, I., Lane, K., Mall, R. K., Tiwari, A., Wei, Y., Wellenius, G. A., Prabhakaran, D., Schwartz, J., Prabhakaran, P., & Ljungman, P. (2024). Impact of heatwaves on all-cause mortality in India: a comprehensive multi-city study. Environment International, 184, 108461. https://doi.org/10.1016/j.envint.2024.108461

[9] Aditya Valiathan Pillai and Tamanna Dalal. (2023). How is India adapting to heatwaves?: An assessment of heat action plans with insights for transformative climate action. CPR report.

[10] Forthcoming report from the Sustainable Futures Collaborative on "finding the finance" for heat action plans

vulnerable groups such as children, women, and outdoor workers. Access to high-quality, routinely collected health data is crucial for filling these knowledge gaps, especially concerning outpatient visits for conditions like heat stroke, which are challenging to obtain due to the absence of standardised electronic health records. Leveraging routine data from programs like the Integrated Disease Surveillance Programme (IDSP) presents an opportunity to enhance understanding of vector-borne diseases' dynamics, given the program's substantial capacity improvements.

Way Forward

To bridge these gaps in governance and data frameworks, we must first develop state-level climate institutions that serve as knowledge hubs to collate and disseminate localised evidence, facilitate inter-sectoral coordination for effective policy implementation, align climate and health goals with a particular focus on vulnerable populations such as women and young children, and nest planning and implementation from local to regional levels. In this regard, the case study on mainstreaming heat action elucidated above can serve as an example of how to mainstream governance for climate and health.

Second, states should consider developing health solutions platforms that can aid in long-term planning with respect to adaptation by providing long-term climate projections that can inform plans to address vulnerable populations and areas, map agro-ecologically suitable solutions across sectors such as water conservation, forestry and agriculture, and identify pathways to finance these solutions from the district to state level and in the short and long-term. Avenues for financing such as central sector schemes and devolved funds such as through the Finance Commission can prove expedient in this regard.

Finally, health sector capacity should be augmented to mainstream climate programming across existing health sector schemes such as the National Health Mission, and we must invest in an adequate data architecture that can support the development of the foundational evidence necessary to drive contextual and timely adaptation strategies.

5. Ahmedabad Heat Action Plan: A Successful Public Health Intervention against extreme heat

Contributed by: Dileep Mavalankar and Mahaveer Golechha, Indian Institute of Public Health-Gandhinagar

With climate change, the frequency, intensity and duration of heat waves are rapidly increasing. The Indian subcontinent's heat waves have catastrophic health consequences and are termed as a “silent disaster”. There is a direct link between higher temperatures and increased mortality and morbidity due to heat stress (Ebi et al., 2021).

In 2010, Ahmedabad witnessed a severe heat wave, which lasted for almost one week during peak summer in the month of May from 19-17th. The temperature reached 47 degrees Celsius. There were media reports of increased morbidity and mortality in the city. The Indian Institute of Public Health-Gandhinagar (IIPH-Gandhinagar) with help from the Natural Resources Defense Council (NRDC) analysed the all-cause registered daily mortality in the city and observed a huge spike in death during the 2010 heat wave. While the average mortality per day is 100 people (provided the population of the city was about 5 million in 2010), the mortality recorded on 21st May 2010 when the heat wave, was 310 deaths. A comparison of the all-cause mortality for the heat wave week with the previous year’s average revealed that there were 800 additional deaths during the heat wave. Analysis of the whole month of May 2010 showed 1,344 additional deaths were recorded in the city as compared to expected mortality.

Ahmedabad Heat Action Plan 2013: First of its kind

To help build community resilience against extreme heat, the Indian Institute of Public Health - Gandhinagar led the creation of threshold-based heat action plans in collaboration with other partners including the Ahmedabad city government, NRDC, the Indian Meteorological Department (IMD), University of Washington and other stakeholders. This HAP was first time implemented in 2013 and in each subsequent year.

This HAP involved many stakeholders, but the main owner and implementer was Ahmedabad Municipal Corporation (AMC). The central objective of HAP was to reduce the impact of heat waves on human health. The four major components of this plan are:

- Early warning and communication systems and interagency coordinated actions
- Increasing awareness among people of the ill effects of heat and how to protect oneself
- Capacity building of the medical and paramedical service providers to manage health emergency cases
- Reducing Heat exposure and promoting adaptive measures.

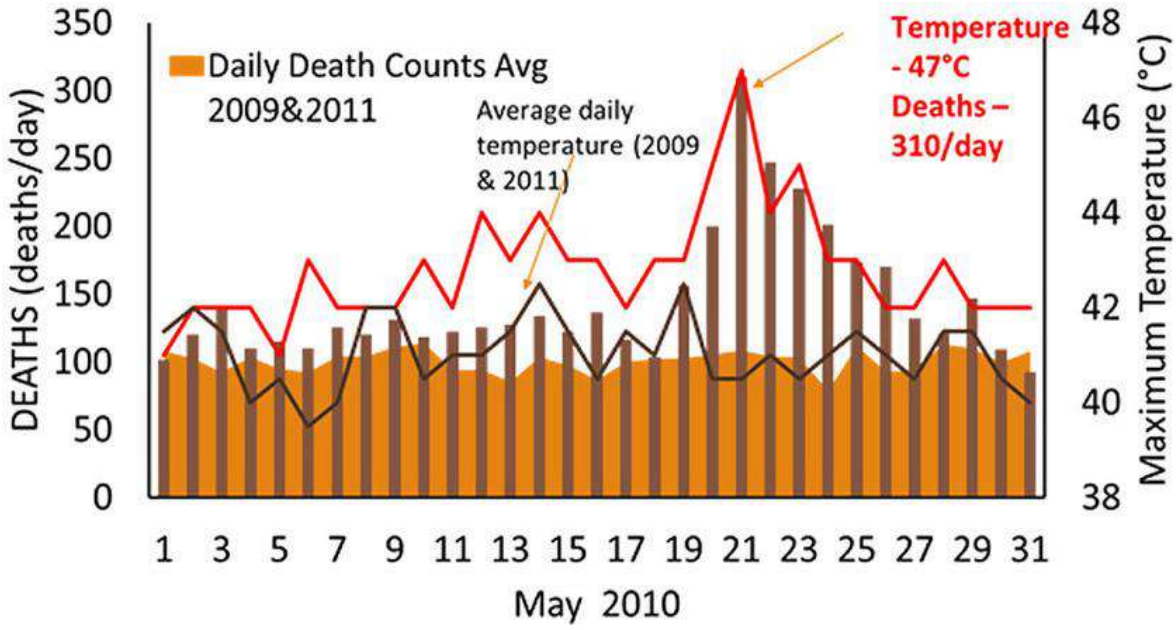

Fig 1. Daily Temperature and all-cause mortality correlation graph in the city of Ahmedabad in May 2010

The HAP identified thresholds and used a traffic light type of alert system – yellow alert, at 41-42.9°C, orange alert at 43-44.9°C and Red alert at 45°C or more. These thresholds were determined based on the inflections of the temperature mortality curve. This was the first time such health-based thresholds were being set up for a heat action plan in India.
The HAP was also designed as a public health policy mechanism that would identify heat emergency levels for the city and explain activities and standard protocols for various line departments of the city administration. It incorporated best practices from various countries, and strategies and included a robust community outreach campaign. Strategies to identify the most vulnerable to extreme heat, including their places of residence and work, and recognize and prioritise policies and programs to address current and projected future health risks were incorporated.

The Ahmedabad heat wave mortality analysis, which was published along with the implementation of HAP, has had a very large impact on Heatwave resilience planning in the Indian context. A declining trend in the impact of heat on human health in Ahmedabad city has been observed since the rolling out of HAP in 2013. About 800 fewer deaths were reported in May 2014, compared to May 2010. In the year 2015, all regions across India witnessed an intense heat wave but in Ahmedabad, heat-related mortality remained low during high-temperature days.

The plan also helped in changing the perception of extreme heat events and their impact on different stakeholders and policymakers. National Disaster Management Authority (NDMA) has recognized heat waves as a natural disaster having significant health impacts and instructed the states and districts to prepare their HAP. The emergency ambulance services (108) and occupational groups (Traffic police) are also now better sensitised and equipped to deal with Heat waves.

The Ahmedabad HAP model has been appreciated at National and international levels. States like Maharashtra (Vidarbha region) and Odisha developed and rolled out similar

HAPs in 2016. World Health Organization and World Meteorological Organization initiated discussions with the IIPH-Gandhinagar team to develop similar HAP for South Asian countries.

This Heat Action Plan (HAP) was the first of its type in South Asia. A mix of public awareness efforts, medical staff training, and straightforward policy adjustments have saved many lives at a modest cost. The project offers a foundation for publishing and sharing information with local and worldwide communities. It can be used as a model for decreasing heat vulnerability and as a guide for areas with limited resources.

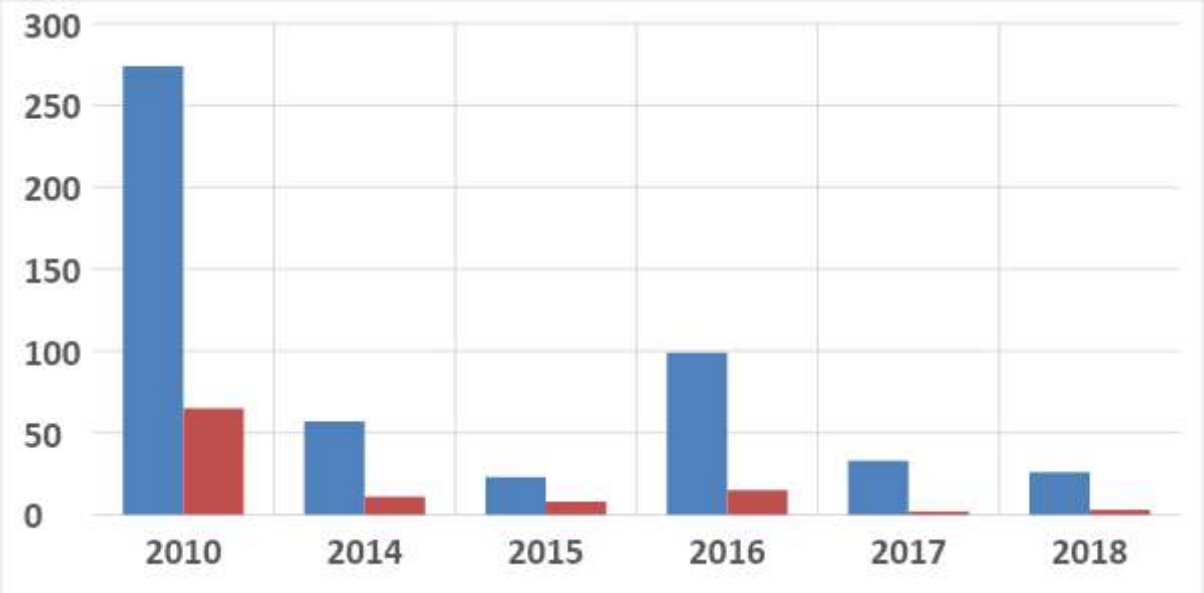

Fig.2. Reduction in the number of heat stroke cases and mortality after implementation of the Ahmedabad Heat Action Plan in 2013

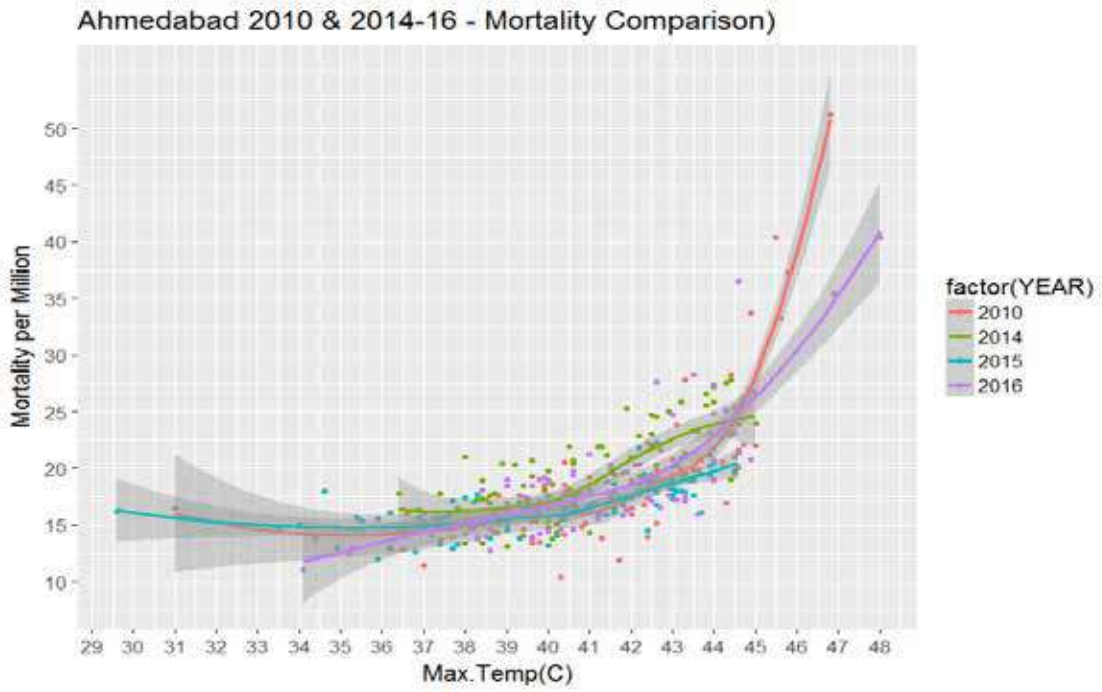

Fig. 3. Comparison of Temperature - Mortality relation in various Heat Wave Years

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6. Adapting to increasing risk due to heatwaves: local level action

Contributed by: Shreya Wadhawan, Shravan Prabhu, and Vishwas Chitale, The Council on Energy, Environment, and Water (CEEW)

As per recent findings, 2023 was the hottest year on record globally and the world is inching closer to surpassing the 1.5°C global warming threshold earlier than anticipated. The effects of escalating climate change are expected to manifest regionally in ways through climate variabilities and extreme weather events that will disproportionately affect vulnerable populations, particularly in developing and tropical countries like India (World Meteorological Organization, 2023).

Globally, heatwaves have contributed to approximately 166,000 human deaths during 1998–2017 (Pascaline & Rowena, 2018). In countries like India, nearly 80 per cent of the population resides in climate-vulnerable districts and experienced around 25,000 heat-related deaths between 1990 and 2015 (NDMA, 2020; Mohanty & Wadhwan 2021). In May 2023, a heat wave was declared across ten states of India, which covers more than 100 crore people. Addressing the implications of escalating climate change requires a comprehensive understanding through detailed mapping of variabilities and extreme weather events, accompanied by the design of effective action plans to mitigate and adapt to the adverse effects of events like heat waves.

Thane's Heat Action Plan: Building Community Resilience

CEEW has prepared a heat action plan (HAP) for Thane City, a coastal city in Maharashtra that experiences the impacts of dry temperature and humidity. The plan focuses on mapping trends and hotspots of heat stress, followed by the formulation of robust mitigation, preparedness, and response strategies to combat heat risk in Thane Municipal Corporation. The plan recognises the dynamic nature of heat extremes, the compounding effects of humidity and urban heat islands, and the authorities provided by the Constitution (Seventy-fourth) Amendment Act, 1992 (CAA). It integrates these factors comprehensively while devising effective local-level heat action strategies. The HAP also maps heat risk at a granular level, down to administrative wards and proposes response strategies for each stakeholder and department.

The Thane HAP's mission is to achieve zero mortalities from heat extremes in the city, reduce heat-related illnesses and heat stress, and minimise economic impacts across sectors. To achieve this, the plan lays out the following objectives:

- Granular mapping of heat hazard under various climate change scenarios, establishing local heat-health thresholds for early warnings, and mapping vulnerable populations
- Designing effective preparedness and response strategies, with a focus on health and disaster management, to ensure zero human mortalities
- Reducing heat-health risks, heat stress and heat-related illnesses by implementing robust tracking, surveillance, and innovative cooling solutions
- Long-term reduction of economic losses in different sectors through region-specific heat risk mitigation strategies
- Capacity building of relevant stakeholders to prepare for, respond to, undertake a review of the heat action plan implementation and update the heat action plan annually

A multidisciplinary approach was employed to formulate the HAP, integrating technical tools, scientific analysis, policy evaluation, and stakeholder engagement. Building upon the foundation provided by the NDMA guidelines of 2019 for Heat Action Plans (HAPs) and the National Disaster Management Plan 2019, a comprehensive framework for effective heat action was established. This framework comprised three critical components:

1. When to take action: Local city-level heat thresholds have been established for Thane city based on both apparent and ambient temperature. This will allow accurate heat-health early warnings and alerts for various stakeholders.
2. Where to take action: To identify the at-risk and vulnerable populations, a ward-level heat risk index based on the IPCC AR5 framework consisting of indicators for hazard, exposure and vulnerability has been developed (IPCC, 2014).
3. How to take action: A stakeholder responsibility matrix for both heat risk mitigation and response and preparedness with clear roles and strategies has been developed.

In addition, the Thane HAP also provides strategies for continuous monitoring, evaluation and revision of the plan.

Way Forward

India has over 4,800 Urban Local Bodies (ULBs), most of which are already experiencing significant impacts from climate change like heatwaves, urban flooding, and water scarcity. This underscores the importance of integrating climate change adaptation at various levels across the country. A key challenge in this integration is the current capacity of government officials to incorporate climate change into planning processes. To address this, a dedicated country-level climate change capacity enhancement program for all relevant government officials across the country is required. Additionally, a strong monitoring and evaluation framework is essential to maintain the focus on climate action in India.

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7. Mainstreaming gender in climate policy in India

Contributed by: Chandni Singh, School of Environment and Sustainability, Indian Institute for Human Settlements

India's national and subnational climate policies recognize gender as a key determinant of vulnerability and an essential factor in building adaptive capacity locally. The National Action Plan on Climate Change (NAPCC) and State Action Plans on Climate Change (SAPCC) have begun integrating gender perspectives. The NAPCC, formulated in 2008, says,

> *...the impacts of climate change could prove particularly severe for women. With climate change, there would be increasing scarcity of water, reduction in yields of forest biomass, and increased risks to human health with children, women and the elderly in a household becoming the most vulnerable. With the possibility of decline in the availability of food grains, the threat of malnutrition may also increase. All these would add to deprivations that women already encounter and so in each of the adaptation programmes, special attention should be paid to the aspects of gender. (NAPCC 2008, page 14)*

The NAPCC provided states with a national articulation of the gendered impacts of climate change. Although the framing homogenises all women as vulnerable, does not acknowledge vulnerable men, and is blind to intersectional vulnerability, it paved the way for states to mainstream gender in their SAPCCs. A review of 28 SAPCCs found that most states explicitly mention gender as a mediator of vulnerability and adaptive capacity but operationalise it inadequately and unevenly. Gender studies show how gender is operationalised in development policy and shape how well goals of reducing gender vulnerability and achieving empowerment are met. Table 1 highlights how these aspects of gender recognition have implication for climate adaptation policy.

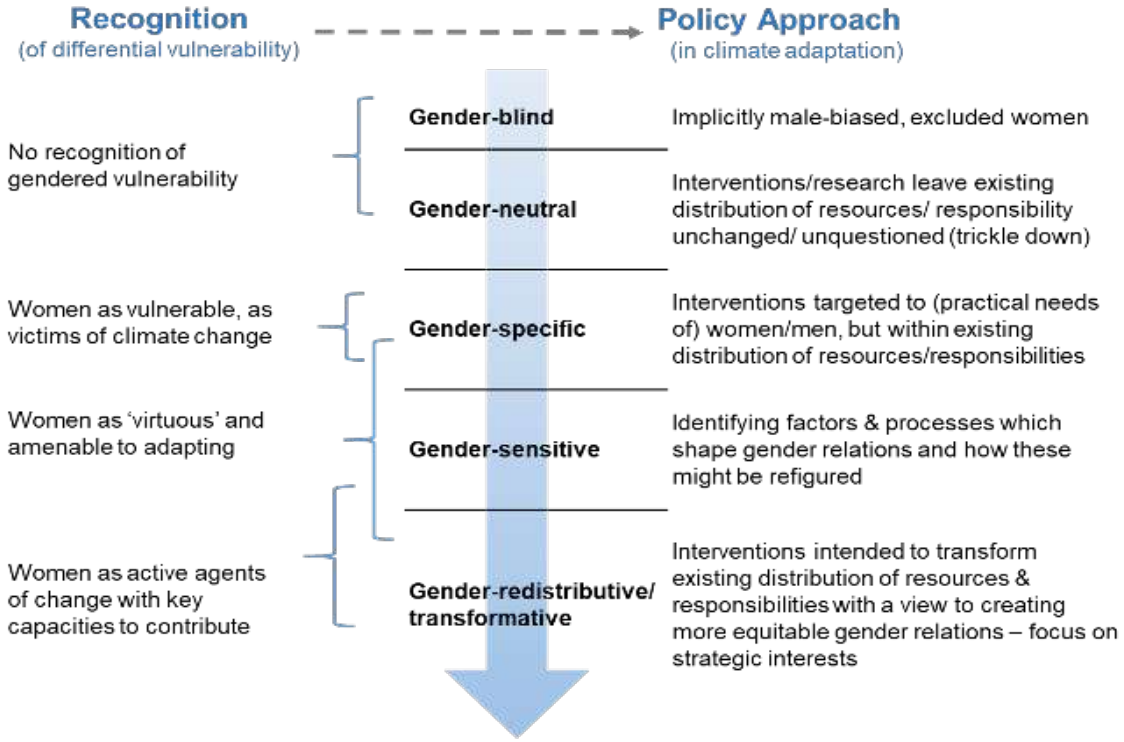


Figure 1 *The ways we recognise gendered vulnerability shape how gender in operationalised in climate change policy. Source: Singh et al. (2021)*

Findings

- 12 SAPCCs did not mention or acknowledge gender
- 16 SAPCCs mention gender
- 15 states still view women as victims of climate change, mainly focusing on increased work burdens (time to collect firewood or water) as indicators of this.
- 3 states (Tripura, Kerala and Uttarakhand) acknowledge women's knowledge and societal roles as key for climate resilience building
- Only 4 states (Bihar, Chhattisgarh, Gujarat, Uttarakhand) speak of women as change agents, i.e., holding power and potential to shape and drive local adaptation

Table 1 *Recognition of gendered vulnerability differs across SAPCCs. Source: Singh et al. (2021).*

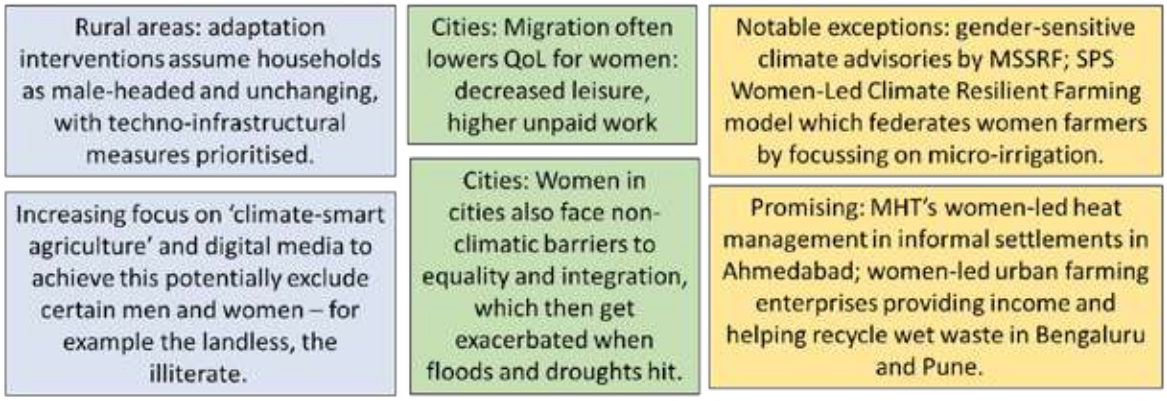
How gender is recognised	Illustrative quotes from policy documents	States using this framing
Women as vulnerable, as victims of climate change	Climate change impacts on gender are 'particularly severe for women' and that 'in each of the adaptation projects, special attention be paid to aspects of gender' (p 14, NAPCC). Approach to SAPCC Priorities for 2014-2019 mentions 'creating climate change safeguards for women, landless labourers, marginal workers, tribal and other vulnerable communities' (p. 176, Gujarat)	NAPCC, Rajasthan, Gujarat, Bihar, Chhattisgarh, Jharkhand, Tamil Nadu, Tripura, West Bengal
Women as 'virtuous' and more amenable to adapting, undertaking behavioural change	'Women help in increasing the social capital and make the community resilient. It has been seen through the work of SHG groups and especially during the post disaster recovery period. Therefore, it is important to nurture such social capital through the strengthening women's institutions like SHG groups to enhance their resilience.' (p. 27, Tripura) 'The specialized knowledge of women about forestry, botany, biodiversity and water management makes them critical resources in combating deforestation. To realize their potential, the Forest Department will examine options for adopting policies that support women's leadership and recognize their expertise and support women in combating gender discrimination.' (p. 87, Uttarakhand)	Tripura, Gujarat, Uttarakhand, Maharashtra
Women as active agents of change with key capacities to contribute	Women are agents of change to reduce energy consumption 'building a cadre of women who are energy savers…' (p. 189, Gujarat)	Gujarat, Kerala, Uttarakhand, Bihar, Chattisgarh, Tripura, West Bengal
No mention	NA	Andhra Pradesh, Assam, Karnataka, Madhya Pradesh, Odisha, Mizoram, Punjab, Haryana, Manipur, Meghalaya, Sikkim, Uttar Pradesh

Overall, all SAPCCs view gender through binaries of male/female-headed households masking intra-household heterogeneity, relational gender dynamics and changing masculinities. Fourteen SAPCCs allude to intersectionality where they mention gender intersecting with livelihood opportunities, especially in agriculture and forest-based livelihoods (Tyagi & Das, 2018); labour divisions; natural resource access and use; and existing deficits such as caste-based marginalisation (Ravera et al., 2016). In all SAPCCs, gender is equated with women. Only the SAPCCs of Nagaland, Chhattisgarh, and Uttarakhand acknowledge that certain men are also vulnerable to climatic risks.

Early signs of gender mainstreaming and transformative action in India

Global studies show that adaptation is undertaken by a range of actors at different locations and scales, and across different sectors (Petzold et al., 2023). While individuals or households are the most prominent actors implementing adaptation, they are the least involved in institutional responses to climate risk management, and this is particularly magnified in the Global South (Petzold et al., 2023). Global assessments also show that poorly implemented climate adaptation that is not locally-led and participatory, can sometimes have adverse impacts on SDG (Gender Equality) (Roy et al., 2022; Susan Solomon et al., 2021).

In India, there are no studies systematically assessing how current climate change adaptation is affecting gendered vulnerability or whether they are helping meet gender equity goals. Scattered evidence paints a mixed picture.

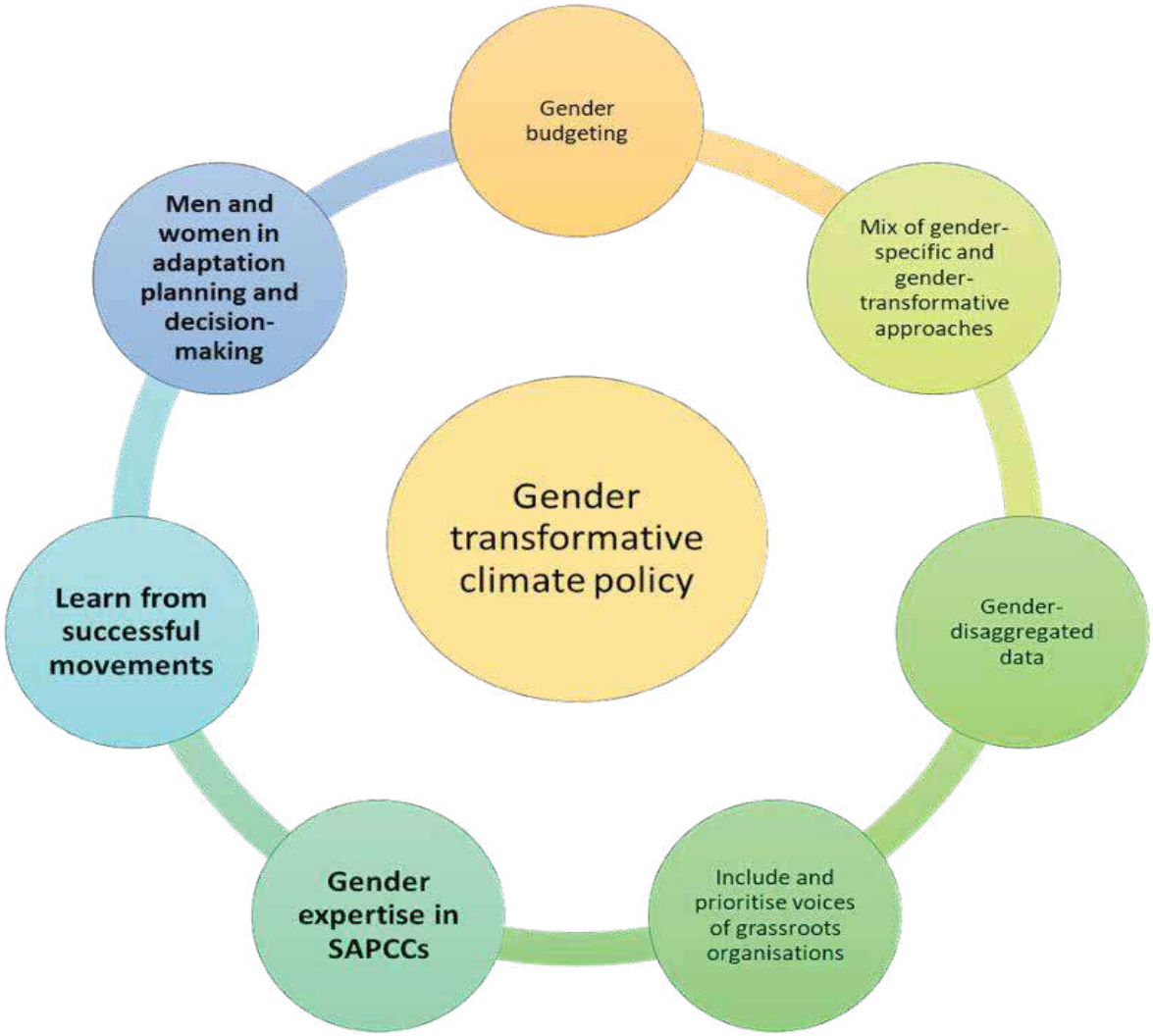


Recommendations

Currently, Indian states are revising their SAPCCs, with some states developing gender plans (e.g., Kerala). As greater attention and investment flow into climate adaptation, lessons from the pros and cons of mainstreaming gender but be learn and used to revisit how we can enable systemic, gender-transformative change.

1. Focussing only on women alone when talking about climate change vulnerability erases the relational lives men and women lead. As farming livelihoods become more precarious, poor and marginalised men and women are facing a crisis of identity and agency.
2. States in India are already recognising gendered vulnerability but fall back on tropes of women as victims or virtuous (Arora-Jonsson, 2011).
3. Gender-targeted interventions are underway and promising but transformational approaches that challenge the structures that reproduce exclusion and hierarchy are few. The ongoing revision of SAPCCs in India could be one way vehicle to mainstream a gender-transformational approach in sub-national climate action.

Figure 2. *Gender-transformative climate policy needs to move beyond gender budgeting to learning from successful collective action and social movements beyond the arena of climate change. All genders must be part of such a transformational agenda.*



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8. Gender Budgeting, Climate Change and Health

Contributed by: Lekha Chakraborty and Divy Rangan
Lekha Chakraborty is Professor at NIPFP and Governing Board Member of International Institute of Public Finance Munich; and Divy Rangan is former research fellow at NIPFP

As stated by the UN (2024), women are increasingly being seen as more vulnerable than men to the impacts of climate change. Women represent the majority of the world's poor and are proportionally more dependent on threatened natural resources, and they are affected by a number of factors – social, economic and cultural. Climate change events such as more-frequent and more-severe droughts and floods have adverse impacts on women and children, for instance, girls drop out of school more often than boys due to the gendered expectation that they should help with domestic household responsibilities or look after their siblings (UNICEF, 2024).

Climate change disproportionately affects women in various regions, as highlighted by studies conducted in Rural Australia and Bangladesh. In Rural Australia, Boetto and McKinnon (2013) found that gendered roles and responsibilities exacerbate the impact of extreme weather events on women, leading to increased incidents of domestic violence during floods. Similarly, Abedin, Habiba, and Shaw (2013) demonstrated the multifaceted effects of climate change on women in Bangladesh. These effects include higher mortality rates during cyclones and floods, increased health risks due to waterborne diseases and inadequate sanitation facilities, and challenges to physical security and dignity, such as domestic violence and loss of privacy in shelters. Additionally, climate change threatens women's economic livelihoods by causing losses in housing, agriculture, livestock, productivity, and access to markets, leading to income loss and unemployment.

Gender Budgeting for addressing health impacts of climate change:

Gender Budgeting is a fiscal innovation tool used to translate public policies into 'beyond GDP' commitments incorporating a gender lens. It has both equity and efficiency dimensions. It is a crucial tool in 'just transition'. The adoption of gender budgeting has caught pace with several countries in the Asia Pacific region experimenting with gender budgeting as a PFM tool of accountability and fiscal transparency.

Highlighting climate change impacts on health, the methodology of gender budgeting, particularly the public expenditure benefit incidence analysis, reveals a concerning trend of elite capture of public spending by non-poor income groups. This means that wealthier individuals are disproportionately benefiting from government spending compared to low-income groups. Specifically, the distributional impact of public health spending often does not reach those in the poorest income quintiles, exacerbating health inequities. Moreover, the reliance on out-of-pocket spending for healthcare among low-income households further worsens their financial burden. Despite the recognition of the importance of the health sector in post-pandemic fiscal strategies, there is a notable absence of long-term investments in healthcare. In fact, the size of government expenditure on health has not surpassed 1% of GDP. This lack of substantial investment raises concerns about the sustainability and adequacy of healthcare services, particularly for vulnerable populations who may rely heavily on public health systems. Additionally, However, there are several hurdles in the procedural implication like the lack of gender-disaggregated data and of the flexibility of finance at a local level, thereby thwarting the process of deepening gender budgeting.

Way forward

Strengthening gender budgeting as a long-term Public Financial Management (PFM) tool incorporating climate change concerns and the fiscal incidence on health is crucial. Thus, gender budgeting is a powerful tool of fiscal transparency and accountability to translate gender commitments into budgetary commitments incorporating climate change concerns and health. However, in the post-pandemic fiscal space, gender budgeting needs to be strengthened further to link the "resources to results".

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9. Paryavaran Sakhi Model: A Sustainable Community-Led Solution to Manage Solid Waste in rural Himalayan Region

Contributed by: Waste Warriors Society, Uttarakhand

India faces a severe waste management crisis requiring immediate attention and action. This issue goes beyond environmental concerns, posing significant threats to climate change, public health, agriculture, food security, groundwater quality, and wildlife. Local communities, particularly women and children, are the primary victims, facing economic and cultural losses.

Mass tourism exacerbates the challenge in the Himalayas, an eco-sensitive, biodiversity hotspot. Tourism-related activities in the Indian Himalayan Region generate 8.4 million metric tons of waste annually, with projections indicating a rapid increase.

In the Ramnagar region, although tourism provides livelihood opportunities, it fails to accommodate women who require flexible hours due to family obligations. Climate change further affects agriculture, limiting crop yields and increasing food expenses. The instability of agriculture-generated income adds to women's burdens, necessitating a shift away from traditional gender roles for economic empowerment.

In Jim Corbett Tiger Reserve, Ramnagar, Uttarakhand, Waste Warrior's community-based entrepreneurial initiative, the *Paryavaran Sakhi Model* (translating to Female Friends of the Environment), represents sustainable change. This initiative addresses the waste crisis in the *Indian Himalayan Region* through community empowerment, gender equality, and inclusive livelihoods. Started formally in 2021, this model engages women from diverse backgrounds, equipping them with entrepreneurial roles for effective waste management despite social barriers, gender norms, and limited livelihood opportunities.

Operational in *Kaniya, Ringora, Himmatpur Dotiyal, Dhikuli, Kyari, Sawal Deh East,* and *Sawal Deh West,* the model has 21 dedicated *sakhis* (local women) across these seven panchayats, one of which is a Van Panchayat. These 21 *sakhis* are a part of 5 Self-Help Groups (SHGs). *Sakhis* collect dry waste door-to-door, segregate it in designated waste banks, and sell recyclable waste. They also lead awareness campaigns, maintain records, organize cleanup drives and discussions, bale waste, and recruit new community members.

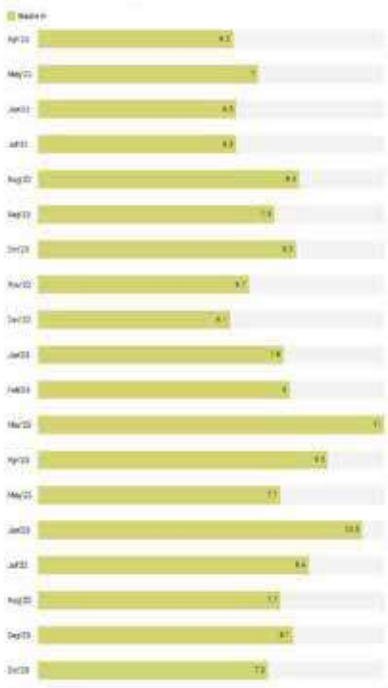
Beyond monetary gains, this work grants them recognition in their communities and by government bodies. Initially met with scepticism, the model's success relied on ongoing community engagement and education regarding women's roles in habitat improvement.
Women now earn wages from user fees generated from door-to-door collection and sale of recyclable waste.

“It isn’t just about money. It is the maan-samman [respect] our work garners that drives us every day. This work has given us an identity in the society as well as our homes,” says Paryavaran Sakhi Karishma.

Through this model, Waste Warriors lead grassroots change. In 19 months (April 2022 to October 2023), *sakhis* collected over 148 metric tonnes (MT) of solid waste, with 53MT sent for recycling from seven panchayats alone in Ramnagar block, Nainital district. This effort preserved 1.4 hectares of land, reduced 10.4MT of CO2 emissions, 4.1 MT of methane emissions, and protected 135 trees from being felled.

Planned for independent operation in partnership with rural government institutions, the model aims to comprehensively address the Himalayan waste challenge. Adaptable and scalable, this initiative promises a brighter, cleaner future for women and their families, emphasizing waste management's vital role in rural development.

Monthwise total waste collected by Paryavaran Sakhis (April 2022-October 2023) (in metric tonnes)



Monthwise Income under Paryavaran Sakhi Model (April 2022-June 2023)

We aim to expand operations in collaboration with government bodies at the panchayat, block, and district levels. Presently engaged in seven panchayats with 21 *Paryavaran Sakhis*, significant progress has been made. Over the next 12 to 18 months (from November 2023 onwards), we plan to extend operations to all 53 Gram Panchayats in Ramnagar. This includes the active engagement of *Paryavaran Sakhis* in educating visitors in the Jim Corbett region about sustainable tourism practices and waste management initiatives.

10. Addressing Nexus of Climate Change & Children's Education & Health: Dettol's Climate Resilient Schools

Contributed by: Chris Varghese and Komal Goswami, Reckitt, India

In response to the escalating impacts of climate change, particularly in states like Uttarakhand, where factors such as melting glaciers and seismic activity exacerbate vulnerabilities, the Dettol Climate Resilient School Project was initiated. This initiative aligns with India's broader Mission LiFE, launched by Prime Minister Narendra Modi at COP26 in 2021.

Mission LiFE alludes to seven themes including: Save Energy, Save Water, Say No to Single Use Plastic, Adopt Sustainable Food Systems, Reduce Waste, Adopt Healthy Lifestyles, and Reduce E-waste. Though launched in 2022, this movement received its due recognition during India's G20 Presidency where the concept of One Health was reinforced in all the processes. India taking up the G20 Presidency in December 2022 embarked on the era of Amritkal, the 25 years head start to 100 years of Independent India.
Before implementing the school-based interventions, Reckitt, in collaboration with local stakeholders, developed the Climate Resilient Index. This tool was crucial in assessing and enhancing climate resilience across India's northeastern states. The index, which grades regions on adaptability, resilience, and vulnerability, helped to identify areas most in need of intervention and will have long-term impact on the creation of sustainable policies.

The Climate Resilient Schools

In accordance with Mission LiFE, to address climate change's impact on children and create a cadre of environmentally conscious and responsible children, Reckitt in close collaboration with the State Government of Uttarakhand established India's first series of climate-resilient schools under Dettol's Climate Resilient School Project in four Dhams of Uttarakhand. By retrofitting with solar panels, energy-efficient lights and fans, low-flow water fixtures, and waste management, these schools have achieved a 65% reduction in water with a substantial drop from 4.2 litres per day per student, and a 64.5% reduction in

electricity units' charges resulting in a significant reduction of 535g of CO_2 emissions per month.
The school students are sensitised to the impact of climate change and best practices to protect themselves and the planet on the basis of the Dettol Climate Resilient School Preamble which encourages children to commit to environment-friendly actions for a greener and healthier tomorrow.
Children are educated through participatory activities and behavioural nudges such as:

- Children's Climate Champion
- Children's Climate Parliament of Char Dhams
- Plastic Waste Management and Composite Pit in School
- Science Lab to familiarise local flora and fauna
- Eco Sensitisation Trips and AR/VR experience in school
- Char Dham Climate Change Cohort will include the mothers of the school children thus taking the message to the communities as well

Dettol Climate Resilient School also launched 1300 Mission LiFE scholarships for children demonstrating the ethos of Mission LiFE. In collaboration with Uttarakhand's OHO Radio, Reckitt recently implemented a full-fledged climate change resilient awareness campaign across 43 schools in 13 districts of Uttarakhand reaching 25,000 school children in person.

Future Possibilities

The introduction of these climate-resilient schools has led to marked improvements in school attendance and student engagement in environmental protection. Furthermore, the Government of Uttarakhand is planning to scale the Climate Resilient School initiative across all districts of Uttarakhand. This case underscores the potential for education-centred interventions to not only mitigate the effects of climate change but also to empower the next generation to lead such efforts, ensuring the sustainability of these adaptations.

- Mission LiFE (Lifestyle for Environment)[11] nudges the global community towards mindful and deliberate resource utilization and practice a lifestyle that is synchronous with nature without harming it based on seven themes of Save Energy, Save Water, Say No to single-use plastic, Adopt Sustainable Food Systems, Reduce Waste, Adopt Healthy Lifestyles, and Reduce E-waste.
- Based on the concepts of Mission LiFE, and akin to the 3Cs of Detol's Climate Resilient Schools, to protect children from the impact of climate change on education, it is important to retrofit the schools' campuses which are vulnerable to

[11] https://missionlife-moefcc.nic.in/aboutLiFE.php

climate hazards with solar panels, energy-efficient lights & fans, low flow water fixtures, waste management, climate-resilient WASH facilities, thereby transforming the school campuses to become climate-friendly in terms of water, energy, waste, biodiversity and carbon emissions.

- Climate-proofing education, be it in the form of school infrastructure or incorporating Mission LiFE-inspired school curriculum/ STEM-based curriculum to mould children to become environmentally responsible individuals in every walk of their lives is critical.
- The STEM-based curriculum[12] should encompass the themes as follows:
    - The science – How the planet works, and how human activity is affecting the climate.
    - Disaster response – What to do in case of flood, fire, hurricane, etc.
    - Environmental challenges – Understanding the relationship between the climate crisis and biodiversity loss, plastics, the hole in the ozone layer, etc.
    - Solutions and action – Policies, processes and technologies; green skills; how to make change at home, in your wider community and around the world.
    - How to take care of the health of oneself and family through adequate hygiene and sanitation practices during a climate-induced event

[12] UNICEF CCRI report, 2021

11. How men and women cope with weather-related agricultural production risk: A case study of cereal and tomato farmers in Haryana

Samyuktha Kannan, Wageningen University and Berber Kramer, International Food Policy Research Institute

Introduction

Climate change threatens to increase the frequency of adverse weather events and reduce agricultural productivity, particularly in warmer regions of the world (Ortiz-Bobea et al 2021). In developing countries, where a large portion of the population depends on agriculture for their livelihoods, harvest failures are the most commonly reported income shocks faced by smallholder farming households (Dercon 2002). Households employ several strategies to prepare for income risks ex ante and cope with their consequences ex-post. Ex-ante *risk management* strategies such as reducing or forgoing investments can prevent the accumulation of productive assets and trap already poor households in persistent poverty (Carter and Barrett 2006). Ex-post *risk coping* strategies such as increasing borrowing or reducing consumption can have negative implications for welfare (Eastin 2018).

Studies show that the consequences of risk are often not distributed equitably within a household, with women disproportionately bearing the negative impacts of weather-related shocks (Asfaw and Maggio 2018). In this case study, using quantitative and qualitative primary data, we investigate whether risk-coping strategies are different across genders within farming households in the Indian context. We explore whether risk-contingent social protection strategies such as crop insurance can be a solution to mitigate impacts, and what features could make such strategies more effective for vulnerable groups such as women. The shared findings draw on research around a digital crop insurance innovation in Haryana between 2018 and 2023 (Ceballos, Kramer and Robles 2019).

Context and study design

Located in the hot semi-arid trans-Gangetic plain of India, Haryana is one of the most agriculturally advanced regions in the country but continues to lag behind on indicators of women's empowerment, including sex ratio and literacy among women. Over 90% of land cultivated in this region is irrigated and the vast majority of farmers cultivate rice and wheat, which are relatively risk-free crops (Govt. of Haryana 2022). However, in recent years, with rapid depletion of the water table, and an increase in unseasonal rain, crop failures due to drought, excess temperature, lodging, and pests and disease become more common (Yadav and Rai 2001). Susceptibility to production (and price) risk is also one of the major hurdles preventing farmers from transitioning from rice and wheat towards more nutritious and sustainable cropping systems (Basu 2024). Despite the availability of a subsidized national insurance program for several crops, very few farmers are insured against catastrophic weather-related crop damage due to poor awareness and perception of crop insurance and difficulty in assessing losses accurately, among other reasons (Khan et al 2019; Kramer et al, 2022).

This case study draws on data from a multi-year experimental impact evaluation of an ICT-based crop insurance innovation, led by the International Food Policy Research Institute (IFPRI) and implemented in partnership with the Borlaug Institute for South Asia (BISA). In preparation for this evaluation, we conducted qualitative and quantitative surveys assessing risk profiles and coping strategies of tomato, wheat, and rice farmers in Karnal,

Kurukshetra, Yamunanagar, and Panipat districts between 2017 and 2020. We invited 1664 randomly sampled farmers cultivating less than 15 acres from 100 villages to participate in the study. The male and female heads of each household were each interviewed separately at baseline, prior to insurance program implementation.

Main findings

(i) Women suffer the consequences of agricultural production shocks differently than men.

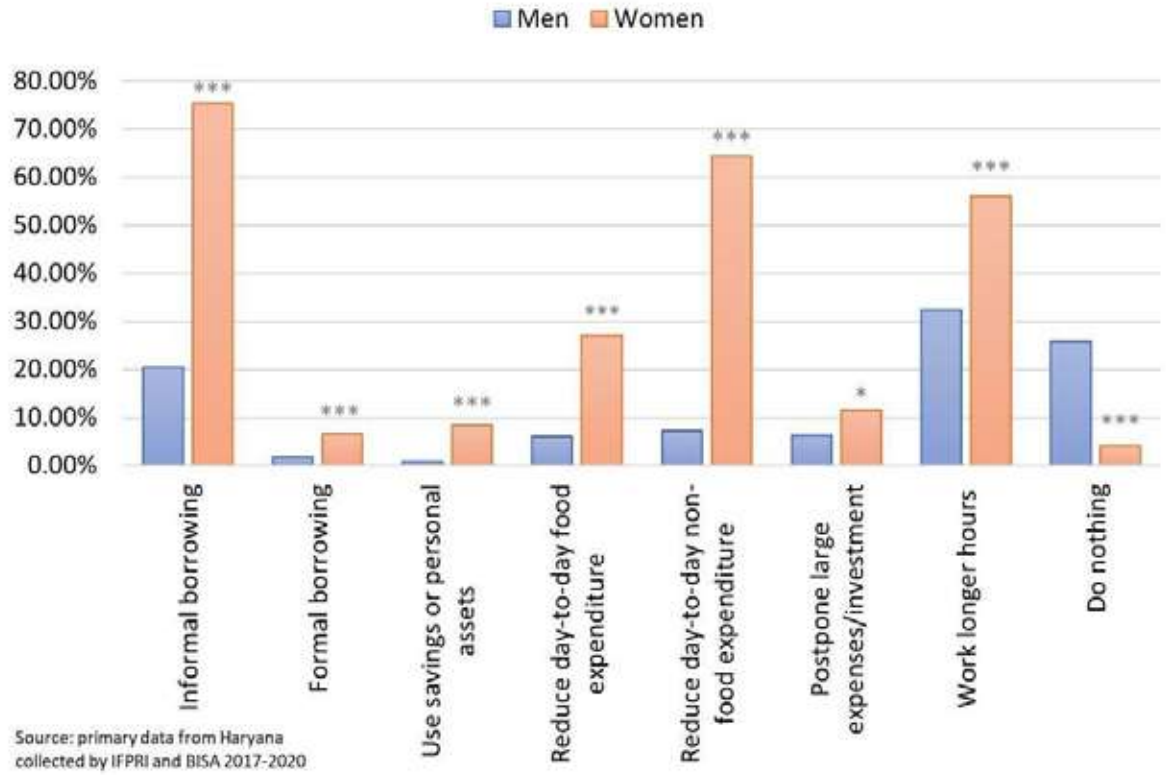


Figure 1: *Differences in coping strategies to weather-related crop production risk among men and women.*

While most women in the study region did not play an active role in agriculture, most were aware of production losses suffered and supported their households to cope with shocks. Adopted coping strategies differed vastly between men and women, with women often assuming primary responsibility for smoothing income and consumption. In a subset of 555 households where both male and female respondents reported crop losses, women were significantly more likely than men to borrow (mostly from informal sources of credit such as kins and community networks), reduce food and non-food expenditures. and seek additional work. Women were 55% more likely to borrow informally from kinship and community networks, 21% more likely to reduce expenditure on food or eat less, 57% more likely to reduce expenditure on non-food consumables such as clothes and 24% more likely to seek additional work. Qualitative research revealed that men typically shared information on financial constraints with women and expected them to identify ways to manage household expenses including during income shocks (Misra et al., 2020).

*Stars represent the significance of gender co-efficient of a within-household fixed effects regression with errors clustered at the village level. * p<0.1 **p<0.05 ***p<0.01*

(ii) Horticulture producers are more susceptible to negative consequences of production risk

Damage due to extreme weather and other weather-related factors such as pests and diseases was more common in horticulture crops, with over half of farmers reporting crop losses in the last 12 months (2016-17) in the case of tomato, compared to less than 25% in the case of rice and wheat. Tomato growers farmed on smaller landholdings of 0.5-1 acre and 96% were tenant farmers or sharecroppers with little access to government subsidies and loans. Compared to women from rice and wheat-growing households, women from tomato-growing households were significantly less empowered[13] (33%), were less likely to belong to women's groups (2%) and were far more likely to report suffering from health problems (44%) and experience tension in the household (94%) after crop loss events. These findings are likely to be further exacerbated by price risk also common in horticulture markets.

***(iii)* If formal financial instruments such as crop insurance are to be a solution, they need to better serve women and a diverse range of crops**.

Crop insurance and social protection tied to crop damage such as conditional cash transfers can help farmers better cope with losses without having to rely on informal borrowing. However, such programs are currently not aimed at women, are not easily available for horticulture crops and suffer from low take-up overall. In a separate exercise conducted with 100 households in 2017, we found that willingness-to-pay for insurance[14], for both commonly available weather-index-based insurance and novel indemnity insurance piloted by IFPRI, was significantly lower by about 20% among women. Key barriers reported by women included lack of access to information, low mobile ownership to use ICT-based methods such as mobile money to transact, lack of trust in financial institutions, low ownership of land and low decision-making power in agriculture.

Way forward

Our findings support a large body of research indicating that when uninsured, agricultural production shocks from climate change can have serious welfare consequences that often disproportionately impact women. Differences in access to resources, institutions, information, and decision-making power reduce the adaptive capacity of women (FAO, 2011). If crop insurance is to play a role in reducing the negative welfare impacts of crop damage, it needs to be redesigned in a manner to reach disadvantaged populations – including women and horticulture producers – despite these constraints. Although traditional crop insurance is heavily restricted by regulation, governments and financial intermediaries can explore novel financial tools such as risk-contingent credit, state-contingent cash transfers to women or collective insurance of women's groups, and leverage technology to improve the supply of affordable insurance for horticulture and nutrient-dense crops. Stronger evaluations of the performance and effectiveness of these solutions are areas for further research

[13] Scored 0 in an index based on 3 dimensions of the Women's Empowerment in Agriculture Index (WEAI) (Malapit et al. 2019) indicating that they were not empowered in any of the dimensions of instrumental, intrinsic or collective agency

[14] Willingness-to-pay was estimated using an incentivised Becker-DeGroot-Marschak mechanism

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12. Transforming Agriculture in Meghalaya through Sloping Agriculture Land Technology (SALT) Implementation

Contributed by: Sauramandala Foundation, Meghalaya

Caption: Farmers holds the seeds of plants used as part of SALT farming

In the hilly regions of India's North-Eastern states, shifting cultivation—commonly known as "slash and burn" or "jhum"—has been the backbone of subsistence agriculture for generations. However, this traditional method has been scrutinised due to environmental impacts and reduced agricultural yields. Jhum involves clearing forested land by cutting down vegetation and burning it to enrich the soil. Although this method was sustainable in the past, rapid population growth and increased pressure on land have shortened fallow periods, reducing soil fertility, increasing erosion, and negatively impacting local biodiversity.

Environmental degradation from *jhum* has been a concern due to air pollution, deforestation, and soil erosion, leading to landslides and other natural disasters. Furthermore, shifting cultivation has yet to keep pace with changing climatic conditions, leading to unseasonal and erratic rainfall, further complicating agricultural practices. The decrease in crop yields and a lack of interest among the younger generation in practising traditional farming have triggered a crisis in the hill communities.

Given the matrilineal societies in Meghalaya, where women play a significant role in agriculture and household management, the impact of agricultural decline has broader social repercussions. Food insecurity and malnutrition become serious issues, affecting children's development and women's health. With limited employment opportunities in the region, many people are compelled to migrate for work, creating additional stress on families and communities.

Intervention

To address these challenges, Sauramandala Foundation, with support from the Meghalaya Basin

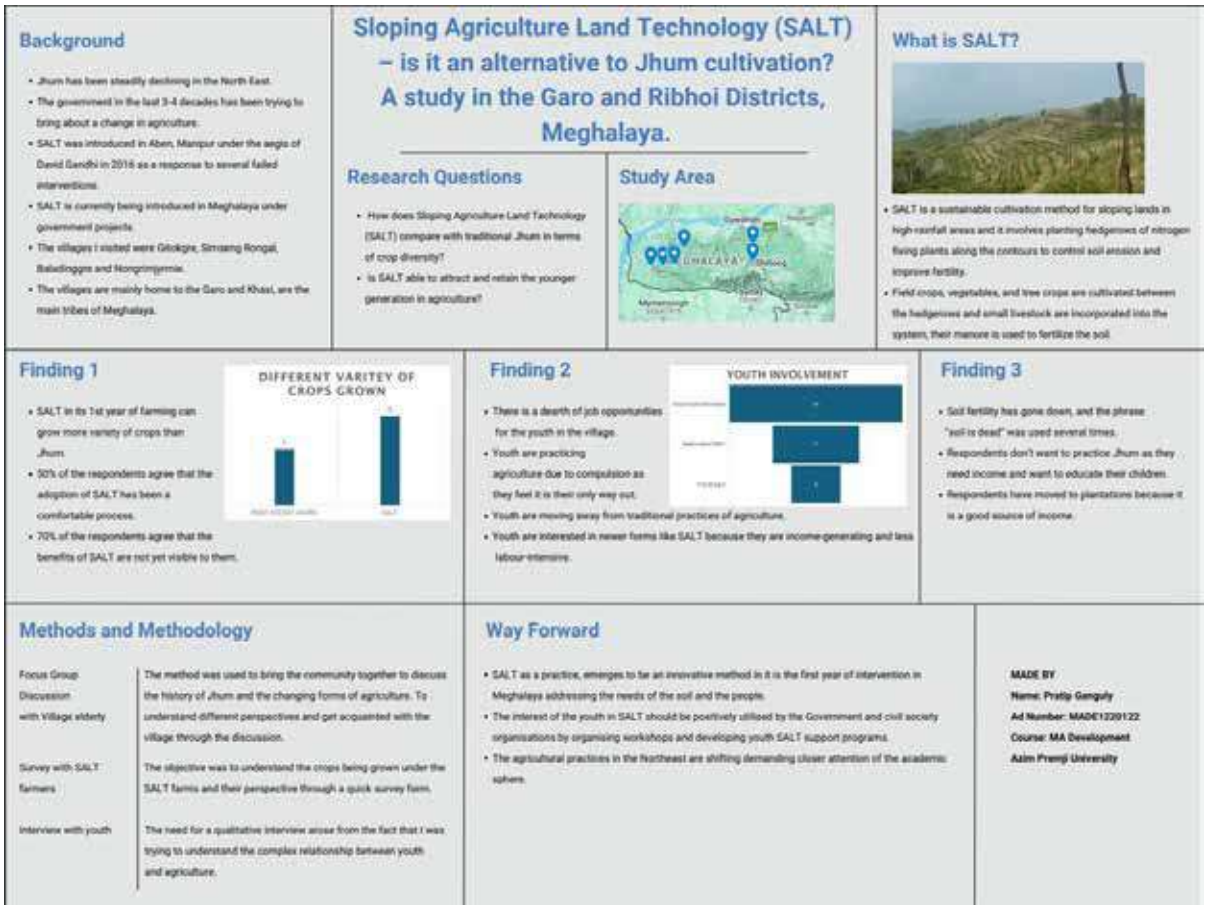
Picture: *David Gandhi demonstrating the use of A-frame to trace contour lines*

Development Authority, engaged Mr. David Gandhi, an expert in Sloping Agriculture Land Technology (SALT), to provide a sustainable alternative to *jhum*. SALT, initially designed for sloping terrains with high rainfall, focuses on controlling soil erosion and enhancing soil fertility through contour planting and agroforestry techniques. By planting hedgerows of nitrogen-fixing plants along the contours, SALT reduces erosion and improves soil quality. It incorporates a mix of field crops, vegetables, tree crops, and small livestock, providing a balanced and sustainable system.

In April-May 2022, the Meghalaya Basin Development Authority and Sauramandala Foundation collaborated to conduct seminars and field training on SALT, culminating in establishing 80 demonstration plots across Meghalaya's agro-climatic zones. This project has shown that SALT can be a viable alternative to *jhum*, offering sustainable livelihoods for farmers while preserving the environment.

Results and Challenges

A study by Mr. Pratip Ganguly from Azim Premji University highlighted the benefits of SALT. Of the 40 respondents from a batch of 90 farmers who participated in the first pilot, 50% found the adoption process comfortable, and 70% noted that SALT's benefits were not immediately visible but improved over time. Furthermore, adopting SALT led to a broader variety of crops and a greater focus on sustainable practices.



Despite these successes, the scaling of SALT poses challenges. Sustained training and capacity-building among farmers are essential, as is ensuring access to necessary resources such as seedlings for hedgerows and livestock. Moreover, traditional farmers need financial assistance and technical guidance to transition from *jhum* to SALT.

Way forward

After the pilot programs' success, SALT has become a cornerstone in Meghalaya's efforts to promote sustainable agriculture. The state's reliance on agriculture and allied activities as a primary livelihood source makes SALT an ideal landscape management and restoration solution. With continuous training and capacity building of the cultivators particularly young farmers, facilitating technical support for them, engaging government actors and generating awareness on the potential of SALT, mobilising finances and scaling it to other areas in Meghalaya and other hilly regions of the northeast can become vital to the long-term success of this sustainable agriculture method. Additionally, involving local communities and integrating SALT into broader sustainable development goals is crucial. Collaboration with local stakeholders, non-governmental organisations, and educational institutions can help foster innovation and ensure best practices are shared widely. By addressing the socio-economic aspects and offering opportunities for youth, SALT can become more than just a farming method; it can be a means to revitalise communities and provide a sustainable future.

13. Empowering Manipur's Fishing Communities: Securing Rights in the Face of Climate Change

Contributed by: Pradip Phanjoubam, Journalist, Manipur

The vulnerability of Manipur's fishing communities, particularly women and children, is exacerbated by climate hazards, notably changes in weather patterns and environmental degradation. This is observed in Manipur's Loktak Lake, with small huts on floating islands which have been given the collective nomenclature of Champu Khangpok, with a little over 134 households. Unlike farmers, fisherfolks including those residing at Champu Khangpok, have not been given any official identity or basic landed property entitlements as they live on water. Any change in policy and land revenue can impact their lives and leave them displaced.

The sense of vulnerability of this community is also on the rise in recent times, given the increase in the government's priority on tourism. Tourist-friendly alteration of landscapes or reservation of expanses of waterbodies for the purpose have expectedly affected them, and as observed in Loktak's floating islands again, they have ended up evicted as encroachers as they hold no land deeds. Climate change further exacerbates their vulnerability and threatens their livelihood, by affecting marine life - disappearances of unique species of fishes and aquamarine vegetation, and the uncertainty of the cycle of seasons and the rainfall patterns. Deforestation in the river catchment areas in the mountains greatly reduces the water retention capacity of soils on the hillsides. The consequence is that monsoon water is discharged almost immediately, making rivers less perennial. The other consequence of deforestation in the catchment areas is, that it causes greater soil erosion and therefore greater sedimentation on the riverbeds and lake bottoms. Rivers and lakes hence tend to get shallower but also breach their banks more.

These shifts have adversely affected the fishing communities in these regions. Women in Manipur's fishing communities bear a disproportionate burden as they are primarily responsible for managing the household and caring for children. While men engage in physically demanding tasks such as setting up fishing nets and harvesting catches, women play a crucial role in processing and selling the fish. They often commute to markets on land to vend the catches, ensuring a steady income for their families. This division of labour places additional pressure on women, who must balance the demands of earning a livelihood with their caregiving responsibilities.

Way forward

It is imperative to provide official recognition to the fishing communities of Manipur and ensure they receive commensurate constitutional entitlements and protections. This recognition would not only validate their existence and contributions but also safeguard their rights and livelihoods against external pressures, such as tourism development and environmental changes. Additionally, constitutional protections would empower these communities to assert their rights and interests in decision-making processes concerning their land, resources, and well-being. By acknowledging the importance of their occupation and securing their rights, policymakers can promote the sustainable development and resilience of Manipur's fishing communities for generations to come.

14. Climate Change Impact on Education of Children in Assam

Contributed By: Enakshi Dutta, Roots to Branches Foundation

Assam, India's most climate-vulnerable state according to CEEW's 2021 assessment, experiences significant impacts from climate change, including earthquake risks and severe flood threats. Annually, floods affect about 3.9 million people, causing average economic losses of INR 1,186 crore from 2010-2020. New areas, unprepared for climate-induced floods, are increasingly affected, escalating challenges across the state.

Particularly vulnerable are children; UNICEF ranks India 26th out of 163 in its 2021 children's climate risk index. While systematic research is lacking, it is clear that climate change profoundly affects the education system, hindered by both fast-onset natural hazards (e.g., floods, cyclones) and slow-onset (e.g., droughts, environmental degradation and pollution).

In 2023, Roots to Branches Foundation conducted a gender assessment study in Assam's highly vulnerable districts, Dhemaji and Morigaon, to deepen understanding of climate change impacts. Dhemaji frequently faces floods and erosion, while Morigaon is susceptible to multiple hazards including floods, cyclones, droughts, landslides, and river erosion. Stakeholders particularly highlighted how climate change affects the education system in these areas.

The study's primary stakeholders included children and youth aged 15-20 (boys and girls), and women aged 21-65 from vulnerable social and economic groups. Secondary stakeholders were community influencers like PRI representatives, teachers, religious leaders, and SHGs, as well as officials from Disaster Management and Women and Child Development departments. Civil society organisations at district and state levels were also involved.

Key findings of the study:

1. Education-related issues


School buildings devastated by floods

- **Access to Education:** In Dhemaji, floods disrupt children's education for 2-5 months due to submerged roads and lack of affordable transport, often limiting options to boats. Post-flood, damaged roads further hinder access, particularly for girls, forcing many to relocate for school, and heightening safety risks. Boys moving to towns unsupervised face increased risks of dropping out and even engaging in substance abuse.
- *"Girls usually do not study till the 10th standard as their riding the bicycle to Mayong and Jhargaon which is between 11-13 km is difficult." - Adolescent girl from Morigaon*

- **Learning Loss:** Children in flood-prone areas annually miss at least two months of school due to floods, resulting in significant learning loss. Floods disrupt utilities, leading to school closures for up to six months, and damage structures, while also destroying educational materials which many families cannot afford to replace. The ensuing lack of electricity often forces the use of expensive kerosene lamps, further widening educational gaps reported in ASER assessments[15].
  - *"Online classes are not as effective in rural areas as in urban areas. Mostly due to the fact that many rural families cannot afford sufficient smartphones required to access online education. Lack of network and electric connections during floods also affect the implementation of such programmes. Even children, whose families manage to buy a smartphone with internet connection for online classes, become susceptible to the misuse of mobile phones and risk personal safety and mental health." -- Chairperson, Assam State Commission for Protection of Child Rights*
- **Dropouts:** Post-disaster, children often drop out due to family income insecurity and transport issues. Boys leave school to work on farms or migrate for income, while girls drop out post-ninth grade due to inadequate menstrual hygiene facilities and economic pressures, raising risks of early marriage or trafficking.
- **Access to higher education:** The social welfare department highlights a bias favouring boys over girls in accessing higher education in rural areas. Initiatives like Samagra Siksha Abhiyan and the National Institute of Open Schooling aim to enrol out-of-school girls, but educational opportunities remain limited for them post-high school due to distance, travel costs, and safety concerns, which discourage parents from allowing their daughters to study far from home.

[15] Pratham. New Delhi. 'Annual Status of Education Report - National Findings. January 2023. https://img.asercentre.org/docs/ASER%202022%20report%20pdfs/allindiaaser202217_01_2023final.pdf

2. Child Protection issues

- **Trafficking:** There is a heightened risk of trafficking for youths seeking work outside their regions, especially after floods in both districts. Girls are often trafficked under the pretext of employment. Although no cases of missing youths are reported, parents frequently lack information about their children's whereabouts or job details.
- **Child Marriage:** Child marriage is prevalent in communities, often accepted socially and facilitated by parental willingness, especially after girls drop out of school. This practice leads to early pregnancies and associated health risks like anaemia and malnutrition, increasing child and maternal mortality. Boys often marry young after dropping out of school to work. Elopements, common among 8th to 10th graders and aided by mobile phones, are rarely challenged by parents due to social stigma. Stakeholders note that floods heighten the risk of early marriage as families use it as a strategy to cope with poverty and reduce marriage expenses.

  *"In my 23 years of service in the police department, I observed that domestic **violence** is directly related to early marriage. Girls get married at a very young age and suddenly after marriage, their responsibilities grow along with early childbirth. They are unable to handle it and get frustrated. This leads to quarrels between the husband and wife." -* ***Police Official***

- **Safety & Security:** Girls fear moving freely, especially after dark, due to concerns about harassment and violence. Flood conditions worsen mobility, with boats being the only, often unaffordable, transport option. Pregnant women particularly struggle, with reports of boat deliveries and drownings. Additionally, inadequate sanitation and privacy in relief shelters compromise women's security.
- **Sexual abuse:** Medical officials note rare reports of rape at health facilities but confirm instances of rape-related pregnancies. The Chairperson of ASCPCR highlighted the increased risk of abuse during disasters like floods, with children confined at home and limited support. Disasters disrupt social norms, heightening sexual harassment risks for women and girls, yet many cases remain undisclosed to protect family honour. National crime records reveal consistent cases of rape and assault from 2019 to 2021 in both districts.
- **Child Labour:** Child labour is common in migrant communities, driven by school dropouts and economic needs. Children work on family farms or manage household duties, often missing school during harvest seasons. Annual floods worsen this by destroying crops and livelihoods, pushing families into poverty and compelling children, especially boys, to work.

Recommendations:

To reduce the vulnerability of children to climate impacts, multi-stakeholder engagement is crucial. Recommendations include engaging children in safety audits, enhancing their knowledge on child rights and disaster preparedness, and building multi-purpose flood shelters. Initiatives such as forming children's clubs, creating child-friendly spaces, and strengthening community-based disaster management are vital. Moreover, embedding climate change education in teacher training, integrating child protection in education programmes, raising local government awareness, and ensuring education for climate-displaced children are essential. Such actions empower children as agents of change, equipping them to enhance climate resilience within their communities and beyond.

15. Narrowing Gender Gaps and Building Adaptive Capacities: Key Learnings from Assam and Odisha

Contributed by: Rengalakshmi R and Rajkumar R, M S Swaminathan Research Foundation

The adverse impacts of climate change are deepening the existing gender inequalities in vulnerability, adoption of climate-smart technologies and associated decisions, and other well-being outcomes in Assam and Odisha, India. Specifically, access to improved technologies, knowledge, skills and agricultural extension services is limited for women compared to men farmers. Besides, they face constraints in accessing entitlement schemes including subsidies for adopting any agricultural technologies and services, since land records are the basic requirement for access, which are in men's names. The women's land ownership in Odisha is 4.1 per cent and 1.7 per cent in Assam which is far below the national average of 14 % (Agriculture Census, 2016). These gaps led to lesser participation of women in decision-making activities, access to locally-led adaptation technologies to adapt to climate change, farming systems diversification, and inadequate support for technology demystification & innovation to local context and pedagogy.

Given this backdrop, promoting context-specific gender equality strategies serves as agents of change in the adoption of climate-smart agricultural technologies to reduce climate risks. The climate-smart technologies focussed on both intensification and diversification approach in the domains of suitable varieties/planting materials, planting patterns, soil health management, irrigation regimes and plant health management considering the context-specific climate risks.

Social mobilization and organization of women and men and joint planning with bottom-up approach: Intersectoral analysis was carried out to understand the structural inequalities and organized men and women equally for all training and capacity-building initiatives with due importance to women joining the programmes without any hesitation. This strategy enabled changes in women's participation which is a sequential process by addressing the manifestations of the gendered vulnerabilities to climate change. This process was enabled with concerted actions over three to five years. In the initial years of engagement, the process started with a social mobilization and baseline assessment which helped the facilitators to understand the key issues, gendered needs and challenges. These need-based capacity-building programmes along with gender-sensitive approaches embedded in social capital played a crucial role in ensuring more than 80 per cent of women farmer's participation and gaining new knowledge and skills.

Building the capacity of women farmers on climate adaptation technologies: The number of women farmers who participated in the training programs is high because it is organized in their village, and the theme is a need-based approach that is farmer-friendly and organized at a time convenient to them. The approach of farmers' field school and championing farmers' support in facilitating a horizontal knowledge network and sharing triggered the farmers to learn the nuanced aspects of the technology and started innovating according to their available resources. The approach of community-based knowledge management processes enabled women farmers to participate in technology adoption-related discussions at the household level. The process of participatory technology demonstration to build their knowledge and skills on Climate Smart Agricultural technologies helped them to understand and gain new skills and relevant

institutional linkages in the field. As a result, 70 to 80 % of women are actively involved in agriculture marketing, production and decision-making on agronomic practices which reduces climate risks to an extent of 63 to 78 %. About 62% of women are involved in climate adaptation technologies and practices like varietal selection, seed treatment, planting methods, irrigation methods, soil and plant health management and deciding the harvest and storage compared to the baseline assessment, five years before the interventions.

***Harnessing collective power to enable women's participation*:** To overcome some of the social norms in adopting the technologies, participating in the training programmes, interacting with outsiders etc, collective power has been promoted through farmer groups or producer organizations. It enabled women to gain more skills and knowledge on new technologies which reduce climate risks. About 25 women's groups were formed in each of the field sites which helped them to address the local social norms in interacting with outside men, mobility – outside the village to the input shops, farmers training centres etc. The whole process is facilitated with the support of trained women intermediaries to provide need-based support and give confidence to women farmers and mainstreamed through farmer producer organizations (FPOs).

***Promoting digital tools for community-based knowledge management and building backwards and forward linkages**:* Besides providing necessary knowledge and information, the Village Knowledge Centres, the knowledge hub and the local facilitators extended post-training support services to adopt the learning including access to quality inputs, market information etc. The knowledge hub regularly maps the gendered needs of farmers within and across seasons, thus enabling them to extend demand-driven, and value-added knowledge systems that support them to make informed decisions. The knowledge hub plays a significant role in providing a platform for women to improve their capacity and skills in carrying out their agricultural operations by employing different innovative digital technologies and building linkages with institutions thereby promoting sustainable agriculture and improving their livelihoods. They can articulate their views on various things. They go to KVK and the agricultural department to get inputs and avail the subsidies. Their participation in the knowledge hub level programme has given them clarity in thinking and improved speaking skills. They now interact with others without any fear or inhibition and feel confident. It is said that farm women are more connected with each other which helps them learn from one another. The interventions at the field level brought the farmers together and evolved as a farmer collective to increase the economy of scale. Now, they have linked the community-based agro-advisory system as a bundled service along with other services of the farmer collective.

The combination of such contextualised strategies with higher investments in social capital and horizontal networks at the grassroots level helped mobilizing women farmers around the climate-smart technologies, information and linkages to different types of institutions to sustain the actions. Apart from direct impacts on women farmers in agricultural production, the deeper engagement resulted in changing gender relations in the following critical areas:

1. Reduced violence against women and receiving good recognition from the family and society and important social norms have changed (women's mobility, interaction with outsiders, speaking in public meetings, involvement in marketing etc)
2. In more than 70 % of households,' financial transactions are managed by women but in the decision-making process, both are involved. Now women's voices have

increased, men are consulting women – on agricultural operations and domestic activities

3. Mobility - There is no restriction for women to participate in meetings outside the villages and even at the district level irrespective of age group.

Picture: Audio conference - Collective learning, Ganjam Odisha

The above strategies are process-based and context-specific and done with closer facilitation in a partnership approach. Such action needs a medium to longer term to bring changes in gender relations, which is gradual and needs investment in terms of time for contextualization and support to facilitate backwards and forward linkages in adoption. Also, the interventions are to be mainstreamed through the knowledge hub, a platform for them to come together in the village to bring sustained changes.

The crucial areas that need attention are:

Financial and managerial sustainability of the knowledge hub: how far the FPOs have strengthened themselves to support these women intermediaries. In this case, strengthening the FPO is very crucial in taking the knowledge hub further.

Sustaining the partnership values with institutions: Engaging and working with the win-win approach with boundary partners are crucial in sustaining the momentum and getting continued support from them. The conflicts with local institutions will offset the development over a period which the centre gained.

Right attitude and capability of the facilitators: The facilitator has to play a neutral and unbiased role while linking the farmers with different institutions and partners. Need to bring win-win conditions for partners and act without any conflicts among individuals and institutions.

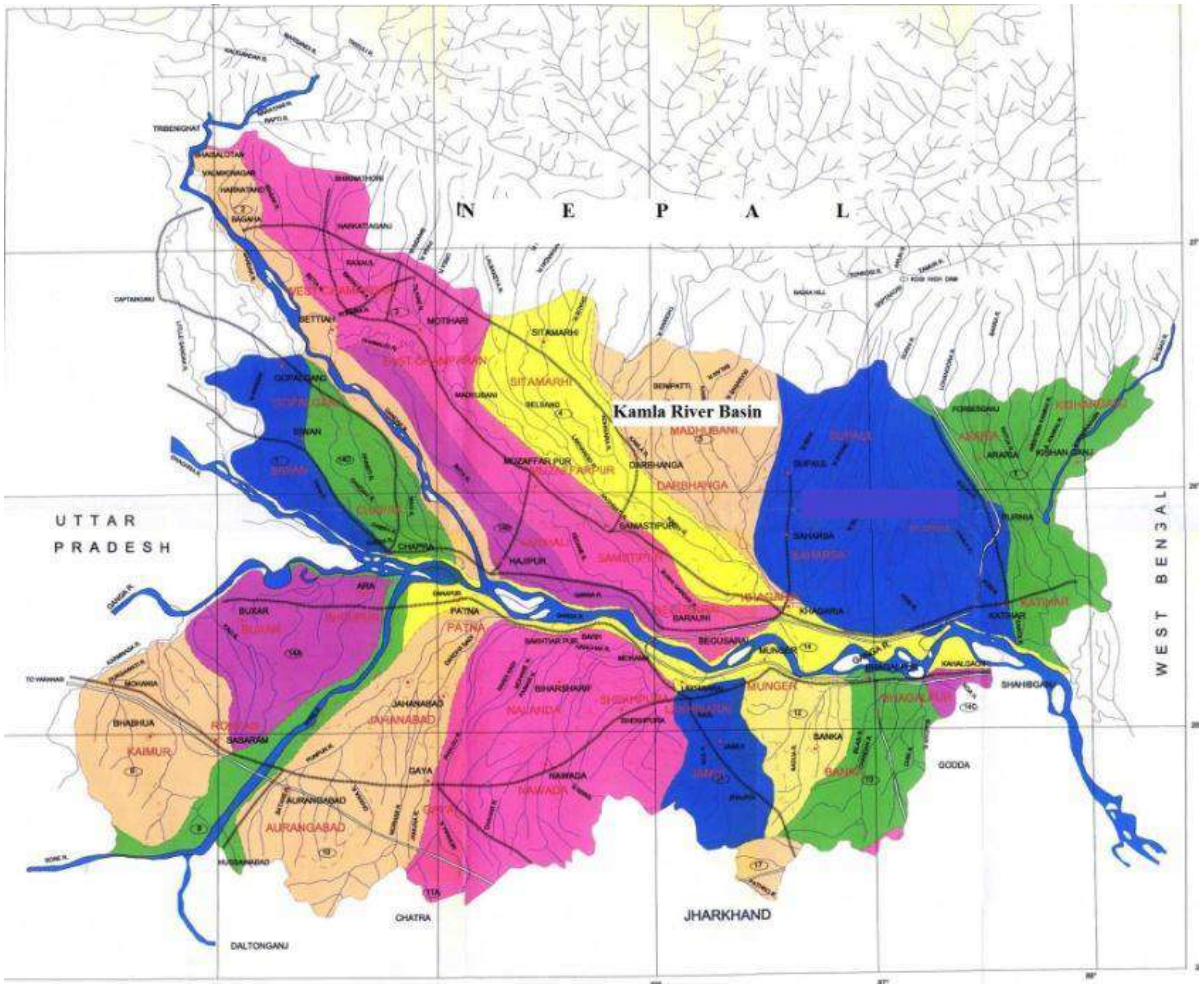
Source: *Learning's from the RESILIENCE Project implemented in Assam and Odisha with the funding support of The Royal Norwegian Embassy, New Delhi.*

16. Lessons from Indigenous Wisdom: Insights from Rural Bihar's Marginalised Communities Towards Climate Resilience

Contributed by Nidhi Jamwal, Journalist. Reports on Environment, Climate and rural issues

Bihar is India's most flood-prone state. Due to its geographical location in the Indo-Gangetic Plains of Northern India, it faces recurrent floods due to the convergence of many rivers, often originating in Nepal, entering the geographical expanse of Bihar, leading to frequent floods in nearly 28 out of 38 districts in Bihar. Nearly 76 per cent area of North Bihar and 73 per cent of South Bihar is flood-prone, according to the state government's Water Resources Department.

The floods are not limited to the monsoon season alone, according to a study "*Post Disaster Recovery: Assessment of Needs in Moderate Flood Conditions",* carried out by non-profit Megh Pyne Abhiyan. The study found that in the Pashchim Champaran, Khagaria, and Saharsa districts of North Bihar, the small, *pahadi* rivers on the India-Nepal border report flash floods up to 50-60 times in a year.



Source: Water Resources Department, Government of Bihar

Compounded by climate change and changing rainfall patterns, the region also poses a dual risk of floods and droughts, severely affecting the health and livelihoods of its inhabitants, particularly rural women and children. Floods not only disrupt daily life but also exacerbate existing challenges faced by vulnerable communities. Rural women, in

particular, are at heightened risk during such disasters due to factors such as lack of access to safe sanitation facilities, health hazards, and economic instability caused by crop and infrastructure damage.

For centuries, the local communities in North Bihar have been dealing with recurrent floods, and have thus developed indigenous methods of responding to the threats climate change impacts pose to their livelihoods and health. Similarly, several civil society organisations are also finding solutions in ancient knowledge to address climate change.

Following are three case studies on climate resilience from north Bihar, based on best practices of applying indigenous wisdom to reduce community vulnerabilities to climate change impacts in Bihar.

Megh Pyne Abhiyan's Phaydemand Shauchalaya (Ecosan Toilets)

During the flash floods in North Bihar, millions of rural women and young girls in North Bihar suffer during these natural disasters as they have no access to a safe spot for *maidan jana* (a local term for defecation) during the floods. Recognising this, Megh Pyne Abhiyan's Phaydemand Shauchalaya (Ecosan Toilet), meant for flood-prone areas, and is becoming popular among rural women in Paschim Champaran. This toilet has two specially-designed ecosan toilet pans placed above two concrete chambers, which are divided by a wall. The toilet and its chambers are constructed on a raised platform. This ensures that even during an extreme flood event, these toilets remain operational.

Each pan has a 10-inch diameter space in the centre, which leads to the chambers below, where the faeces are collected. Sloping away from this open space are two basins at the front and back with their own drainage. These collect urine and wash water, separately. After defecating, the user sprinkles some ash or sawdust on the faeces and closes the lid of the excreta hole. However, to prevent insect attack, not even a drop of wash water or urine should get inside the excreta chambers.

One chamber of the ecosan toilet is used for the first five to six months, and once that is full, the user shifts to the second chamber. Moreover, these ecosan toilets offer dual benefits, as beyond offering a safe place for defecation to rural women, they also convert human excreta into organic manure, offering a sustainable agricultural resource and reducing dependence on costly fertilizers.

Flood-compatible Paddy Cultivation in Saharsa District.

In response to the threat posed by climate change on food crops and agricultural productivity, there's a growing recognition of the importance of cultivating traditional crops that exhibit resilience to environmental challenges. Among these, indigenous flood-resistant rice varieties like Desariya dhan have emerged as crucial assets, particularly for marginalized communities such as the Musahar in the Saharsa district.

In Sahorwa village, home to 110 Musahar families, the annual flooding caused by the nearby Kosi and Kamla Balan rivers presents a persistent challenge. Situated between these embankments, the village remains submerged for seven to eight months each year. To secure food for their families amidst these conditions, the villagers have turned to cultivating Desariya dhan, a local rice variety well-adapted to their flood-prone environment.

Desariya dhan, believed to have evolved from wild rice strains in the eastern Indo-Gangetic plains, including the floodplains of Bihar and Uttar Pradesh, belongs to the genus Oryza. Remarkably, this rice variety can thrive even in floodwaters reaching depths of five to six feet. As flood levels rise, so does the stem of the plant, ensuring its survival. The rice grains of Desariya dhan are known for their robustness and coarseness, coming in three distinct

types: white, black, and a mixed variety of black and white grains, known as cheeta or barogar dhan.

Silt Farming in North Bihar

In North Bihar, floods are often perceived as calamities that bring destruction to livelihoods and properties. However, amidst this perception lies a crucial aspect often overlooked: floods also serve as a source of sustenance for millions of farmers through a practice known as silt farming. This traditional method has been a lifeline for farmers inhabiting the *diaras* of North Bihar for centuries.

Diaras, essentially island deltas within rivers formed by the deposition of sand, are integral to this unique farming system. These lands, belonging to the river, submerge during the monsoon season when rivers swell. However, post-monsoon, diaras resurface, providing fertile grounds for landless farmers to cultivate various crops. Agricultural experts highlight the significant benefits of floods to agro-productivity in diara areas. Floodwaters not only deposit nutrient-rich silt but also aid in pest control, contributing to the overall health of crops.

During the rabi (winter) season, landless farmers take advantage of the sandy soil and good drainage characteristic of diara lands to sow a variety of crops such as cucumber, watermelon, muskmelon, bitter gourd, bottle gourd and pointed gourd. By April and May, when the produce is ripe, farmers transport their yield to local markets, generating income for their families.

Way Forward:

Amidst the various challenges posed by climate change, the ancient indigenous methods practiced by the rural communities, for example in Bihar offer valuable insights into sustainable adaptation strategies. By harnessing traditional knowledge and wisdom, particularly in flood-prone regions like North Bihar, we can uncover innovative solutions that not only mitigate the impacts of climate change but also promote resilience and sustainability of the ecosystem.

17. Strengthening Indigenous Food Systems as a Pathway for Resilience

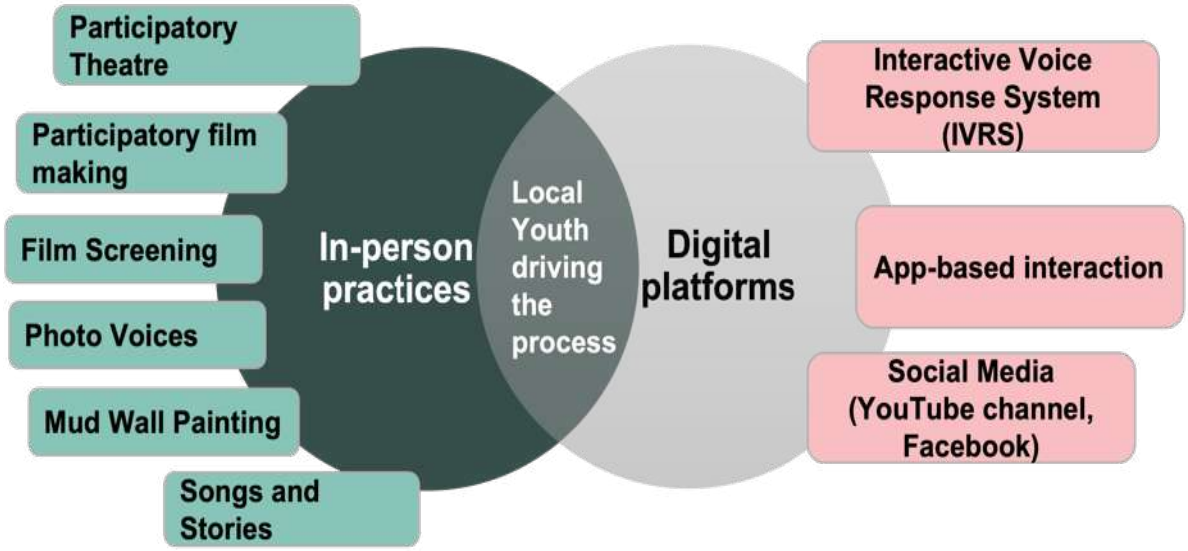
Contributed by: Nitya Rao (University of East Anglia, UK) and Arundhita Bhanjdeo (with PRADAN, during the time of this research)

Food insecurity is a "pressing public health concern" in India (Dhamija et al., 2021). Micronutrient deficiencies and lack of dietary diversity are areas of concern, particularly for women and girls, and more so amongst indigenous communities inhabiting remote rural areas (Green et al., 2016; Rao, 2023). High rates of anaemia in tribal women (64.6%; [NFHS-5; IIPS]) and tribal children (72.4%; [NFHS-5; IIPS]) in India reflect their poor nutrition and health status. The situation is exacerbated by the growing impacts of climate-induced risks including extreme weather events, water shortages and rising temperatures on yields, crop growth, soil quality, costs, and the overall livelihoods ecosystem. The State of Food Security and Nutrition in the World reports that 74 per cent of the population could not afford a healthy diet in 2021 (SOFI, 2022).

Food systems comprise activities relating to the production, processing, distribution, preparation and consumption of food (Fanzo et al., 2017). Tribal or indigenous communities living in bio-diverse regions of rural India primarily rely on their own cultivation, forest foods, government-promoted public distribution shops (PDS) and the markets to source their food. Their traditional ecological knowledge of gathering and preparing local foods that are not just accessible, available, and affordable, but also nutrient-rich, ensured resilience to climate change alongside food and nutrition security (Ghosh-Jerath et al., 2021). However, shifts in access to forests and community lands (with deforestation), production practices (towards monocropping) and diets (rise in processed and packaged foods), have invisibilised many of these local foods, leading to their stigmatisation, especially amongst youth, and the gradual erosion of indigenous knowledge and practices. In the context of climate change, and the challenges to increasing crop production, systematic integration of these local foods into the calorie-dense national food systems is an important pathway to building the resilience of food systems and ensuring food and nutrition security of rural tribal communities.

Participatory Action Research for behaviour change towards sustainable food systems and dietary diversity:
In the Santal Parganas region of Jharkhand and south Bihar, an action research project was implemented by a project intervention CHIRAG[16] (Creative Hub for Innovation & Reciprocal Research and Action for Gender Equality). As a part of the project, a platform was co-created for the documentation and exchange of knowledge on sustainable food systems amongst the Santals, one of the largest indigenous communities in India, using various creative and participatory tools. Local youth engaged as 'changemakers' at the core of this collaborative team consisting of researchers, NGO partners, nutritionists and women's collectives.

[16] Funded by the Global Research Translation Award at the University of East Anglia, UK, CHIRAG was a collaborative project comprising PRADAN, Gram Vaani, Kalinga Institute of Social Sciences, and Santal Youth.



First, in-person interactions and creative practices were used to generate and document local, indigenous and intergenerational knowledge and practices on food. For instance, participatory theatre on themes around sustainable food systems encouraged debates and dialogue around people's historical food practices and how and why they have shifted. Participatory filmmaking and screening of the films in the community led to people, especially women, questioning myths and their own stigma, and exchanging perspectives on food and nutrition, ways of cooking, food preferences, etc., thereby strengthening their voice and agency (Rao et al., 2022). A YouTube channel created and owned by an *Adivasi* youth club still hosts films made by them about traditional and local food practices. This documentation led to a detailed analysis of the nutritional components of the foods consumed. A recipe book was created with 9 seasonal meal templates, combining recipes with nutritive values that adhered to national and global recommendations on micro and macro-nutrient intakes (Armes et al., 2024). Through workshops and cooking demonstrations, these recipes are being disseminated to the women in the Santal community, to enhance their knowledge about the nutritive values of locally collected foods and enable them to improve their dietary diversity, nutrition and health. In one of the workshops, a woman in her 40s commented, "*I am having Jonra dakaa (maize porridge) after almost 2 years and I remember that I used to like it so much when I was younger. I don't know how and when we stopped eating these foods on a regular basis. Maybe now we will start again.*"

Second, a participatory digital-community led-media platform serving as an 'articulation and documentation space' was developed. Operated using a 10-digit free mobile number, people can call (and receive calls) and listen to content on topics such as crop production, forms of collection or foraging, food preparation, indigenous recipes, hygiene, and folk stories and songs created by the local youth, with support from a technical team. At the same time, callers can provide feedback on the existing content, and record their own content. Surveys conducted through IVRS (Interactive Voice Response system) reported an increased knowledge of the importance of dietary diversity after listening to the content. The use of both the Santali and Hindi languages helped bridge the digital divide and enabled women, in particular, to contribute to the creation of content for the platform in their own language. In addition to IVRS, an App has also been developed for smartphone users in the community (mostly men), external stakeholders, local government, and frontline workers.

Picture: Participatory Film making and Film Screening

Picture: Photo essays on local food prepared by Youth

Way Forward:

In light of the climate change-induced impacts on agriculture and food and nutrition, building resilience into our food systems is critical and community knowledge needs to be integrated into this discussion. A critical element of this model of engagement was going beyond agriculture to understand different sources of food, their seasonality and the cultural practices around them, to better shape nutrition outcomes, especially for women and children, alongside building climate resilience.

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18.Horti-pasture plot development in hot arid western Rajasthan for Drought Resilience

Contributed by: UNNATI[17], Rajasthan

Around 60 per cent of Rajasthan is part of the Thar Desert. It accounts for 62 per cent of country's hot arid area. The region faces the challenge of desertification and recurrent droughts as well as increasing human and livestock pressures. There is a local saying describing drought over a century – '*Saat kaal, sattais jamana, trisath kuria kacha; teen kaal, aisa padela, maa poot mile na pacha' (*Out of every 100 years 27 are good, 7 severe drought, 63 drought and 3 such droughts in which families get separated).

Social exclusion is one of the root causes of vulnerability of the marginalised groups in Rajasthan including the Dalit population, women and girls. Discrimination is manifested in lack of access to basic services, social security and common property resources. Most Dalit households are marginal landowners engaged in subsistence agriculture, agricultural labour and animal husbandry. They are insecure in terms of drinking water, fodder and livelihood. Drought continues to deteriorate their life and livelihoods year after year. The absence of fall-back mechanisms causes chronic stress on fragile coping mechanisms resulting in distressed migration. Marginal households are less resilient to financial hardships when hit by climate shocks.

While male members migrate, women remain responsible for household work, agriculture and livestock rearing. Women and girls face health impacts of chronic stress, the burden of work, low diet diversity and the inter-generational cycle of malnutrition. Their economic, social and democratic participation is limited because of caste and patriarchal dominance, lack of leadership and work pressure.

Intervention Strategy[18]

Horti-pasture was promoted for fodder security and to strengthen community capacity for drought risk reduction. In a typical plot of 132 ft by 132 ft, 64 locally suitable fruit plants, adapted to the desert climate and according to the preferences of farmers are planted interspersed at 15 ft. Typically Ber (Ziziphus Mauritiana), Gunda (Cordia Myxa), papaya, moringa or lemon has been planted. A fence is constructed to protect from soil erosion, wind and animals. For irrigation, a traditional rainwater harvesting tank with a volume of around 30,000 litres (12 ft deep x 11 ft diameter) and a catchment of around 3m is constructed. The water harvested during the rainy season supports irrigation for 7-8 months.

[17] UNNATI is registered under the Societies Act in 1990 and working primarily in the states of Gujarat and Rajasthan on social inclusion and empowerment, governance, social accountability and disaster risk reduction.

[18] A cost-benefit analysis is available.

It is observed that monsoon has very little bearing on the horticultural yield. Between the fruit plants, local grass varieties grow that serve as animal fodder. Growth of 21 local nearly extinct varieties of grass and trees has been recorded. Fencing and tree cover increase bio-mass and improve soil fertility allowing families to inter-crop with guvar, pulses (moong or moth) and vegetables for home consumption or sale.

Around 500 horti-pasture plots have been developed with women farmers since 2013. Liladevi Bhatia a farmer from Sindhri says that she has been earning more than Rs.20,000 from the sale of her fruits every year in the village itself. Gauri Devi (*in the picture on the left*) from Phalodi says that the same plot did not yield Rs 2,500 earlier. Horti-pasture has reinstated the faith of marginal cultivators in their land and opened new avenues to ensure basic nutritional security for desert communities and their cattle.

Way forward

The intervention is conducive to scalability using public programs like MGNREGA, DAY NRLM, micro irrigation schemes etc. Tanks are already being constructed under 'apna ket, apna kaam' of MGNREGA. Marketing linkages could be facilitated for the produce. This intervention has the potential to not only improve the environmental resilience of the region but also promote livelihoods and improve economic returns for the marginal populations in climate-risk regions.

19. A women's insurance cooperative designs a 'heat insurance' product to support informal women workers during heat waves

Contributed by: SEWA Federation, Gujarat

The summer months are increasingly seeing above-average maximum temperatures across India. Gujarat is one such state that has been experiencing extreme heat waves.[19] Heatwaves present multifarious challenges for India's informal women workers, especially workers who are pregnant and breastfeeding. In addition to increased risk for mortality and morbidity, extreme heat also pushes female wages below the poverty line in three sectors, including agriculture, construction, and other service activities, which account for 70 per cent of total female employment[20].

Workers can mitigate some of these negative consequences of climate change, if they perceive the risks, are aware of various coping mechanisms, and are able to take appropriate adaptive measures. Collectives of workers, such as cooperatives, can offer solutions in the form of products that are tailor-made to serve the contextual needs of their members. Worker cooperatives, which are owned, managed, and run by workers themselves, are uniquely placed to design contextual solutions for both macro and micro-level effects of climate change. The worker-owners, who are experiencing the effects of climate change, through their cooperatives, have access to a pool of resources, which can help them create local solutions for their specific issues. For women workers, who are often denied these resources, cooperatives can therefore become a means to gain agency, ownership of their livelihoods, and the ability to demand and design change.

One such example of SEWA's cooperatives is VimoSEWA - a multi-state insurance cooperative, owned, managed and used by the informal women workers of various trade groups, where they are the policy-holders. VimoSEWA- launched a heat insurance product - one of the first of its kind - in the Ahmedabad district in March 2024. This will be offered for four months between April and July 2024.

This is a parametric policy which pays policy-holders based on the number of days that see maximum temperature at 43.2 degrees Celsius. This has been calculated based on historical trends of Ahmedabad's maximum temperature. Importantly, this policy is realized based on atmospheric metrics and not on other conditions such as when a holder falls sick or is admitted to the hospital, for instance. VimoSEWA has partnered with an insurer, ICICI Lombard, to make this product available to informal women workers in Ahmedabad District.

All women can purchase VimoSEWA's heat insurance.

A one-time premium of Rs 350 (USD 4.20) needs to be paid. The insured will receive proceeds against a specific number of days across the four months when the maximum temperature is above 43.2°C; Rs. 1,200 for any 7 days, Rs. 1,800 for 11 days, Rs. 2,400 for 20 days and Rs. 3,000 if the trigger temperature is reached for 30 days.

This way, informal workers are not forced to work under conditions where they are vulnerable to heat risks, and they are compensated for lost wages. As of April 6th 2024, VimoSEWA has sold 1800 such policies and will continue selling these till the end of April. Being a cooperative, any profits earned through this initiative will benefit all of VimoSEWA's

[19] https://internal.imd.gov.in/pages/heatwave_mausam.php

[20] https://onebillionresilient.org/extreme-heat-inflames-gender-inequalities/#key-findings; https://preparecenter.org/wp-content/uploads/2022/12/India-Heat-Perceptions-Research-by-R.Kotharkar-2022.pdf

shareholders. While VimoSEWA intends to scale this beyond Ahmedabad city and district, based on learnings from the first year, the profitability of this venture needs to be ensured to make this a financially viable and sustainable product.

Future areas of intervention and recommendation

VimoSEWA has also tied up with the Government of India's National Institute of Occupational Health (ICMR-NIOH) to build evidence on the impact of heat on health, work hours, wages and household finances in Ahmedabad. The cooperative will use these insights to diversify and design other relevant cost-effective products to support workers
Women-led informal workers cooperatives can be engaged as important stakeholders, while planning for action on public health risks posed by climate change, given their social capital and reach amongst vulnerable informal women workers. These would include simple, preventive health information and education on early signs and symptoms of heat stroke, for example, and measures for timely mitigation.

Government departments can also partner with such women worker's cooperatives to disseminate important key messages (as posters and other IEC materials for example), which could also be an income generation activity.

Creating enabling environments or mechanisms for such worker's cooperatives to partner with private entities (such as ICICI Lombard, in the above example) can help make quality services accessible to informal women workers who may otherwise remain unreached. Private players with stronger capacities for ensuring compliance can help overcome compliance-related barriers faced by informal women's cooperatives. Meanwhile, co-creating insurance products and appropriate preventive health messages can reduce the risk of climate change-induced health risks like extreme heat.

20. Decentralised Millet Processing Units as a Mechanism for Building Resilience in Women Farmers

Contributed by: SELCO Foundation

Uninterrupted access to energy in climate-vulnerable areas is key to building short-term and long-term resilience.

Women carry out significant labour work in agriculture – on and off-farm, some paid and some unpaid. Appropriate technologies suitable for small landholding farming and the specific needs of women on farms have great potential for mitigating major climate risks, reducing drudgery for women and ensuring reliability of incomes. Economic stability becomes crucial in achieving resilience against unforeseen climate shocks and variabilities. Bibi Jan is a farmer and entrepreneur from Teertha village in Dharwad district— an undulating landscape with rich black soil. Dharwad falls under hot, semi-arid eco-region with a high probability of droughts with very little humidity. Endemic to the conditions, the farmers of Dharwad have historically grown millets.

Picture: *Women in Teertha village showing the processing of millets*

Millets are cereal grains rich in fibre, and nutrition and require less water than other cereals making them drought-resistant. Every season, several truckloads of little millet grains are shipped out of the region to processing centres in faraway places. Farmers are often forced to sell the grain at lesser prices, and this leads to reduced/lower consumption of the crop they grow themselves.

Manual processing of little millets involves a lot of drudgery and is mostly carried out by women. Though cultivated continuously, they are not consumed around the year as the communities would prefer due to the lack of processing and storage facilities. This issue

was addressed by setting up a local processing unit, owned by the community.

Bibi Jan has been a champion by bringing together over 1,000 female farmers to promote millet cultivation in Teertha. She along with her 14-member team of women established the Bibi Fatima Women's Self-Help Group with the support of a local NGO, Sahaja Samrudha in October 2019. While they had been growing millets, they had always processed manually and traded locally. To support increase in production, processing and efficiency, the group decided to adopt millet processing machines.

The majority of agricultural technology in India caters to large landholding farmers. Current millet processing machines are either for large scale (more than 800-100 kgs a day) or compromise on the quality of grains processed (70% are broken). Small and marginal farmers often have processing needs of 250-500 kgs per day instead. Furthermore, on-farm labour is also carried out by women across the millet value chain, and harvest becomes crucial.

SELCO Foundation in collaboration with various stakeholders has been working with hardware enterprises to create and customise inclusive technologies that are relevant to marginalised populations. In this case, a medium-scale efficient millet processing unit run by women farmers, powered by solar energy for uninterrupted energy access.

The SHG's aspirations were aided by the Indian Institute of Millet Research (IIMR) as they provided free machinery to the SHG. Due to issues with irregular power supply and prolonged power cuts, the group decided to install a solar energy system to power the machines. The SHG contributed 20% costs of the whole solar energy system. However, there are financial instruments like loans that can be availed from government banks and schemes. There have been efforts at familiarising local bankers to understand unique business models and use them as leverage to grant capital for farming enterprises.

Decentralized millet processing units in remote areas reduce massive amounts of drudgery for women who are processing it manually otherwise. As the processing machine increases productivity, with proper market linkages this has also encouraged community members to grow different kinds of millets. We have also observed an increase in local consumption. Supporting indigenous crops like millet directly adds to the nutritional security of the community.

The efficient processing of millets has reduced the time and labour required. This has freed up the women to focus on other activities, such as marketing their products. The group's income has also increased significantly from 8,000 – 10,000 Rs/Month to 20,000 – 25,000 Rs/ Month, allowing them more income and investment for their entrepreneurial aspirations. Their recurring costs of electricity have gone down by 62%. They are now carrying out operations in packaging and branding and thinking of ways to expand their business with product diversification (millet-based health drinks, ragi-based protein powder).

Future areas of intervention and recommendations

- There are many such community groups that need farmgate processing for either local consumption or catering to market demand. This is not just an opportunity for food producers but also for other community members who do not have access to land necessarily (most women even if they do 'own' land, do not often make decisions about it) to establish an enterprise through sales of millets locally and in other areas.
- There isnt enough data, information, or insight from a woman's perspective in terms of what kind of hardware-based solutions would aid their work in the agriculture sector.
- To make this scalable, policies and schemes must be linked to availing financial support in climate-resilient value chains like millets. It can be expanded to more indigenous crops that are good for the planet and locally consumed.
- While community-based processing allows for more autonomy over the finished product, market linkages still need to be strengthened to ensure stable income.
- Such projects must be led by community champions who ensure the sustainability of the enterprise. Creating more avenues for identifying and encouraging such champions is an integral part of this program.

21. Women Building Localised Economy with Regenerative Ecology in the Role of "Green Motivators"

Contributed by: Buzz Women, Karnataka

The livelihoods of rural women in India are profoundly threatened by the multifaceted impacts of climate change, including but not limited to shifts in weather patterns, increased frequency and intensity of natural disasters, degradation of natural resources, and disruptions to agricultural activities. Research shows that climate change affects women far more disproportionately - women from rural areas have less control over resources and have limited decision-making powers, women sacrifice and eat less than the men due to gender-biased expectations in times of food shortages, women also suffer higher mortality during, and after, extreme weather events and women and girls experience higher violence since climate change aggravates this due to displacement, resource scarcity and food insecurity.

A study undertaken in 2021 by the Council on Energy, Environment and Water (CEEW) is India's first-of-its-kind district-level climate vulnerability assessment. It presents a climate vulnerability index (CVI) of states and union territories by mapping exposure, sensitivity, and adaptive capacity. The southern zone of India is the most vulnerable to extreme climate events and their compounding impacts and Karnataka's climate vulnerability index shows a high range. The Gross Domestic Climate Risk analysis of 2023 places Karnataka as the 65th province most at risk globally and 14 states in India are among the top 100 provinces of the world! Over 50 % of Karnataka's population depends on agriculture and more than 80 % of the farmlands are rain-fed. Hence, weather variations cause huge problems for the livelihood of farmers. As a result, rural women face heightened vulnerabilities and economic insecurities, with implications for their well-being, household resilience, and community development.

Addressing the intersecting challenges faced by rural women in the context of climate change is imperative to promote gender equality, sustainable development, and resilience in rural communities. Buzz Women supports the creation of a localised economy with regenerative ecology through the mechanism of mindset shift and behavioural change to build resilient households and communities. The programme builds the capabilities of women to combat the everyday effects of climate change by enabling opportunities to take action. We have a well-researched curriculum that trains village women on the why, what and how of climate change. We identify a climate action agent, Green Motivator (volunteer) in every village because they know the effects of climate change and their land, soil, and water best and nurturing local leadership to take climate action is sustainable. We take the Green Motivators through a learning journey on what climate change is and how they can take steps to mitigate it or adapt to it through a six-month-long training program.

The green motivator will first implement adaptation measures in her household and farm to demonstrate success before motivating other SHG women to take similar climate-positive action. The Green Motivator will then mobilise village women and their community to come together in solidarity to fight against climate change by organising Participatory Rural Appraisals. Here, the community will set green goals and create a roadmap to achieve it. For example - communities set up kitchen gardens, which run

primarily on reused wastewater and eco-friendly agricultural practices. The crops grown in the garden are used for domestic purposes and supplementing food security for their families. The women will be trained to be ecopreneurs which means that they will be enabled to diversify their family's income source by running climate-friendly businesses such as kitchen gardens, desi poultries, cold oil presses, and waste segregation.

Income generation for these women facilitates better decision-making capacities and strengthens their capabilities to take climate action at a community level. This program is based on the "Produce Local, Consume Local" principle, aiming to transform rural economies by promoting local production for local consumption. Alongside, it is equally necessary to recognize the current ecosystem gaps, turning those into opportunities for entrepreneurial women. Such gaps in marketing, financing, logistics, and production support can in fact present interesting possibilities for women who aspire to be ecosystem players. Many of the women entrepreneurship interventions are not designed with a climate lens and are in fact promoting enterprises which are climate-negative. By promoting local for local, rural women to adapt to the everyday effects of climate change while simultaneously strengthening their livelihoods.

Future areas of intervention and recommendations

Scalability: This intervention is scalable using the SHGs in the villages and training women on the effects of climate change and the climate action that they can take at the local levels. The NRLM/SRLMs can become the vehicle through which ecopreneurs can be nurtured.
Key gaps: Lack of support for community-based adaptation that can facilitate solutions to food insecurity, loss of livelihood and poverty.

Pathway to address the issue: The pathways adopted for scaling should be bottom-up which encourages the development of community-based adaptation initiatives that enable women and local communities to identify, prioritise, and implement climate resilience actions tailored to their specific needs and circumstances. Community-based adaptation facilitates local production and consumption which can strengthen livelihood strategies of rural women and their families.

22. Empowering Tamil Nadu's Fisherwomen

Contributed by: S.Velvizhi, M.S. Swaminathan Research Foundation

Marine and coastal ecosystems are incredibly vulnerable to ocean warming and rising sea levels. These changes directly affect the lives and livelihoods of people in coastal fishing and farming communities worldwide. In India's coastal regions, fisheries and aquaculture are significant sources of income for both men and women. The marine and coastal resources, including fish, crabs, prawns, seaweed, and other biomass, are essential for economic well-being and food security.However, climate change has brought several challenges, including declining fish stocks due to rising sea temperatures and ocean acidification. This decline has affected the livelihoods of fishermen and women who depend on these resources. Additionally, fisherwomen face significant poverty-related challenges, such as limited access to resources to invest in their work. As a result, many fisherwomen rely on local moneylenders for credit, often at high-interest rates, to sustain their livelihoods. Moreover, fisherwomen face the challenge of limited access to marketplaces to sell their products, which can be time-consuming and physically exhausting. These challenges add stress and fatigue, making it challenging to earn a fair income.

Furthermore, with the risk of climate change and worsening outdoor conditions due to rising temperatures and heat waves, fisherwomen are exposed to significant health risks. For example, women engaged in seaweed collection in the Rameswaram islands of Ramanathapuram district of Tamil Nadu face formidable challenges. High waves, high wind, and increased sea surface temperatures increase risks leading to severe injuries and health issues—incidents of boats capsizing result in grave injuries, fatalities, and substantial losses of harvested algae. Likewise, women engaged in fish vending, head loading, fish drying, and small-scale fish marketing in coastal districts of Tamil Nadu also face severe challenges due to frequent tidal floods, increasing temperatures, unusual rainfall patterns, and heat waves. Tidal flooding has affected their houses and the area where the women handle and dry their fish. Thatched homes near the shore are increasingly susceptible to damage from local winds, amplifying climate-induced hardships for families, including older people and children.

Fish for All Research and Training Centre at M.S. Swaminathan Research Foundation: Empowering Fisherwomen

Fish for All Research and Training Centre at M.S. Swaminathan Research Foundation has been playing a crucial role in addressing some of these challenges by empowering fisherwomen and strengthening resilience of communities in the region. Prof. M.S. Swaminathan conceptualised the Fish for All program based on the felt needs expressed during the post-tsunami interactions with the coastal communities.

The Center employs various methods to attain its primary objective, which include raising awareness about climate adaptation by educating communities about the effects of climate change on fishing and strategies for mitigating its impact. It also enhances

livelihood options for local fisherwomen through training in alternative income-generating activities like value addition and small-scale fish farming.

The Centre promotes women's collectives, which can provide a platform for women fishers to share their experiences, support each other, and address their needs. A community-based processing facility in the Center's premises helps improve the quality and value of the fish caught by local communities. It demonstrates the value of upgrading low-value fish through value-added processing techniques such as solar drying, smoking, etc., which helps increase fisherwomen's income and reduce post-harvest losses. The direct market linkages with traders helps eliminate intermediaries and ensures fisherwomen receive fair prices for their produce.

Additionally, affordable and energy-efficient ICTs such as mobile applications, help lines, and audio advisory services enable fisherwomen to access real-time information related to post-harvest fisheries, early warnings related to temperature, rainfall, coastal flooding, cyclones, high waves, wind, and market information. This ensures fisherwomen have access to crucial information to help them make informed decisions about their fishing activities and livelihoods.

The Center also provides training and capacity-building programs to fisherwomen to improve their understanding of fish resource management, disaster preparedness, and management practices. Through its various programs and activities, the Center aims to ensure fisherwomen have the necessary skills, knowledge, and resources to build resilient communities and adapt to changing climatic conditions.

23. The Impact of Natural Calamities and Climate Change on the Mental Health of Children

Contributed by: Lakshmi Vijayakumar, Society for Networking Empowerment and Holistic Action (SNEHA)

Children, due to their dependence on adults and ongoing development, are particularly vulnerable to the psychological consequences of natural disasters and extreme weather events caused by escalating climate change.

The devastating tsunami that struck the coast of Tamil Nadu, India, in 2004 serves as a powerful illustration of the mental health impact of natural disasters on children. The tsunami's immense force caused widespread destruction, displacing communities, leaving many dead and missing, and inflicting deep emotional trauma on survivors, particularly children. In the immediate aftermath of the disaster, emergency relief efforts focused primarily on providing food, shelter, and medical assistance to survivors. However, it soon became evident that addressing the psychological trauma caused by the tsunami was equally critical for long-term recovery. Psychosocial intervention teams comprising mental health professionals, social workers, and volunteers were deployed to affected areas to provide immediate support and assess the psychological needs of survivors.

Building psychological and emotional resilience in children after Tsunami 2004:

One of the key approaches to addressing the psychosocial impact of the tsunami was the **implementation of structured intervention programs targeting children and adolescents.** These programs were designed to provide a safe space for children to express their emotions, learn coping strategies, and rebuild a sense of normalcy in their lives. Surveys were conducted among children, caregivers, and community leaders to identify prevalent mental health concerns, age-specific challenges, and cultural considerations. This, apart from in-depth interviews with children and families provided a more nuanced understanding of individual experiences and emotional distress.

It was observed that children were especially vulnerable to the psychological consequences of the disaster. Some common reactions observed included anxiety and fear, depression, anger and irritability, and regressive behaviours as a coping mechanism where children reverted to earlier stages of development. While acute reactions may subside with time and support, these experiences associated with a natural disaster can have lasting consequences for a child's mental health.

Based on the needs assessment, a range of culturally sensitive interventions were implemented. These include:

- **Training of Community Workers**

  Following the tsunami, there was a pressing need to provide psychosocial support to affected communities, but there were limited mental health professionals available to meet this demand. To address this gap, various organisations and agencies initiated training programs to equip local community members with the skills and knowledge needed to deliver effective psychosocial interventions, such as basic counselling skills, understanding trauma and its effects, techniques for facilitating emotional expression, crisis intervention strategies, and self-care practices for the community workers themselves. The training programs empowered community workers to serve as frontline responders in delivering psychosocial support to their communities.

- **Psychoeducation**

  To provide a safe space for children to express their emotions and learn coping strategies, SNEHA adopted a child-centred approach to psychosocial interventions that emphasised understanding and addressing the unique emotional and developmental needs of children, as well as promoting their resilience and well-being.

  SNEHA led structured group sessions for children, fostering connections with peers facing similar challenges and promoting social support networks, friendships, and belonging. Through group activities and discussions, children developed interpersonal skills and resilience. Additionally, SNEHA provided psychoeducation sessions for both children and caregivers, teaching cognitive-behavioural techniques to manage anxiety and stress. Caregivers learned to create nurturing environments and recognize signs of distress, ensuring timely professional support when needed.

- **Play Therapy and Creative Expression**

  Art and play therapy techniques were widely used to facilitate emotional expression and processing among children. These creative outlets not only allowed children to process their emotions but also served as tangible reminders of their strength and resilience in the face of adversity. Collaborations were established with trained therapists and mental health professionals to provide guidance to facilitators and volunteers involved in implementing art and play therapy programs, ensuring that interventions were evidence-based, ethical, and responsive to the unique needs of each child.

- **Support Groups**

  Group-based interventions played a crucial role in providing social support to children affected by the tsunami. A key program component was forming peer support groups in schools and communities. In these groups, children shared their stories, listened to each other's experiences, and offered words of encouragement and solidarity. Through these peer connections, children felt less alone in their struggles and more hopeful about the future. Support Intervention programs also involved family members and caregivers in the recovery process, recognizing the important role of family support in children's emotional well-being. Parenting skills training, family counselling, and communication exercises helped strengthen family relationships and create a supportive environment for children.

- **Building Resilience**

  Psychosocial interventions supported individuals in making sense of their experiences and finding meaning in the aftermath of trauma. Through storytelling, narrative therapy, and reflective exercises, individuals were encouraged to reframe their narratives, identify sources of strength and resilience, and envision possibilities for personal growth and transformation. These interventions promoted post-traumatic growth and helped individuals cultivate a sense of purpose and optimism in their lives.

Impact:

The interventions spearheaded by SNEHA and allied institutions yielded pivotal outcomes. Firstly, they enhanced mental health accessibility by establishing community-based programs and mobile clinics, effectively eradicating barriers like stigma and geographical distance. Specifically, children affected by the tsunami had access to specialised mental health services tailored to their unique needs. Secondly, through targeted psychosocial support initiatives, including counselling and group therapy, SNEHA and partners helped assuage trauma and fortified resilience among survivors, particularly children. Thirdly, capacity building efforts empowered local communities and healthcare providers to address mental health needs adeptly, ensuring children received tailored support from trusted figures. SNEHA's advocacy and psychoeducation initiatives also helped dismantle misconceptions about mental health, fostering a culture of help-seeking and resilience. And finally, by fostering safe spaces and employing therapeutic activities for self-expression, these interventions not only facilitated healing but also seeded long-term societal resilience, extending benefits far beyond individual survivors. By increasing awareness, reducing stigma, and equipping survivors with practical skills and resources, these programs empowered individuals to cope more effectively with the psychological challenges of rebuilding their lives after the disaster.

Way Forward:

To ensure sustained mental health support post-disaster, it's imperative to establish long-term services integrated into primary healthcare, prioritising specialised and accessible care for children within existing infrastructure. Continuous investment in local capacity building is also vital in disaster-affected areas, equipping healthcare providers and community workers with trauma-informed approaches to support children effectively. Strengthening community-based networks can help facilitate ongoing psychosocial support and resilience-building activities, while school-based programs and teacher training can promote early intervention. Mental health education must also be integrated into the educational curriculum while research efforts should focus on understanding long-term effects and evaluating intervention efficacy, guiding evidence-based practices. Overall, policy development must prioritise mental health within disaster management, advocating for increased resources and commitment to building resilient communities.

24. Climate Change, Youth and Empowerment

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Introduction

According to the Sixth Assessment Report of the IPCC, human-induced global warming of 1.1 degrees C has spurred changes to the Earth's climate that are unprecedented in recent human history. Climate change impacts on people and ecosystems are more widespread and severe than expected and future risks will escalate rapidly with every fraction of a degree of warming. People across the world's drylands will experience water stress, heat stress, and desertification, while the share of the global population exposed to flooding will rise by 24%.[21] Key effects within India are increased temperature, erratic monsoon patterns, water scarcity, coastal vulnerability, biodiversity loss, and enhanced health-related problems.[22]

The above context paves the way for building adaptation measures for vulnerable communities worldwide. In India, youth in the age group of 15-29 years comprise 27.2% of the population (2021). There is a potential opportunity to enhance their knowledge of climate change and provide green skill-based prospects for building their portfolios and aspirations while contributing to climate action.[23]

Youth Climate Conclave (YCC)

To provide answers to these contemporary contexts, the Delegation of the European Union, in partnership with The Energy and Resources Institute (TERI), United Nations Children's Fund (UNICEF), India, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), India, and Council on Energy, Environment and Water (CEEW), along with the Ministry of Environment, Forest and Climate Change (MOEFCC), Government of India as nodal ministry, implemented four editions of Youth Climate Conclave and trained 7800 youth on climate action in the age bracket of 10 – 25 years.

TERI is an independent, multidimensional organisation with capabilities in research, policy, consultancy, and implementation. A need was felt in the early 2000s for mainstreaming Education for Sustainable Development (ESD) as an outreach arm of TERI to penetrate deeper with knowledge and age-appropriate action agenda in the future citizenry. In 2002, the Environment Education and Awareness (EEA) division was formed, committing to building the capacities of youth. Youth Climate Conclave was conceptualised in 2019 to engage youth in a positive and proactive way in science-based discussions on the most relevant climate change issues and identify opportunities for youth & governments to drive

[21] IPCC, 2023: Summary for Policymakers. In: Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland, pp. 1-34, doi: 10.59327/IPCC/AR6-9789291691647.001

[22] The impact of climate change in South Asia includes rising temperatures, which have resulted in increased heat waves and related health issues, with India experiencing a significant temperature rise of around 0.6 degrees Celsius over the last century (Indian Meteorological Department). Source: "Climate Change and India: A 4x4 Assessment - A Sectoral and Regional Analysis for 2030s" by the Indian Network for Climate Change Assessment (INCCA)

[23] Youth in India, 2022, National Statistical Office, Ministry of Statistics and Programme Implementation, Government of India, New Delhi.

joint action to fulfil the climate change agenda. The programme focuses on interspersing classroom-based discussions with non-formal learning platforms. The dual approach is adopted such that students from multidisciplinary backgrounds can participate and enhance their knowledge of critical issues of relevance.

A few salient features are competitions (photography, blogging, short video and debate) for bringing out the creative side of students and enhancing research and knowledge through self-learning and preparing for competitions. The mainstay of the programme is an annual two-day meet to discuss climate science topics, actions adopted by stakeholders and the Government of India and deliberation over youth priorities and the Indian agenda on climate action. The discussions led to the development of a participatory outcome document by the youth known as the '**Youth Declaration on Climate Action**' which comprises adaptation measures that will be adopted by the youth and mitigation measures that can be adopted by the decision-makers. To ensure that the youth voices are heard and accepted at the global platforms, the outcome document was presented at events of global repute such as Adaptation Futures 2020 and World Sustainable Development Summit 2020, 2022 and 2023. The participating youth has shown a strong commitment to the cause of sustainable development. Additionally, it has also been observed that youth were able to perceive their role in addressing climate change and are aware of the steps that need to be taken to lessen the adverse effects of the climate change phenomenon.

The conclave is an amalgamation of technical talks, plenary sessions, interviews of experts led by youth, group activities on bringing out the experience of youth representing the entire nation, films and video messages screening and debates. The programme strives to strengthen critical thinking among students, their creativity, scientific understanding, communication, collaboration, multilingualism, problem-solving, ethics and social responsibility.

Future areas of interventions

Over the years, YCC alumni have emerged as a cohort of committed individuals for the cause of climate change. The alumni network is the extended arm of YCC that reaches out to students in their universities and schools, thus creating a ripple effect of learning. To maintain a continuous engagement with youth a YCC boot camp was organized in December 2023, which assessed youth's viewpoint about environmental concerns, and their environmental quotient and role. It was suggested that a more action-oriented experience would allow students to impart their learning or adopt community-level engagement. Youth appreciated the networking platforms they are offered and have expressed to continue in future editions too.

In 2024, 5th edition of YCC will be launched with strong spin-offs and tie-ups with the potential to make global outreach while undertaking local actions, especially on platforms like COP 29. The main objectives will be to decipher local solutions to strengthen the country's action plans to address climate change, provide opportunities to strengthen the YCC alumni network, and create avenues for peer-to-peer learning to enhance the participation of youth and communities in outreach activities.

Case 25: Stitching Together a Good Future

Contributor: Saju M K, Zone Programme Lead, West Zone, Caritas India

Life had become particularly agonising for 23-year-old Poonam Sunil Solanke who had lost her husband three years back. In the face of rejection and stigmatisation of family and village community, Poonam had to do something exceptional to stay alive and to raise her two little children.

"We had taken Rs. 50,000 (€600) from local moneylenders for cultivating soybean and cotton. In 2019, the crops failed because of drought. We did not have money even to feed ourselves, so we could not pay off the loans. My husband was distressed over his inability to get food for the children and the mounting debt took a toll on him", Poonam narrated how the tragedy broke loose on her family. Tortured by his inability to earn a living, Poonam's husband Sunil committed suicide by consuming pesticide on 21 July 2019. "I was blamed for the death of my husband, and I was branded as an insane and characterless woman", the 23-year-old widow narrated the horror that unfolded in her life.

However, she was determined to live for the sake of her two children – a four-year-old daughter and a two-year-old son. "I didn't know how I would survive. Raising two kids alone with no support is a huge responsibility", Poonam described how she restarted her life. "Life was a big, scary question mark for me. How will I feed my children? How will I educate them? How will I get a roof for me and my children? How will I pay back the loan? Will this world allow me to live as a widow? These questions haunted me", Poonam added.

"I knew that I had to fight and live for the sake of my little children. My destiny has been cruel but I need to give a better life to my children. For feeding my children I started working as a wage labourer in the day and made earthen pots in the morning and evening", Poonam narrated how she struggled to keep the hearth burning. Poonam supplemented her income from wage labour and pottery with the earning from the household works that she did in the neighbourhood. "It was difficult for me to go to work because my children were too small to be left alone at home. Most of the days I took them to workplace; on other days I left them with a neighbour family", Poonam said.

In the year 2021, Poonam came in touch with *Samarth* project team which has been helping women-headed households to start income generation activities and access government welfare services. "The frequent and friendly visits of *Samarth* team helped me become more positive. I also managed to recover from the shock. I started thinking positively and I found a new hope in life", Poonam described how life started to get better.

"Since my children were very young, I could not think of starting any livelihood which would take me away from home. Therefore, I decided to start a tailoring shop. But I had no house of my own", Poonam said. *Samarth* team contacted her relatives seeking their support to settle Poonam down with a small business. One of her uncles offered to give a small room to Poonam to start the tailoring centre. Poonam along with her two children moved to Pathrot village in Amravati to start living at her uncle's place. *Samarth* team helped Poonam with an initial investment of Rs. 8,000 (€80) to start the tailoring unit. She started the tailoring unit and named it '*Aanchal Tailoring Centre*' after her daughter whose name is Aanchal.

“It was a small beginning. I did not earn much in the first few months. I did not lose hope”, Poonam narrated the initial struggles of her business. “Fortunately, the business started picking up and now I earn a daily profit of Rs. 250 (€3) which is just sufficient for me and my children to start our life afresh”, Poonam said.

Even though she had studied until Class XII, she did not know about government schemes that are available for widows. *Samarth* team informed her about the schemes that she is eligible for and linked her with widow pension scheme under which she receives monthly pension of Rs. 1,100 (€14). Since Poonam does not have her own house, *Samarth* team helped her apply successfully for government assistance for constructing a house under Prime Minister Housing Scheme. Her house is under construction in Devri village from where she came to live at her uncle’s home. The new business brought a fresh lease of life to her children as well. Both children have been enrolled in local schools.

“I am relatively free of stress and tensions. Society had stigmatised me and branded me as a woman with bad character. I could not celebrate any festival or participate in social gatherings. Fortunately, things have changed. Ever since I started the small business, I feel I have more acceptance in the society”, Poonam said with confidence and optimism.

“Economic self-reliance is very empowering for a woman. It is a good feeling to be independent. I am very happy that I can take care of my children with my own income”, Poonam said with a satisfied smile.

Poonam with her two children in front of her hut

APPENDIX III

LIST OF PARTICIPANTS IN THE CONSULTATIVE WORKSHOPS

Chennai

Date: 12th February 2024
Venue: M S Swaminathan Research Foundation

Sr.no	Name of the participant	Affiliation
1	Dr. A. R Nambi	World Resources Institute, India
2	Dr. Ashwin Mahalingam	IIT Madras
3	Dr. Chandni Singh	Indian Institute of Human Settlements (IIHS)
4	Dr. C.U. Thresia	Department of Community Medicine, K. S. Hegde Medical Academy, Deralakatte, Mangalore
5	Dr. Devanathan Parthasarathy	IIT Bombay
6	Dr. Dorairaj Prabhakaran	Public Health Foundation of India (PHFI)
7	Ms. Enakshi Dutta	Roots to Branches Foundation
8	Dr. Indira Singh	Indian Institute for Human Settlements (IIHS), Bangalore
9	Dr. Jagdish Krishnaswamy	Not attended
10	Dr. Lakshmi Lingam	TISS Mumbai
11	Dr. Lakshmi Vijaykumar	SNEHA
12	Dr. Liby T. Johnson	Gram Vikas
13	Dr. Marcella D Souza	WOTR Centre for Resilience Studies (W-CReS)
14	Ms. Nivedita Krishnamurthy	SBI Fellow, Bangalore
15	Mr. Pradip Phanjoubam	Journalist, Shillong times
16	Dr. P Shirisha	National Institute Of Epidemiology (ICMR)
17	Dr. Shankar Mani	
18	Dr. Srinivas Goli	Indian Institute of Populations Sciences (IIPS)
19	Ms. Suma TR	
20	Dr. Sunil Kaul	Bodoland Territorial Council (BTC), Assam
21	Prof. T. Jayaraman	MSSRF
22	Dr. Velvizhi	MSSRF
23	Dr. Vishwajeet Kumar	Community Empowerment Lab

Delhi

Date: 16th February 2024
Venue: India International Centre

Sr.no	Name of the participant	Affiliation
1	Dr. Aakash Shrivastava	National Centre for Disease Control
2	Dr. Bhargav Krishna	Sustainable Futures Collaborative
3	Dr. Chandrakant Lahariya	
4	Dr. Chris Varghese	Reckitt, India
5	Dr. Deepshikha Sharma	National Institute of Disaster Management
6	Ms. Jarjum Ete	
7	Ms. Kuntalika Kumbhakar	PRADAN
8	Prof. Lancy Lobo	Centre for Culture and Development
9	Dr. Luigi D'Aquino	UNICEF India
10	Dr. Mimansa Mishra	UN World Food Programme
11	Dr. Navneet Kaur Manchanda	World Bank
12	Dr. Neha	The Energy & Resources Institute (TERI)
13	Ms. Nidhi Jamwal	Independent Journalist
14	Dr. Nitya Rao	University of East Anglia, UK
15	Ms. Patricia Mukhim	The Shillong Times
16	Dr. Poornima Prabhakaran	Public Health Foundation of India (PHFI)
17	Dr. Rajeshwari S. Raina	Shiv Nadar University
18	Prof. Ranjan Ghosh	
19	Ms. Rukmini Banerjee	DASRA, ClimateRISE Alliance
20	Dr. Saachi Bhalla	Bill & Melinda Gates Foundation (BMGF)
21	Dr. Sandeep Thacker	UNICEF India
22	Ms. Shreya Wadhawan	The council of Energy, xx and Water (CEEW)
23	Dr. Sreevatsan Raghavan	Translational Health Science and Technology Institute
24	Dr. Swapnil Jain	Voluntary Health Association of India
25	Ms. Taru Mehta	The Energy & Resources Institute (TERI)
26	Dr. Vijay Rukmini Rao	
27	Dr. Vandana Prasad	Public Health Resource Network (PHRN)
28	Ms. Vartika Singh	
29	Dr. Walter Fernandes	North Eastern Social Research Centre

Guwahati
Date: 21st May 2024
Venue: Hotel Novotel, Guwahati

S.No.	Name of the participant	Affiliation
1	Mr. Rafiqul Islam	AGUP
2	Mr. Chumben Humtsoe	Independent Consultant Public Health
3	Dr. Doma T Bhutia	Advocate General of Govt. of Sikkim
4	Mr. Eklavya Prasad	Megh Pyne Abhiyan
5	Ms. Enakshi Dutta	IDEA NE
6	Ms. Indu Chukhu	The Arunachal Times
7	Mr. Jyotishman Dutta	Down Town University, Assam
8	Mr. Luit Goswami	Rural Volunteer Centre
9	Mr. N Apong	IBAPWO
10	Mr. Padmanav Chakravarty	Dalmia Cement
11	Ms. Pallabi Rajkhowa	FST
12	Mr. Parag Mahanta	Farm 2 Food
13	Mr. Partha Pratim Bordoloi	Farm 2 Food
14	Mr. Peter Paul Barla	Rural Volunteer Centre
15	Mr. Pranab Panging	Aide et Action / Action Education
16	Ms. Rhea Panicker	The Arunachal Times
17	Mr. Sandip Khaitan	Co Chairman ASSOCHAM North East Council
18	Dr. Sreelekha Ray	Voluntary Health Association of Tripura
19	Dr. Swati Nayak	International Rice Research Institute
20	Mr. Tambor Lyngdoh	Synjuk Ka Hima Arliang Wah Umiam Mawphlang Welfare Society
21	Mr. Tithal Parmar	WASH Specialist
22	Ms. Trishnamoni Hazarika	Farm 2 Food
23	Mr. Ashok Kumar Nath	Sanatan Unnayan Sangstha (SUS)
24	Mr. Imran Malik	AGUP
25	Ms. Philashon Mahung	North East Network

Jaipur
Date: 31st May 2024
Venue: Hotel The Lalit, Jaipur

Sr.No.	Name of the participant	Affiliation
1	Ms. Amita Dahiya	XLRI Delhi-NCRCampus
2	Ms. Bhaswati Das	Sr. Development Professional & Independent Researcher
3	Ms. Debadrita Sengupta	Bal Raksha Bharat
4	Mr. Dilip Kumar Yadav	ARAVALI Jaipur
5	Mr. Dilip Surkar	Vikram A Sarabhai Community Science Centre
6	Mr. Dinesh Vyas	Rajmeru Sanstha
7	Ms. Kirti Jain	Dasra
8	Dr. Leena Chauhan	Gramin Vikas Vigyan Samiti (GRAVIS), Jodhpur
9	Dr. M. S. Rathore	Centre for Environment and Development Studies
10	Dr. Madge Varada Jayant	The Energy and Resources Institute (TERI)
11	Mr. Neeraj Gupta	IPAS Development Foundation, Jaipur
12	Ms. Nidhi Jamwal	Gaon Connection, Mumbai
13	Ms. Padma Bhat	Prayatn Sanstha
14	Ms. Paramjeet Kaur	Bindi International
15	Ms. Pallavi Patel	CHETNA, Ahmedabad
16	Dr. Pranab J Patar	Assam Science Society (Delhi NCR Chapter)
17	Dr. R Priyadarshini	MSSRF
18	Ms. Raavi Aggarwal	Indian Statistical Institute, Delhi
19	Mr. Rajiv Sahai	CECOEDECON
20	Mr. Ravish Chatrath	Directorate of Wheat Research, Agrasain Marg, Karnal
21	Dr. Rengalakshmi Raj	MSSRF
22	Mr. Sachin Talkokulwar	CECOEDECON
23	Dr. Sagar Marathe	Somaiya Vidyavihaar University, Mumbai
24	Mr. Saif Nihal	MSSRF
25	Dr. Saju MK	Caritas India
26	Mr. Sandeep Jain	ASSOCHAM
27	Prof. Shelja K Juneja	IIS (Deemed to be university), Jaipur
28	Ms. Shubhangi Agarwal	ASSOCHAM
29	Dr. Sudipti Arora	Dr. B. Lal Institute of Biotechnology, Jaipur
30	Mr. Utkarsh Patel	Centre for Social and Economic Progress
31	Dr. Vandana Prasad	Public Health Resource Network (PHRN)
32	Mr. Pankaj Verma	Ladli Foundation
33	Ms. Sanobar Iman	CUTS International
34	Ms. Deepika Sivakumar	CECOEDECON

ONLINE CONSULTATIONS

Consultation with Civil Society Organisations

Date: 22nd February, 2024

Sr.no	Name of the participant	Affiliation
1	Akila Lean	Industree Foundation
2	Archana Masih	Waste Warriors
3	Ashwini Kulkarni	Pragati Abhiyan
4	Binoy Acharya	UNNATI
5	Deo Datt Singh	People's Action for National Integration (PANI)
6	Harsh Tiwari	Bindi International
7	Ishita Roy	SELCO Foundation
8	Karan Sinha	Mann Deshi Foundation
9	Mitali Rawat	Waste Warriors
10	Monalisa Padhee	Bindi International
11	Nayana Udayshankar	Dakshin Foundation
12	Neha Abraham	SEWA Federation
13	Neil Kamat	Sauramandala Foundation
14	Nityananda Dhal	PRADAN
15	Prachi Patil	WASSAN
16	Pratap Chandra	Gram Vikas
17	Rakishma M	Slam Out Loud
18	Rani Giri	Swayam Shikshan Prayog (SSP)
19	Ravindra A	WASSAN
20	Sudeep Sharma	Vaagdhara
21	Sudipa Majumdar	Integrated Research and Action for Development (IRADe)
22	Upmanyu Patil	Swayam Shikshan Prayog (SSP)
23	Uthara Narayan	Buzz Women

Consultation with Stakeholders from the State Governments

Dates: 10th April, 2024 and 23rd April, 2024

Sr.no	Name of the participant	Affiliation
1	Mr. Aranyak Mishra	Odisha State Disaster Management Authority (OSDMA)
2	Mr. Balaji	DSTE, Puducherry
3	Dr. Chandni Singh	Indian Institute of Human Settlements (IIHS)
4	Ms. Dipanjana	Pollution Control Board
5	Mr. Ibohanbi Singh	CAMPA Manipur Forest Department
6	Shri I Lipokonen Jamir	Yisemyong, Department of Agriculture, Govt of Nagaland
7	Dr. J. Rajeswar	Environment Protection Training and Research Institute [EPTRI]
8	Dr. J. Sesha Srinivas	Environment Protection Training and Research Institute [EPTRI]
9	Dr. Joy Elamon	Kerala Institute of Local Administration (KILA)
10	Mr. K. Kalamegam. T	
11	Dr Lalita Vithal Baragi	Goa State Climate Change Cell (GSCCC)
12	Shri Lokendra Thakkar	Department of Environment, GoMP
13	Dr. M. Balasubramanian	Institute for Social and Economic Change
14	Mr. Maganbir Singh	Punjab State Council for Science & Technology
15	Dr. Monish Jose	Kerala Institute of Local Administration (KILA)
16	Mr. Pankaj Arya	Govt. of UP
17	Dr. Pradip Sarmokadam	Goa State Climate Change Cell (GSCCC)
18	Ms. Priyambada	Govt. of Odisha
19	Mr. Rahul Nath	DoE, Tamil Nadu
20	Mr. Ramratan Simaiya	Department of Environment, GoMP
21	Mr. Ravi Shah	Department of Environment, GoMP
22	Ms. Somabha Mohanty	UN Women
23	Mr. Sujeet Kumar Sahoo	Govt. of Odisha
24	Ms. Sushmita Patel	Environment Protection Training and Research Institute [EPTRI]
25	Sri T.Vijay Kumar IAS (Retd)	Environment Protection Training and Research Institute [EPTRI]

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