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

ASSOCHAM
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Towards a new dawn
Ministry of Women and Child Development
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Soumya Swaminathan
Chairperson, MS Swaminathan Research Foundation

SUMMARY REPORT

"With our collective efforts, the belief has increased that for the welfare of the world, it is necessary to protect everyone's interests."

[Prime Minister of India, COP 28, UAE]

"The threats to health from climate change are immediate and present. For too long, health has been a footnote in climate discussions. Health must be a permanent feature of the climate change agenda from now on."

[Director General, World Health Organisation]

"There may be no greater, growing threat facing the world's children – and their children – than climate change."

[Catherine Russell, Executive Director, UNICEF]

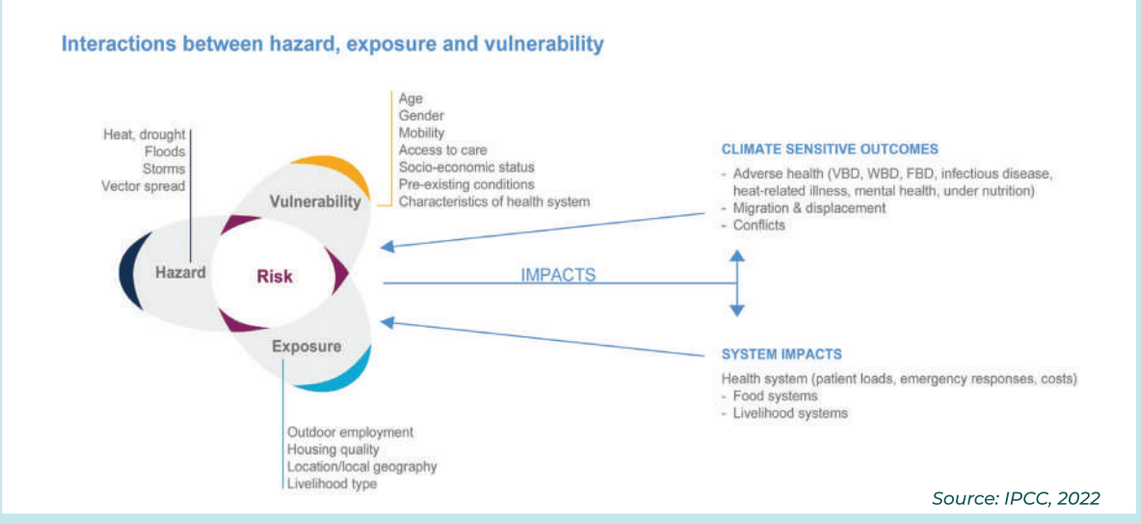
INTRODUCTION AND BACKGROUND

Rapid climate change is impacting every aspect of human life, through both extreme weather events and slow onset events [1]. These events have direct and indirect adverse impacts on sustainable development goals in general and population health in particular [2]. At the same time, serious threats are expected to be posed to livelihoods especially of the poor, those most vulnerable population groups with low capacities to adapt and recover from recurring climate-induced shocks, despite their own negligible contribution to greenhouse gas emissions [3]. 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 [4]. There is an urgent need to take a broader multisectoral systems perspective, taking into account the linkages between a range of interconnected policies including health, employment, energy, water, to name a few. There is urgent need for researchers and practitioners to support policymakers to appreciate, anticipate and work towards preventing and mitigating the effects of climate change on human health and well-being.

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 disproportionate adverse health and nutrition impacts. Climate-related food borne diseases, vector borne diseases, water-borne and zoonotic diseases, and respiratory diseases, increases 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.

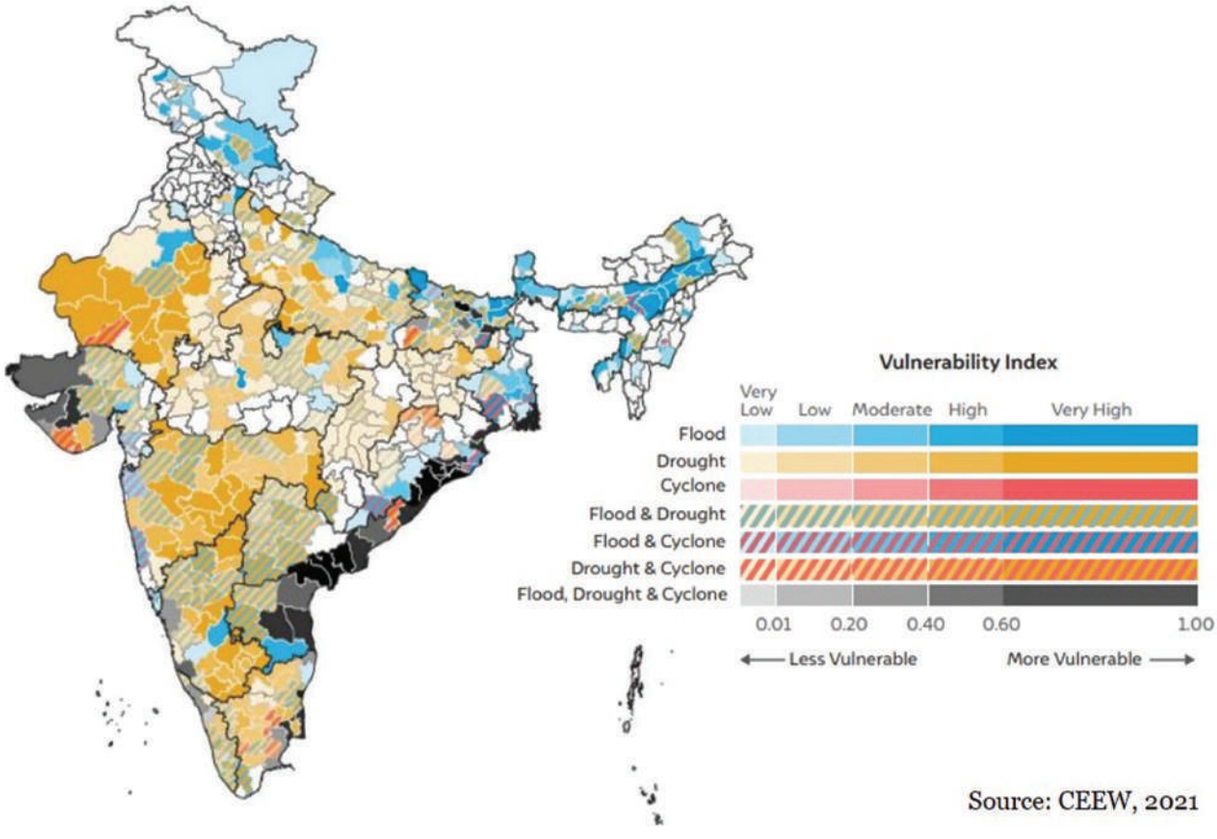


Source: IPCC, 2022

Climate change is a harsh reality now in India.

Between 1901 and 2018, the average annual temperature rose by around 0.7°C [5], [6]. Increasing temperature and changing meteorological parameters have increased the prevalence of heat waves, often termed as a silent killer in the country [7], [8]. At the same time, 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 [9]. Moreover, the current level of pollution is taking 5.3 years off the life of the average Indian, making particulate pollution a major threat [9]. Risks to women are higher because of exposure to indoor air pollution caused by burning of biomass for cooking or heating.

As far as hydro-meteorological disasters (cyclones, floods and droughts) are concerned, 27 out of 35 Indian states and Union territories are highly vulnerable [10]. 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% of India's land experienced over 3 months of extreme drought per year from 2013-2022 [11]. Sea level rise, glacial melts and ground water shortages have been predicted [8], with a rise in extreme weather events [12].



Source: CEEW, 2021

Women are more vulnerable to climate change implications across their life stages.

The climate crises is not gender neutral. According to UNDP, women and children are 14 times more likely than men to die in a disaster. Women often face higher risks & greater burdens from the impacts of climate change in situations of poverty, due to their existing roles, responsibilities and cultural norms [13], specifically to their livelihoods, health, safety and security [14]. 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 [15]. 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 [16], [17], [18]. For the 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.

Climate crisis is overturning the lives of millions of children around the world and in India.

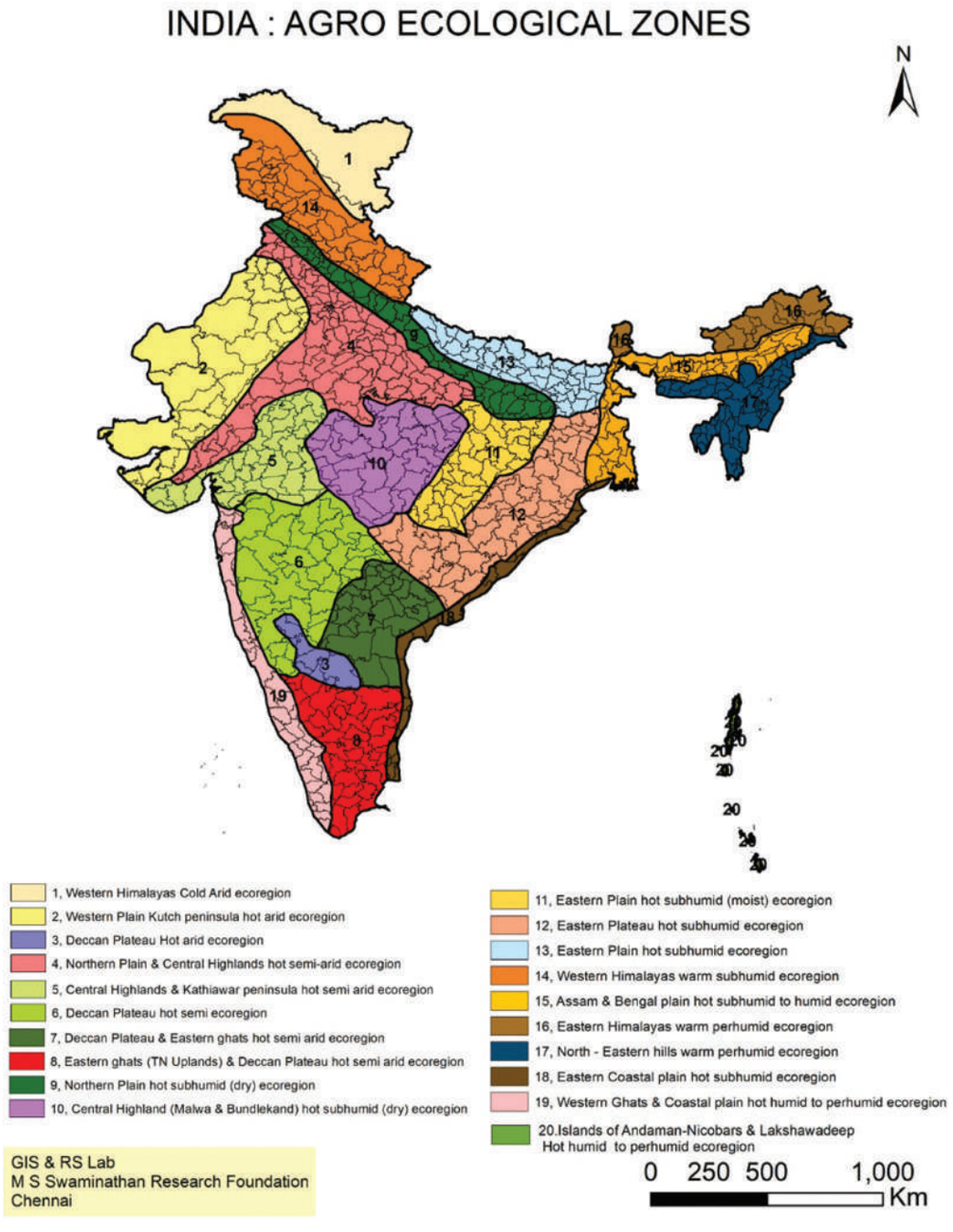
Children's bodies and minds are particularly vulnerable to, and disproportionately affected by, climate hazards. [19], [20]. About 51 percent of India's children are impacted by the double threat of poverty and climate crises [21]. Some 352 million children across the country risk facing at least one climate event annually [21]. 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 [22]. Needless to say, children will suffer the most in terms of food and nutrition security, health, water and sanitation, well -being and education [23], [24]. 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, specially affecting populations with weak immunity. [8], [25].

Equity is deeply interwoven into climate crisis concerns.

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 [26], comprising women, young children, and the elderly, as well as people with existing health problems [27]. 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 [22], [28]. Differential impacts reinforce and even amplify existing inequalities of caste, ethnicity, class, gender, and location unless ameliorative action is taken [18]. 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.

Why climate action needs women and children?

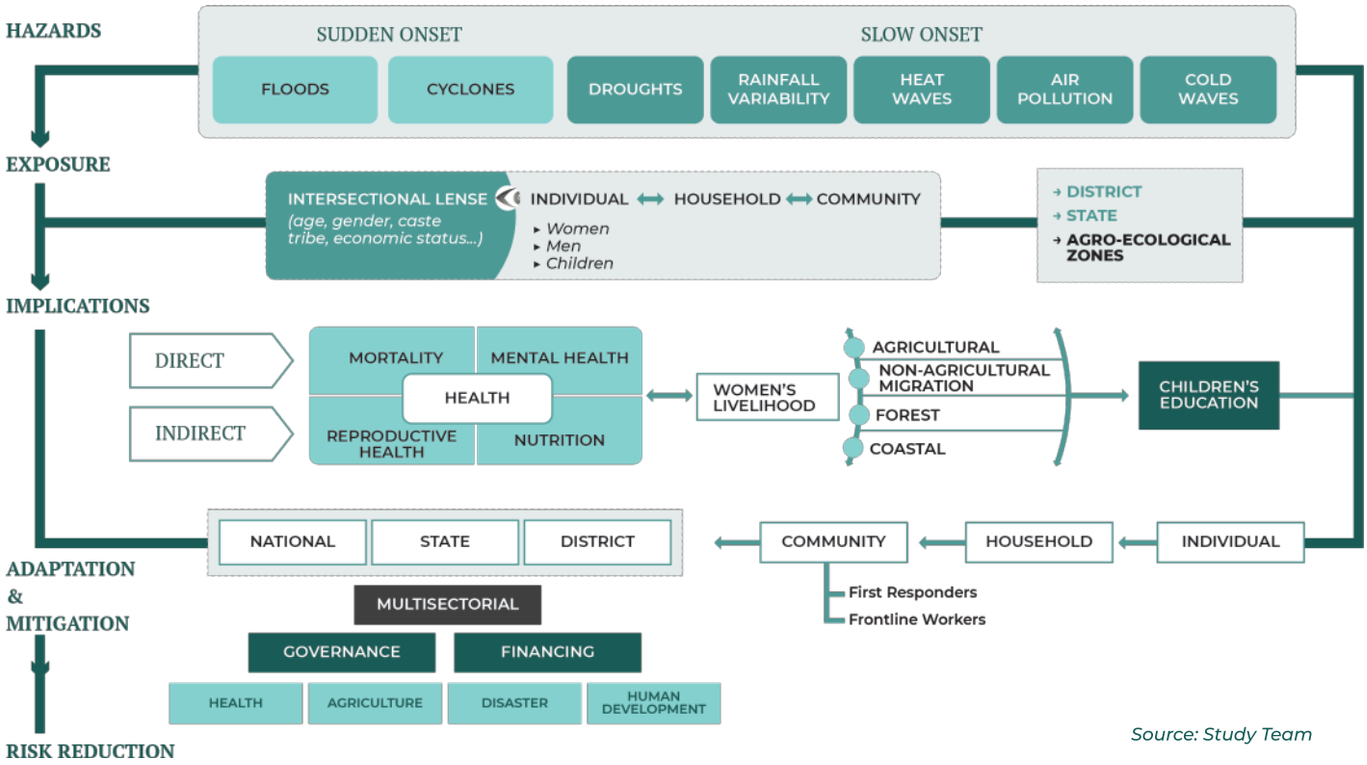
Climate action requires 100 percent of the population - if we want to achieve the Paris Agreement goal of limiting global temperature rise to 1.5ºC. At the same time, empowering women means better climate solutions–When provided with the same access to resources as men, women can increase their agricultural 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 is important to enable them to meaningfully participate in developing just and equitable climate action, especially on decisions and actions that affect them.



STUDY OBJECTIVES

To achieve the above objectives, the conceptual framework adopted is illustrated below. Climate change has complex implications for the whole ecosystem. The implications of hazards differ based on whether they are slow or sudden onset. Consequentially, the implications can be either acute (short-term and immediately visible) or chronic (long-term and indirectly reflected). We attempted to understand the extent of exposure of women and children at the individual, household and community level to seven types of hazards: Floods, Cyclones, Droughts, Rainfall variability, Heat waves, Air pollution and Cold waves. Direct and indirect implications on women's health and livelihoods and children's health and education were studied. 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. This study acknowledges the role of intersectionality in understanding these differential impacts.

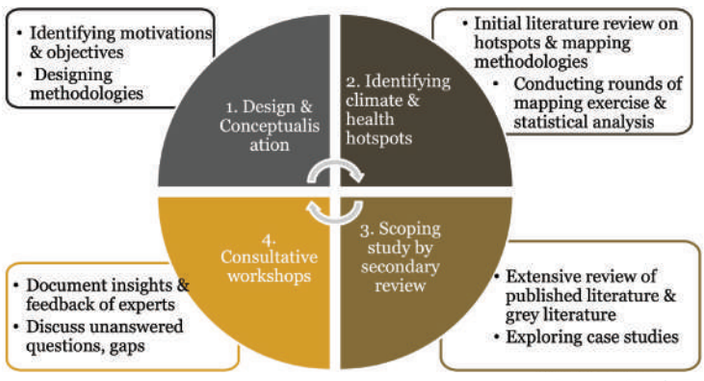
CONCEPTUAL FRAMEWORK
ADOPTED IN THE STUDY



Source: Study Team

METHODS

This scoping study followed four overarching steps as illustrated in the figure below. Identifying objectives and designing methodologies was followed by identifying climate and health hotspots (areas that are both highly climate vulnerable and poor health indicators for women and children) in the country. Hotspots were identified using initial literature



Source: Study Team

review and conducting mapping and statistical analysis. Simultaneously, extensive review of published literature was carried out to study the implications of climate change on various aspects of women's and children's lives (see conceptual framework). We also use case studies from various agroecological zones of the country to present innovative, traditional and local strategies for adaptation to climate change and building resilience of the rural ecosystem, focusing particularly on the strategies led by women. Finally, we organized two consultative workshops with climate, health and livelihoods experts across the country to capture lived experiences, especially from people working on the ground.

Data Sources

Mapping and statistical exercise relies predominantly on two data sources:

a) The District-level climate vulnerability exposure scores published in 2021 by the Council on Energy, Environment and Water (CEEW); and,

b) Data from the fifth round of the National Family Health Survey conducted between 2019-21 under the Ministry of Health and Family Welfare. The latter source furnishes pertinent information on health, and socio-economic indicators.

Variables

While there are numerous efforts to quantify vulnerability to climate change, this study relies on district-level exposure scores calculated by the Council on Energy, Environment and Water (CEEW). These exposure scores result from spatiotemporal analysis encompassing 50 years of data on the frequency and intensity of floods, cyclones, and drought. The assessment of implications of climate change on women consider various indicators, including underweight women, girl-child marriage, teenage pregnancy, and intimate partner violence (IPV). Likewise, the implications on children was assessed through indicators such as stunting, underweight children, minimum dietary diversity, and deaths of under-five children. The list of indicators was selected after a thorough examination of more than 50 indicators available in NFHS data, their relevance based on literature and experts, as well as data limitations.

Approach

The mapping and statistical analysis methods are structured to fulfil three key objectives. Firstly, quantifying the implications of exposure to hydro-met hazards on women and children's health and wellbeing. Secondly, pinpointing the spatial hotspots, where exposure to hydro-met hazards coexist with poor health and wellbeing indicators in India. Thirdly, identifying vulnerable population sub-groups, as women and children are not homogenous. Hotspot identification unfolds in two stages: firstly, identifying the most vulnerable agroecological zones, and secondly, pinpointing the most vulnerable districts. This process offers comprehensive insights for prioritizing strategies aimed at mitigating the compounded negative implications of climate change.

Limitations in Statistical Analysis:

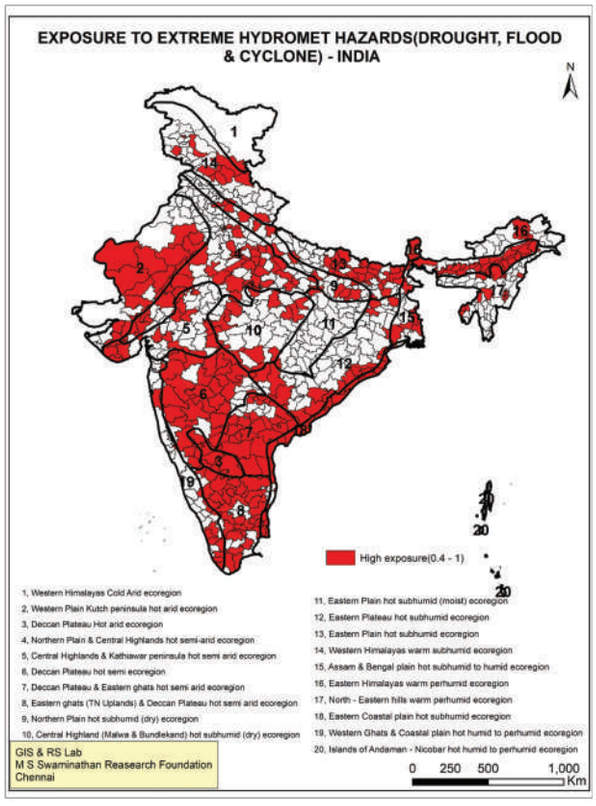
Absence of national level data on climate vulnerability considering all hazards. CEEW exposure score is calculated only for hydro-met hazards i.e. Drought, Floods, Cyclones. It has not considered the heat waves, air pollution, rainfall variability etc.

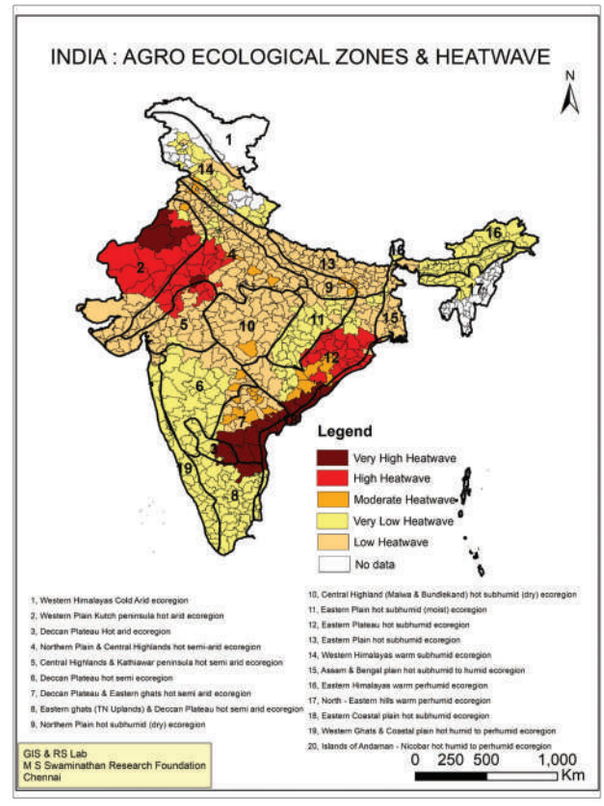
For the health and socio-economic indicators, we relied on NFHS data, which is a cross-sectional survey conducted at certain time intervals in selected sampled households. In addition, the district level data from NFHS is only available since 2015-16, which makes it difficult to compare with CEEW exposure scores, which is based on analysis of 1970-2019 pentad decadal data.

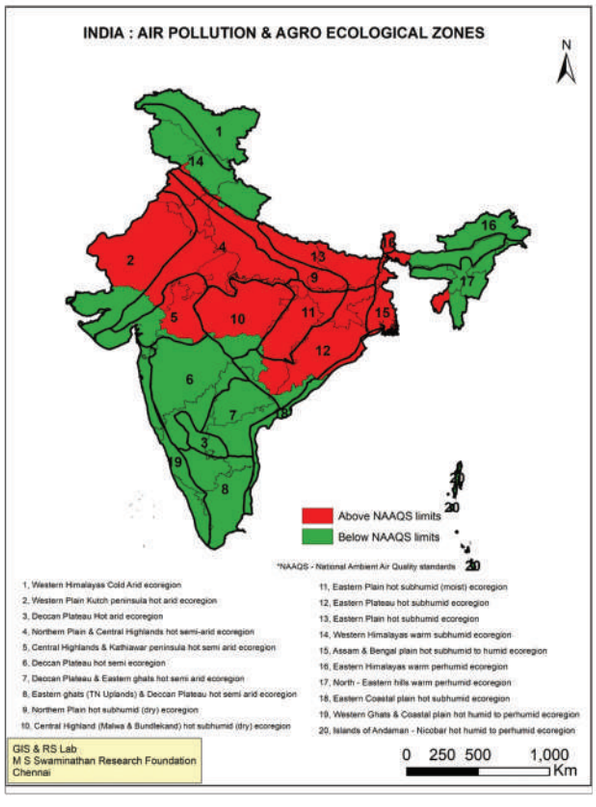
It is challenging to control the role of confounders in the analysis like programmatic and socio-cultural factors. (i.e. simple correlations cannot be drawn between climate variables and health or economic indicators).

Seasonality aspect of hazard exposure is not considered in the analysis, hence, it is not necessary that all children born in a high exposure district are exposed to the hazards uniformly throughout the year.

SETTING THE CONTEXT:
EXPOSURE TO VARIOUS 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% of women and their children below the age of 5 years sampled for NFHS-5 belong to districts with high exposure to hydro-met hazards in 2021. In AEZ-3, 6, 7, 8, and 15, more than 70% sampled women and their children are exposed [29], [10].

Ministry of Earth Sciences report Rajasthan (15 districts) and Andhra Pradesh (13 districts) as the most vulnerable states for heat waves.

The University of Chicago data on air quality indicates that PM 2.5 prevalence exceeds the National Ambient Air Quality Standards (>40 µg/m3 annual averages) by the Central Pollution Control Board in the whole northern and central belts of India. However, if the World Health Organization (WHO) guideline of 5 µg/m3 is seen, much larger parts of the country is exposed to air pollutants.

IMPLICATIONS ON WOMEN'S HEALTH

Women face unique challenges stemming from the impact of climate change on their health, particularly in the context of increasingly frequent and severe climatic events such as heatwaves, air pollution, floods, cyclones, and droughts. These events pose direct threats to women's well-being across life stages, exacerbating vulnerabilities and complicating access to healthcare services. Pregnant women, for instance, face heightened risks during disasters, including exposure to contaminated water, limited access to prenatal care, and challenges in securing safe childbirth facilities. As primary caregivers and providers within their communities, women bear a disproportionate burden in navigating the impacts of climate change. Hence, the United Nations agencies launched a call to action on addressing health risks to women ahead of the worldwide Conference of the Parties (COP28) negotiations on climate change in Dubai [30].

HEAT WAVES

Research indicates a correlation between heatwaves and increased mortality rates; around 1116 deaths were attributed to heatwaves in India annually [31]. Studies in Nagpur showing a significant increase in all cause mortality during such extreme heat occurrences [32]. Pregnant women experience heightened health risks during heat waves, including complications such as preterm delivery [33], gestational hypertension and eclampsia [34]. Occupational heat exposure also poses challenges for female workers, impacting productivity and overall well-being [35]. In conclusion, the comprehensive mitigation of heatwaves impact on public health, especially among vulnerable populations like the elderly, pregnant women, and outdoor workers, is urgent.

AIR POLLUTION

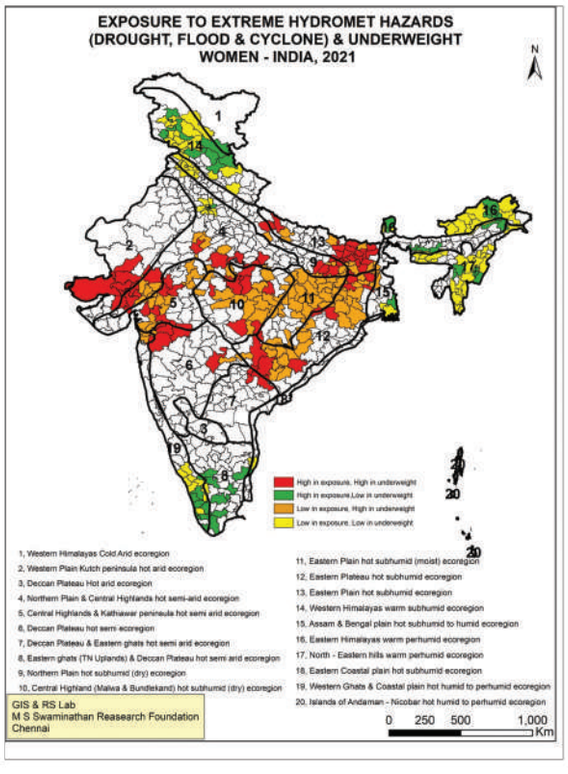
Within the air pollution crisis, women emerge as a particularly vulnerable demographic. Exposure to ambient particulate matter, notably PM2.5, correlates with decreased bone mineral content in women [36]. Poor indoor air quality increases health issues, with symptoms such as breathlessness and coughing reported by a significant proportion of women [37]. Women from lower income backgrounds spending long hours in kitchen, and young children suffer the most from indoor air pollution manifested through respiratory infections and perinatal mortality.

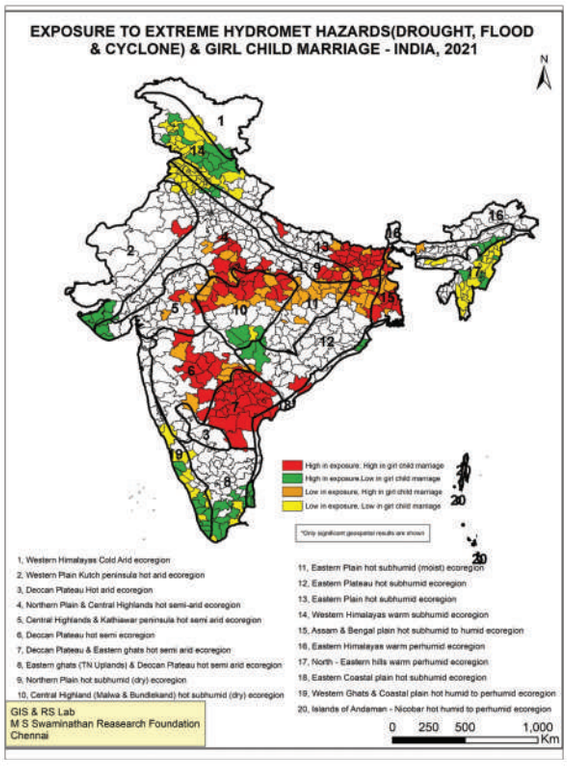
The complexity of addressing multiple air pollutants, such as black carbon aerosols, highlights the need for comprehensive strategies to safeguard women's health in diverse settings [38]. Addressing the gendered impact of air pollution on women's health in India requires urgent, targeted interventions to reduce exposure to both household and ambient air pollution.

To identify statistically significant hotspots highlighting the prevalence of heatwaves or prolonged heat and poor health variables, there is a need to generate detailed district-wise monthly temperature data that is currently lacking. The study however, was able to generate certain spatial hotspots where high exposure to hydro-meteorological hazards such as floods, cyclones and droughts significantly coexist with a higher prevalence of poor health variables such as underweight women and girl child marriage (See maps)

FLOODS

Altered precipitation patterns result in more frequent floods, bringing waterborne diseases, injuries, and mental health issues – women face disproportionate vulnerability, compounded by cultural norms and unequal resource distribution [39]. It increases risks to women's sexual and reproductive health (SRH) with disruption in healthcare services. Increased stress and low birth weight (<2500g) were reported after floods [40], [41]. Extreme weather events like hurricanes, can further disrupt SRH and increase health complications [40], [42]. Societal factors, including the caste system, compound vulnerabilities, affecting access to relief and recovery support [43]. Gender disparities exacerbate challenges in accessing sanitation facilities and maintaining safety in shelters [43], [44]. These challenges disrupt education and increase the risk of child marriage, particularly affecting girls in flood-prone areas. Addressing the specific needs of women is imperative to ensure the well-being of all, during and after disasters.





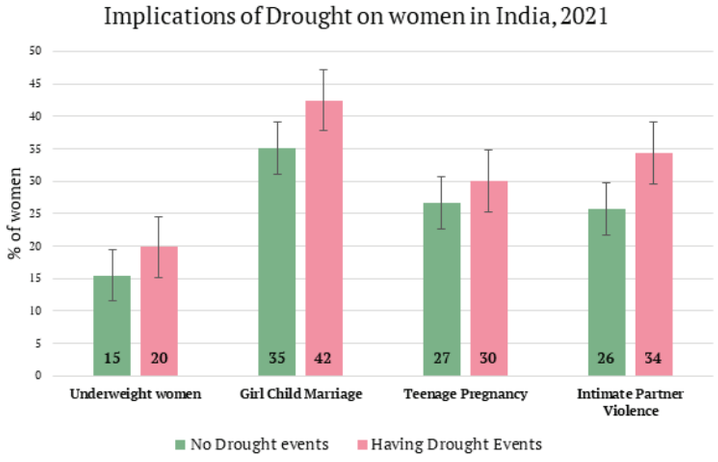
n terms of women's nutritional indicators, northern Bihar (AEZ-13), northern Gujarat (AEZ-2) and some areas in other agroecological zones need immediate attention. Five major hotspots emerge in terms of girl child marriage in areas exposed to hydro-met hazards: northern Bihar and parts of Uttar Pradesh in AEZ-13, southern West Bengal in AEZ-15, Andhra Pradesh and parts of Telangana in AEZ-7, eastern Maharashtra in AEZ-6, parts of northern Madhya Pradesh and southern Uttar Pradesh in AEZ-10 and AEZ-4. It should be noted that the darker green shade in

the map shows the regions where the exposure to hydro-met hazards are high, but both these indicators are better. This may be due to better programmatic implementation as well as community empowerment in coping with the hazards posed to health and livelihoods.

This study recognises that each hazard has different implications and it is difficult to attribute the effects of sudden and short-term hazards like flood and cyclone on various parameters, as their impacts are usually short-term. Contrary to this, slow and long-term hazards like droughts are likely to have more chronic and long lasting effects.

DROUGHTS

Reduced food supply and increased workload are among the immediate consequences of drought with women bearing the brunt of collecting water and managing household responsibilities [45]. This increased workload leads to irregular food consumption and adverse health impacts, including physical strain and mental stress [46]. Moreover, coping mechanisms adopted by women during drought conditions, such as skipping meals, further elevate the risk of severe malnutrition. Farmers, who are predominantly women in India, are particularly vulnerable due to their reliance on climate-sensitive livelihood and socio-economic status [47], [48]. This underscores the complex interplay between environmental factors and social dynamics affecting women in drought-affected regions. Drought imposes multifaceted burdens on women in developing nations, impacting their health, livelihood, and safety. Despite their pivotal roles as stewards of natural resources, women face worsened vulnerabilities under drought conditions.



Source: Study Team

Association of drought with selected indicators using regression analysis

	Odds Ratio
Underweight women	**1.35*** **
Girl Child Marriage	**1.37*** **
Teenage Pregnancy	**1.17*** **
Intimate Partner Violence	**1.50*** **

Significance level ***<0.001

Source: Study Team

Our analysis reveals a higher percentage of underweight women, girl child marriage, teenage pregnancy and intimate partner violence in districts witnessing exposure to drought events based on the analysis of 50 years climatic data. The unadjusted regression analysis further confirms that exposure to drought events increases the likelihood of prevalence of underweight in women significantly by 35%, girl child marriage by 37%, teenage pregnancy by 17%, and intimate partner violence by a haunting 50% [29]. At the same time, the rural-urban differential

analysis reveals higher vulnerability among rural women across these four indicators. Similarly, the distribution by social groups showed that exposure to drought has worse impacts on women's health indicators for both Scheduled Caste and Scheduled Tribes. However, it should be noted that the increase in vulnerability of women in terms of health indicators, is higher for Scheduled Tribes across all these indicators.

Climate change and disasters have adverse effects on not only the physical, but also the mental health of the affected population, a fact also acknowledged by the sixth assessment report of IPCC [8]. Socioeconomic vulnerability, long-term displacement, persistent material damage, and insurance-related problems act as the main predictors of mental health after floods. Studies done after Kerala floods revealed that female flood survivors were affected more with PTSD, anxiety and depression than males. Similarly, a meta-analysis finding revealed that adverse mental health outcomes are resulted due to elevated ambient temperature and likely to be increasing with a warming climate – for every one degree rise in temperature, there is a 2.2% increase in mental health related mortality and 0.9% increase in morbidity [49].

Limitations

Existing studies primarily rely on secondary data sources, with limited empirical insights into the health aspects of women affected by climate change. Furthermore, there is dearth of research focusing on the health status of migrant populations, particularly women, and their susceptibility to climate-related health risks. Impact studies often fail to disaggregate data by rural-urban-peri-urban, demographics or vulnerability, neglecting to address the unique health challenges faced by different gender and vulnerable groups. Moreover, flood related health studies tend to be qualitative, lacking specific quantitative analysis of critical effects like reproductive health and prevalence of vector borne disease such as malaria, dengue, fever, and Zika virus. Lastly, there is an absence of comprehensive research on the specific impact of heat-related health issues on women, particularly concerning their roles in agriculture and household responsibilities.

IMPLICATIONS ON WOMEN'S LIVELIHOODS

In developing countries, rural smallholder farmers, hugely dependent on natural resources for their livelihoods face multiple risks and challenges such as floods, cyclones, droughts, rising temperatures, and increasing rainfall variabilities [50]. The underlying vulnerability of such communities such as high levels of poverty, food shortages, and lack of social safety nets exacerbate the adversity of facing and adapting to climate events. Climate change impacts are not experienced equally and vulnerability to climate change is deeply mediated by an intersection of gender, age, location, livelihoods, and capacities to adapt [51]. Evidence on the gender-differentiated impacts of climate change underscores the disproportionate impacts on women, particularly poor women with lower access to material and natural resources that further limit their capacity to sustain and strengthen their livelihoods [52].

Women in India are largely engaged in informal and traditional livelihoods such as agriculture, forest-based activities, fisheries, tea plantations, and informal labour. Agriculture is impacted by temperature extremes, rainfall variabilities and droughts, thereby having implications for agricultural productivity, incomes and livelihoods [53]. At the same time, 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 [54], and effect on natural resources capital, such as water and energy sources (e.g., fuelwood) [53]. In India, high proportion of drought-affected regions bears a disproportionate burden on women, given their primary role in securing household resources and adhering to traditional gender roles [55].In of Koraput in Odisha that women perform almost the same amount of agricultural work during the peak seasons as men, if not manage farming entirely, when men migrate [56]. 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 by diversifying to the less risky, higher return, non-farm work due to their restricted mobility and gendered norms around home production responsibility, particularly for women with young children [57].

In India, migration remains a key livelihood strategy to diversify incomes and manage risk [58], [59], especially in the context of increasing climate variability [60], [61]. Though several studies examine how extreme events like droughts, floods, and erratic rainfall dampen agricultural livelihoods and drive out-migration [62], [63], fewer studies examine the differential benefits of moving [64]. There are two-prolonged implications of migration on women: First, women who migrate for alternative sources of employment report migration enabling higher incomes and economic standing, better educational prospects, and improved agency [65]. However, migrant women are typically engaged in low-skilled or unskilled roles, have limited access to financial services, and face issues of gender-based violence, work-place discrimination, and higher work burdens as they move [66], [67]. Second, research on 'left-behind women' argues that in the absence of men, women simultaneously experience improved autonomy and increased responsibility (e.g., higher care work for children and elders, increased productive work on and off farm) [66]. Male out-migration dampens health expenditure of left-behind/staying women, leading to negative health outcomes [68]. Among

left-behind women, households where women took on additional work had higher incidences of food insecurity than the ones where women did not work [65].

Forests-based livelihoods and Non-Timber Forest Products (NTFPs) have always been particularly integral to tribal communities living at the proximity of forests and biodiversity.

Fuel, fodder, food, medicine, etc. from the forest are used for selling as well as consumption in the households. Women from these communities are primarily involved in collecting the NTFPs. In states with significant tribal population such as Madhya Pradesh, Chhattisgarh and Jharkhand, when sold, Sal seeds fetch the highest price in the market, followed by Char, tendu leaves and Mahua flowers [69]. The shifting climate conditions have directly impacted livelihoods dependent on them as the market prices of lac, mahua and tamarind have fallen drastically. Evidence reveals depletion of forests and their biodiversity due to a complex set of factors leading to the disruption of the local sources of livelihoods. A study conducted in Jharkhand reveals a significant decline in lac (Kerria lacca) yield as well as deterioration of quality of Non-Timber Forest Products (NTFPs) attributed to rising maximum temperatures [70]. The decreasing forest cover and events such as forest-fires has also led to a rise in human-animal conflict, even in villages located far from the forests [69]. However, implications of loss of forests on vulnerable communities, especially women, are hardly captured.

Similarly, climate change manifested in terms of rising sea levels, increasing frequency of storms, cyclones and increased flooding have negative effects on coastal livelihoods. The evidence from the IPCC Special Report on Oceans and Cryosphere (SROCC) highlights that the warming of the ocean has already affected marine ecosystems [71].This can severely alter the functioning of marine ecosystems including mangroves and cause dramatic impacts on the associated social systems [72]. Population groups dependent on marine ecosystem for their livelihoods are at extreme risks of climatic events and face challenges including occupational uncertainty, damages of equipment and frequent relocation of residence [73]. Women are central to the fish value chain and their historical contribution has been immense, yet, women are often assigned the most unstable and poorly paid positions making women's positions precarious [71]. Climate crises thus has direct consequences on the food security and livelihoods of the fisher-people, and to the wellbeing of women and having negative implications for gender [71]. The lack of attention to gender within adaptation and to collect gender-disaggregated data makes matter more uncertain and worse for the women.

Representative image. Photo: Flickr/carol mitchell (CC BY-NC-ND 2.0)

HOW SUSCEPTIBLE ARE CHILDREN TO CLIMATE CHANGE?

Children are among the most vulnerable population groups for both death and disability due to climate hazards [74]. In five major natural disasters in India from 2000-2016, around 17,671 children lost their lives; 6.8 million children were reportedly in the path of tropical Cyclone Fani in India in 2019; The 2015-2016 drought in 10 states affected 37 million children under age 5 [75]; From 2013-2022, the total number of heatwave days experienced annually by children under the age of one was 43% greater than the equivalent demographic from 1986-2005 in India [11]; and, many states have seen a rise in Acute Respiratory Infections in children significantly associated with air pollution, with Delhi leading [76]. Because children are closer to the ground with higher pollutant exposure and have smaller lungs with higher respiratory rates, they get a higher dose and this impacts many organ systems, apart from the lungs. A landmark case in the UK awarded damages to the mother of a child who died of asthma, blaming the poor air quality; this has led to the coroner specifically listing air pollution as an underlying factor for death.

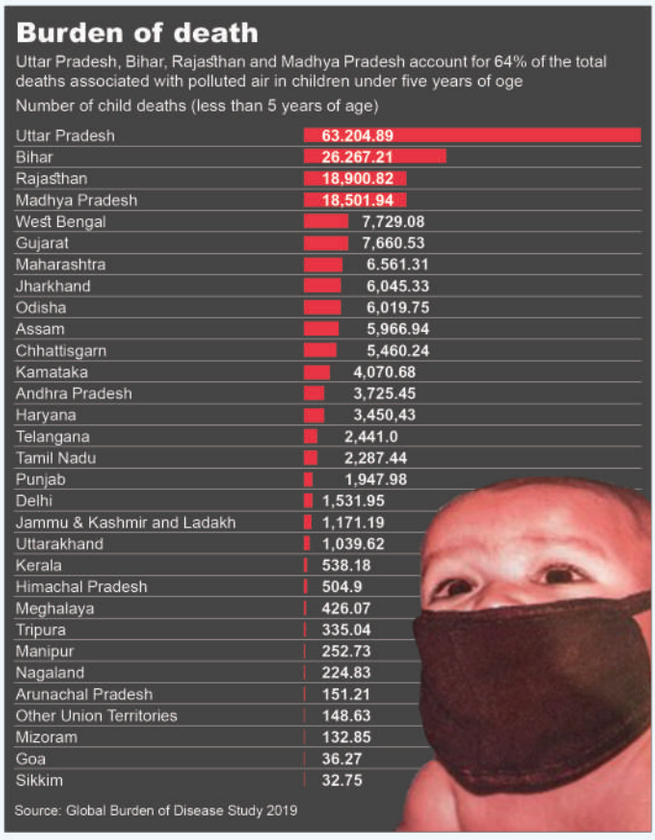



Image source Financial Express

AIR POLLUTION

Air pollution (outdoor and indoor) is thought to have contributed to the deaths of 116,000 newborns in India in 2019. Synergies between air pollution and climate change can magnify the harm to children [20]. Evidence has established the adverse implications of air pollution ***across life stages of children in India:***

In-utero children:

In the first trimester, increase in stunting and wasting for children < 5 years [78].

Pregnant women exposed to PM2.5 leads to adverse **neonatal** birthweight & mortality [79].

Infants and young children

Acute Respiratory infections on **very young children** (<5 years) [80].

High prevalence of upper and lower respiratory symptoms among **school-age children** [81].

Socio-economic factors can further increase children's susceptibility to respiratory diseases caused by air pollutants. Also, children affected by malnutrition are likely to be more vulnerable to the neurotoxic effects of air pollution [20].

HEAT WAVES


Image source Hindustan Times

Children remain the most vulnerable to heat waves due to their high metabolic rates [82], and because they spend more time outdoors participating in more vigorous physical activities, exposing them to heat strokes and burns, and to long-term effects of air pollution magnified by the rise in temperature [83].

In urban areas specifically, the phenomenon of 'urban heat island' makes matter worse [84]. Evidence from Ahmedabad heat waves in 2010 show increase in heat related illness through increase in neonatal intensive care unit admissions in an urban hospital [85]. Similarly, children in Varanasi and Pune city were found to be highly susceptible to, and and facing, increased mortality due to effects of temperature extremes and diurnal temperature variations [86], [87].

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.

DROUGHTS

Exposure in-utero (in the first trimester) increases the child's probability of being underweight (by 1.7%) and severely underweight (by 2.1 %) [88].

Drought conditions are attributed to undernutrition (stunting, wasting & underweight) in infants and children under 5 years of age [89], [90]. Droughts also increase the burden of work for women and children [46]. Empirical studies establishing linkages between drought exposure and child health outcomes have been scant:


Image source Tribune India

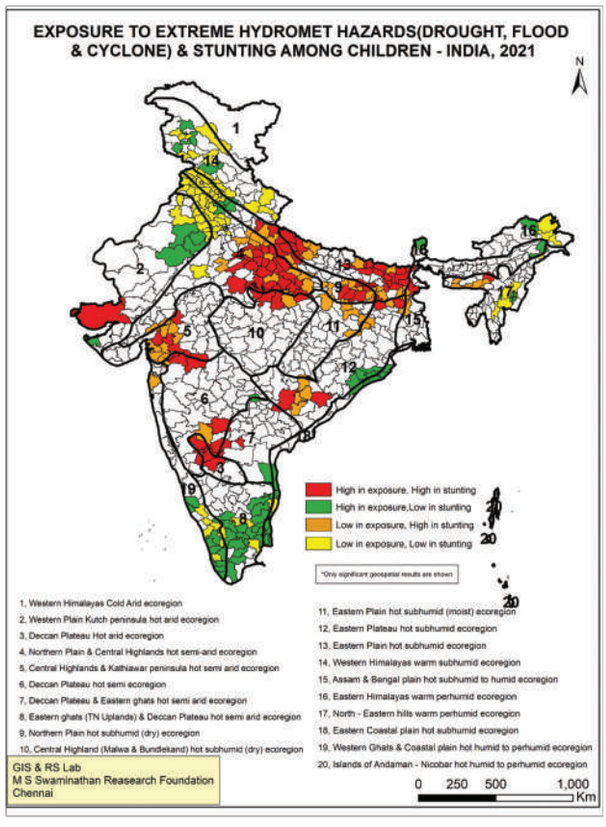
- **Kutch Peninsula hot arid region:** High prevalence of wasting, vitamin A & B complex deficiencies, anaemia, dietary deficits of energy and protein in pre-school children aged 0-5 years [91].
- **Eastern plateau hot subhumid ecoregion:** Widespread prevalence of malnutrition (wasting, stunting & underweight) in over on-fourth to half under-5 years children [92]
- **Deccan Plateau hot semiarid ecoregion:** Psychosocial illness and stress in children due to feeling neglected and overlooked regarding food, medication and sanitation [93].

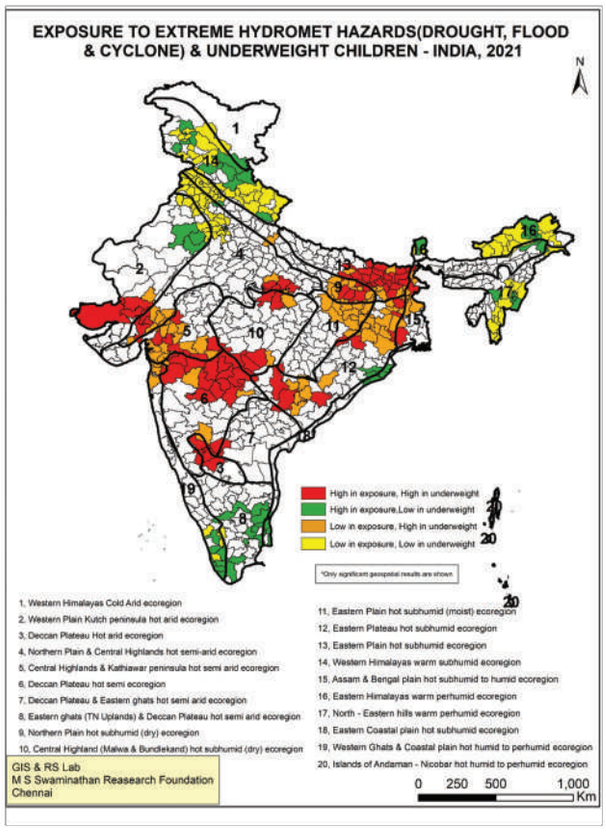
Image source ORS

FLOODS

Context-specific studies in India establish clear links between flood exposure and negative child health outcomes. Macro studies link exposure to excessive monsoon rainfall. & floods in-utero & first year after birth to poor health indicators among children under 5 years. At the same time, the limited empirical studies describe associations ranging from diarrheal and other infectious diseases, child undernutrition to post-traumatic stress symptoms [94], [95], [96], [97].

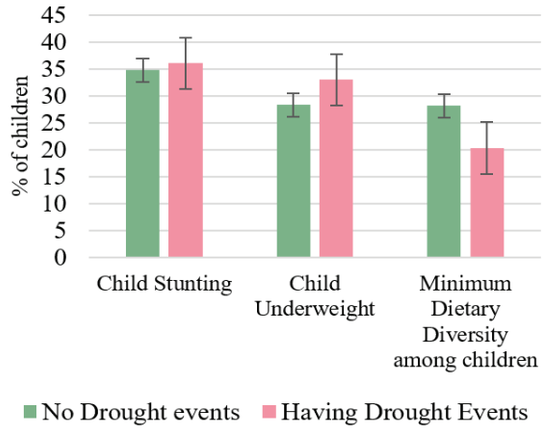
The geospatial maps show the hotspots (dark red shade) where exposure to hydro-met hazards (drought, flood, and cyclone) coexist with stunting and underweight children. The northern Bihar and northern Gujarat regions are hotspots for both stunting and underweight children. Apart from this, the northern plain, including parts of Uttar Pradesh of AEZ-4 and AEZ-9, are hotspots for stunting, and the northern part of Maharashtra and southern part of Madhya Pradesh are a hotspot for underweight children. Also, it should be noted that southern India and parts of coastal belts in Odisha have high exposure scores to hydro-met hazards but perform better in terms of child stunting and underweight, highlighting the role of stronger health systems.





In terms of implications of gradual hazards such as droughts, analysis reveal a higher prevalence of stunted and underweight children, and lower minimum dietary diversity in districts exposed to drought events based on an analysis of 50 years climatic data. The unadjusted regression analysis reveals that children are 6% more likely to be stunted, 24% more likely to be underweight, experience 35% reduction in minimum diet diversity, and 12% increase in the likelihood of deaths in under-five children if they are exposed to drought.

Implications of Drought on children in India, 2021



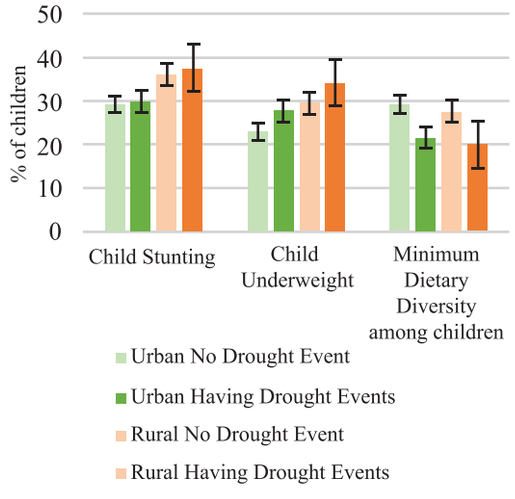
Source: Study Team

Association of drought with selected child health indicators using regression analysis	
	Odds Ratio
Children Stunted	**1.06*** **
Children Underweight	**1.24*** **
Minimum Diet Diversity among children	**0.65*** **
Deaths of children below age 5 years	**1.12*** **
Significance level ***<0.001	

Source: Study Team

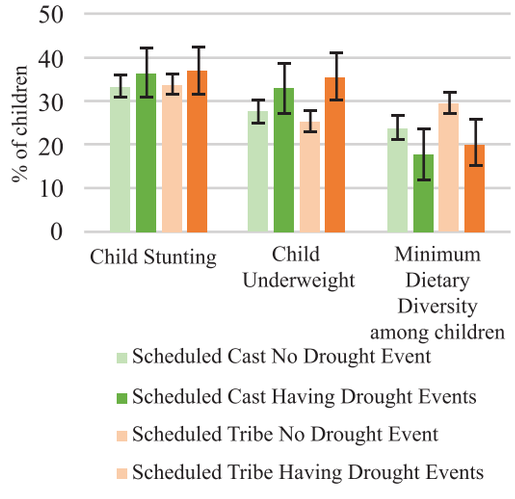
Additionally, the rural-urban differential is clearly depicted in the below graphs. Among the districts exposed to drought events, for child stunting, underweight and minimum dietary diversity, rural children are more vulnerable. At the same time, in terms of social groups, children from both Scheduled Caste and Scheduled Tribes are more vulnerable and their vulnerability increases if they are exposed to drought events. The minimum dietary diversity steeply falls for scheduled tribes if they are exposed to drought events.

Rural-Urban Differential in Implications of Drought on Children in India, 2021



Source: Study Team

Implications of Drought on Scheduled Caste and Scheduled Tribal Children in India, 2021



Source: Study Team

CLIMATE HAZARDS AND CHILDREN'S EDUCATION:

- Access to schools and learning disrupted
- Limiting children's cognitive and socio-emotional development and wellbeing: subsequent social disruption gives rise to anxiety in children for years afterward [98]..
- Health setbacks an adversely impact children's performance in schools, starting from impacts "in-utero" [99].
- Livelihoods disruption due to climate events, esp. in rural
- Children displaced due to migration of parents and are unable to continue their education [100].


Image source Indian Express

Emerging climate change related mental health conditions such as Ecoanxiety (fear of climate change impacts) and Solastalgia (distress produced by environmental change especially in one's own environment) are commonly reported among young and marginalised populations [101]. Children and adolescents are vulnerable during disasters and often report emotional distress and reduced self-efficacy and depression after events such as floods [102]. However, limited attention is provided to study the implications of climatic events on mental health of children and develop adaptation plans addressing such challenges.

Extreme climate events perpetuating social, gendered and structural inequalities

During droughts or floods, the likelihood of girls missing school & education opportunities is higher. School closures and acute climate crises threaten decades of progress made towards gender equality, placing many girls at heightened exposure to gender-based violence, sexual exploitation, forced (child) marriage & adolescent pregnancy [103]. Post-tsunami 2004, a spate of early marriages was reported; In Marathwada region, recurring droughts create demand for household labour units [104]. Children are forced to support in sustaining household livelihoods. 10.1 million children (5-14 years) are engaged as laborers in India (ILO, based on 2011 census). Alternatives such as remote learning and teaching opportunities widen inequalities due to differential access as 60% of school children in India cannot access online learning opportunities [105].

Limitations

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 focussing solely on children has been lacking and children are largely ignored in the response to climate change [19], [24], [26], [82]. In the 2023 Synthesis Report of the Intergovernmental Panel for Climate Change (IPCC) Sixth Assessment Report, the word "children" appears only two times. Evidence presents an accelerated momentum for studying the health effects of climate change only in the past few years [24]. Similarly, children from different socio-economic geographies and age groups would have different 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 [106]. It is important to address this key gap in evidence, to understand differential factors behind children's vulnerability to heat waves and develop a systematic method to measure children's exposure to heat waves. Relatively less research attention has been paid to this area of inquiry, particularly in India.

Jodhpur Heat Action Plan – Mahila Housing Trust

The Mahila Housing Trust (MHT) has trained 13,770 women as climate resilience specialists and impacted 13,664 households with improved water management. In Rajasthan, MHT collaborated with NRDC and Jodhpur Nagar Nigam to prepare the Jodhpur Heat Action Plan, with an aim to help women in vulnerable communities to withstand extreme heat. This strategic plan, realized through a collaborative effort, focuses on mitigating the harsh effects of heat waves, especially in impoverished communities living in slums. A cornerstone of the project is the implementation of a cost-effective cool roof program, which involves applying solar-reflective paint to the roofs of slum houses. This simple yet innovative solution has significantly reduced indoor temperatures, providing much-needed relief to vulnerable populations, including women, children, and the elderly, by enhancing their indoor comfort and health during peak summer months [Contributed by Rukmini Banerjee. Source: MHT]

Composite Water Resource Management (CWRM) Plans for Water Security and Climate Adaptation in Rural Areas

GIZ-MSSRF in partnership with the Dept of Rural Development in Tamil Nadu facilitated 1289 CWRM plans in the two most vulnerable districts in achieving water security. CWRM is a GIS-based tool to develop and implement scientific plans at the Gram Panchayat (administrative) and micro watershed (hydrological unit) level to ensure access to water and related ecosystem services in the context of changing climate and extremities. The process understands the social, climate, water and agricultural vulnerabilities, identifies the key water challenges and proposes key water actions/climate solutions in a saturated approach in the GIS platform. Further, the plan gets verified for its suitability with the participation of local panchayat, and women and men and decides the priorities of action to combat climate risks: seasonal drought, flash floods, heat waves, high-intensity wind, and shoreline changes vis-a-vis water. The different works identified will be mapped with the different public/govt schemes and facilitated at the gram panchayat level. The works covered in the areas of common/public land, individual land and rural infrastructures. [Contributed by Rengalakshmi, MSSRF and Radha Priya, GIZ]

Reviving Springs and Conserving Land

A Stone bund structure at Kantabanji village.
Photograph by Sachin Gurung

In Kantabanji village, facing persistent water shortages, Gram Vikas has empowered the community through watershed management initiatives and conservation activities. By training volunteers like Krishna Chandra Majhi in using the A-frame tool, the organization has overseen the construction of Staggered Contour Trenches (SCTs) and stone bunds, enhancing water conservation and preventing soil erosion. This work, part of Gram Vikas' Water Source Sustainability program, utilizes the mWater app for mapping and managing water sources. Over two years, these efforts have led to noticeable improvements in water availability for household and irrigation purposes, increased tree coverage, and revitalized springs, marking significant progress in the village's fight against water scarcity and contributing to sustainable agricultural practices. [Contributed by Rukmini Banerjee. Source: Gram Vikas, Odisha]

Ecosan Toilets Are Making It Safer for Rural Bihar's Women to Defecate During Floods


Image source Nidhi Jamwal

In Paschim Champaran, Bihar, villagers, especially women, are turning to 'Phaydemand Shauchalayas,' a type of ecological toilet, to cope with annual flash floods that disrupt traditional sanitation practices of the area. These toilets, which remain functional during floods, convert human waste into valuable manure for agriculture, addressing both sanitation and fertility needs without contaminating groundwater. Spearheaded by local women and non-profits, and supported by government subsidies and interest-free loans, this initiative has transformed the community's approach to sanitation, agriculture, and flood resilience, marking a critical step towards addressing sanitation challenges in flood-prone areas of north Bihar. [Contributed by Rukmini Banerjee. Source: Nidhi Jamwal]

Strengthening Indigenous Food Systems as a resilient pathway

Image source PRADAN

In the Santal Parganas region of Jharkhand and south Bihar, project CHIRAG (Creative Hub for Innovation, Reciprocal research & Action for Gender equality), supported by the Global Research Translation Award (GRTA) used various creative and participatory tools to document and exchange knowledge on sustainable and resilient food systems. Working with an interdisciplinary consortium of NGO partners, researchers, nutritionists, and Santal youth, nutritional components of locally available and affordable traditional foods was investigated and nutritionally adequate recipes were designed to form a Santal recipe book. Translation of these recipes among the communities as cooking demonstration workshops by the Santal youth have created conversations around biodiversity loss, shown an improvement in nutrition related knowledge, attitudes and practices among participants, emphasizing the importance of targeted interventions for nutrition literacy and healthier dietary practices. This research contributes to building a pathway to food security and nutrition in India, that goes beyond agriculture to focus on a holistic food system, ensuring resilience and sustainability of the ecosystem. [Contributed by Dr. Arundhita Bhanjdeo]

Green Bodoland Policy

Facing climate change impacts, Bodoland Territorial region, a sixth schedule region of approx. 3.5 million in the northwest part of Assam, has adapted through a pioneering Green Policy, aiming for a 'green, smart, and peaceful' future. The policy, initiated by a government led by a former activist, focuses on conservation and eco-friendly development, allocating 2% of all budgets to green initiatives. Efforts include the creation of new national parks and sanctuaries, Miyawaki forests for rapid reforestation, banning the depletion of underground aquifers, and promoting the use of surface water. Additionally, the region is transitioning to biodegradable packaging for agriculture products and fostering climate-resilient farming practices. This bold move towards environmental sustainability marks a significant step in combating climate change's adverse effects and improving community livelihoods. [Contributed by Dr. Sunil Kaul]

Climate Resilient Schools in Uttarakhand

Image source Dr. Chris Varghese

Launched under the Mission LiFE initiative during COP26, the Climate Resilient Schools project in Uttarakhand, established by Reckitt in partnership with the state government, represents a pioneering effort in India's educational sector to address climate change. These schools have been retrofitted with solar panels, energy-efficient lighting, and waste management systems, achieving a significant reduction in water and electricity consumption and CO2 emissions. The project also encompasses educational programs like the Children's Climate Champion and offers scholarships to students, fostering a generation of environmentally conscious individuals. With plans to expand this initiative across Uttarakhand, the project showcases a commitment to integrating sustainability and climate resilience into the fabric of education. [Contributed by Dr. Chris Varghese & Dr. Komal Goswami]

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

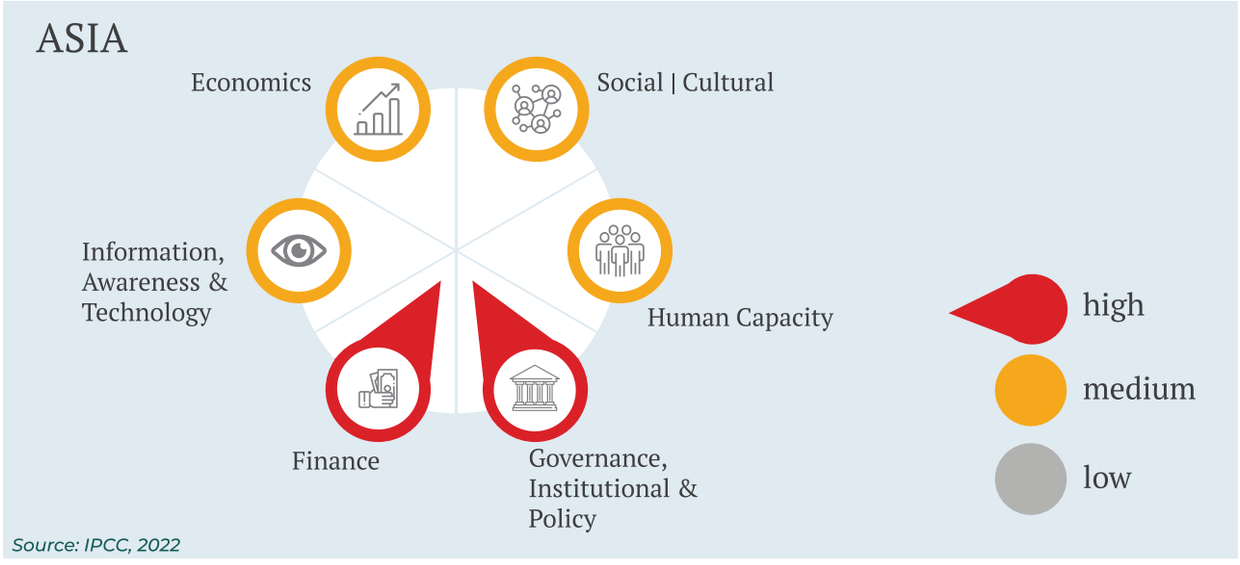
The GARBH-Ini Cohort Study, led by the Translational Health Science and Technology Institute and supported by the Department of Biotechnology, Government of India, focuses on the impact of environmental exposures, particularly air pollution and heat, on pregnancy outcomes. By enrolling 11,400 pregnant women and establishing a biobank of over 1.1 million biospecimens, the study aims to develop personalized prediction tools for birth outcomes. Preliminary findings highlight the significant risk posed by high PM2.5 levels, leading to increased preterm births and fetal growth restrictions. Collaborations with prestigious institutions aim to further explore the effects of heat and pollution, especially on low and middle-income populations, to inform targeted interventions for mitigating these environmental impacts on vulnerable newborns. [Contributed by Dr. Sreevatsan Raghavan]

Mainstreaming Gender in Climate Policy in India

India's climate policy acknowledges gender as a critical factor in vulnerability and adaptation but struggles with inconsistent and sometimes superficial integration of gender perspectives. The National Action Plan on Climate Change (NAPCC) and State Action Plans (SAPCC) highlight the impacts on women, yet often default to portraying them as victims or merely virtuous contributors, missing deeper gender dynamics. A review of 28 SAPCCs shows a lack of transformative approaches, with only a few recognizing women as agents of change. Recommendations for the ongoing revision of SAPCCs stress the need to move beyond stereotypes, recognize the vulnerabilities of all genders, and implement gender-transformative strategies that challenge existing structures of exclusion, ensuring a comprehensive and equitable approach to climate adaptation. [Contributed by Dr. Chandni Singh]

Financing Adaptation in India

Financing Adaptation in India report published by the Climate Policy Initiative (CPI) assesses India's approach to climate adaptation, highlighting gaps in policy and funding for adaptation in India. While India has frameworks for vulnerability assessments, it lacks systematic methodologies for evaluating climate risk and tracking adaptation funding. The report studied the State Action Plans on Climate Change (SAPCCs) of Odisha, Tamil Nadu, Kerala, Haryana, Himachal Pradesh and Goa, and found substantial investment needs. The annual investment needs of the six states alone amount to INR 444.7 billion annually. However, only Odisha and Tamil Nadu address adaptation funding gaps in their SAPCC.



Source: IPCC, 2022

The report points out that the states are primarily responsible for adaptation-related interventions, given the local nature of adaptations. Thus, the key to bridging climate adaptation funding gaps for the states is by incorporating adaptation criteria into fund allocation by the Finance Commission to the states and implementing climate-incentivized borrowing ceilings tailored to state-specific vulnerabilities. The report also proposes the importance of green finance data for informed decision-making and suggests deploying financial mechanisms like public-private partnerships (PPPs) to attract private capital. Furthermore, it proposes developing a Climate Risk Exposure and Adaptation Projects database. [Source: CPI] database.

FINDINGS AND RECOMMENDATIONS

1

The higher vulnerability of women and children to global warming impacts is dominated in the near and medium term by the need for further social and economic development. 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 operationalize these elements adequately and evenly.

Recommendations

a) The ongoing review of SAPCCs in India could be a way to mainstream 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 already addressed this issue. Budgetary allocation, coordination and monitoring and evaluation will be key. Also given the nature of the crisis, new governance structures and mechanisms, including a nodal coordinating body might be needed.

b) 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.

c) Longitudinal cohort studies of impacts of climate change on various aspects of health, household income, education, livelihood and other aspects need to be carried out in the different agroecological zones of India to inform context-specific solutions, for both sudden and more chronic hazards.

2

Pregnant women experience disproportionately higher health risks from the impacts of prolonged heat exposure. 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 is resulting in adverse reproductive outcomes including preterm delivery, gestational hypertension and pre-eclampsia.

Recommendations

a) State Action Plans for Climate change and Health need to prioritize actions to protect women and children from heat effects. 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

b) Implementation of tailored communication messages for pregnant women and mothers on the impact of extreme heat on health. Leverage Auxiliary Nurse-Midwives (ANM), Accredited Social Health Activists (ASHA) and Anganwadi workers to generate awareness among mothers and pregnant women on the adverse effects of extreme heat,

preparedness, measures to reduce exposure and widely disseminate heat-related weather forecast information during the season.

c) A consistent definition of a heat wave, including night temperatures and ambient humidity, needs to be jointly developed by IMD and health ministry, contextualized for different regions of India, from a women and children's health perspective. Facilitate comprehensive heat mitigation plans at the local level in coordination with Gram Panchayats and identify short, medium and longer-term actions. This includes increasing area under tree cover and restoring water bodies as they will bring changes in the micro-climate

d) Cities in particular need to keep urban heat island effects in mind while planning and designing housing and urban infrastructure. Blue-green spaces in cities bring down temperature considerably.

3

Climate change is increasing the frequency of certain diseases, including heat related, pollution related, water borne and vector borne diseases. Data shows that women and girls are disproportionately affected by many of these.

Recommendations

a) 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-related illnesses, and air pollution-related illnesses.

b) 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.

4

Climate change and resultant global warming are increasing the frequency of extreme weather events and climate-induced natural hazards. 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.

Recommendations

Provision of gender clinics, hotlines and helplines for women in areas impacted by extreme weather events. Establish emergency shelters during natural hazards that are gender-sensitive and actively protect women. These clinics and shelters have to be made easily accessible and affordable to all those in need.

5

The continued use of biomass for cooking and heating in homes accounts for a quarter of PM 2.5 ambient air pollution. Furthermore, studies suggest that women (more importantly pregnant women) are more vulnerable to the accumulation of inhaled particles in lung tissue and, consequently, to systemic hypoxia from anaemia linked to lung diseases. Not recorded but commonly observed is the massive use of cooking oils in poorly ventilated kitchens especially in urban or peri-urban slums, adding to the indoor air pollution.

Recommendations

Ensure the availability of clean cooking facilities for poor and vulnerable households, by addressing current gaps in implementation of the Pradhan Mantri Ujjwala Yojana (PMAY). Provisioning of exhaust fans needs to be explored, especially in urban, poorly ventilated houses.

6

Livelihoods especially of rural, agricultural women 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. However, research on the impacts of climate change on migrant women and children is scant. This gap needs to be filled.

Recommendations

Building resilience of women across urban and rural India necessitates a multi-faceted 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 a multi-faceted approach required involving all the relevant departments/Ministries including, inter alia, 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) sensitize departments/ministries to specific gender concerns in climate resilience, ii) review specific 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.

b) Ensure access to safe drinking water by augmenting the supply side of water resources at the local level.

c) 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

d) 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.

7

Women as First Responders: The majority of health care workers at the primary care level are 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.

Recommendations

a) The district mental health program needs to be strengthened with a focus on strengthening coping strategies, as well as identification of anxiety, depression etc at earlier stages, with a streamlined referral and management system

b) 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.

8

Finally, **there is a need for more research to understand the gendered impacts of climate change and to develop and test solutions.** At present, a lot of data is not disaggregated by sex and age. There is scope for innovations at the personal, household and community level to prevent or reduce the impacts of climate change on health and wellbeing. While this report focuses on women and children, other vulnerable groups like the elderly and disabled also need special focus.

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