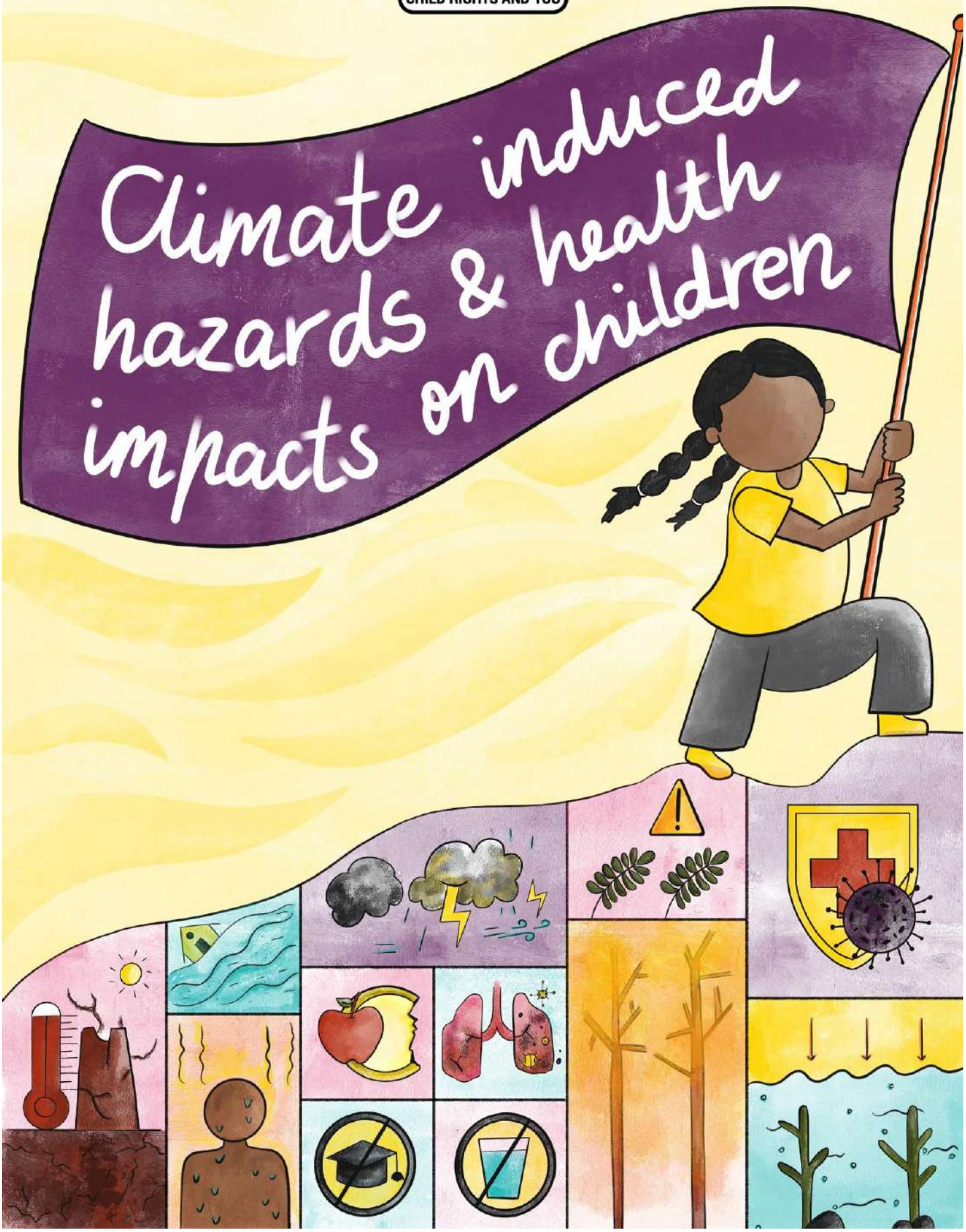
CHILD RIGHTS AND YOU

Climate induced hazards & health impacts on children



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CONTENTS

Foreword

The growing impacts of climate-induced hazards on children and communities in the state of Tamil Nadu, Andhra Pradesh, Telangana, and the Union Territory of Andaman Islands, is a critical and urgent issue. In these areas, environmental changes have become an undeniable reality.

As this study suggests, there are several ways climate change can deepen existing socioeconomic inequalities; through their negative impacts on children's education to health care services provision and even mental health support tailored for the youth. Children and young adults who are vulnerable and still undergoing development tend to suffer significantly from climate dislocations. In addition to disrupting and drastically altering people's lives, floods, droughts, cyclones, or rising sea levels also endanger livelihoods and futures by displacing or devastating populations and periodically emerging aftermaths.

Climate change is not merely an environmental concern; it poses significant risks to human health alongside equity and justice challenges as vividly illustrated in this study which profoundly highlights community voices alongside empirical data collection. The authors capture a comprehensive picture where families relying on agriculture, fishing or small-scale economic activities experience both physical health-related threats as well as economic recovery aftermath.

However, this is not a tale of hopelessness. This report highlights local actions from grassroots innovation to public programs that demonstrate the genius and perseverance of people adapting and responding to our changing climate. It calls for more cohesive, multi-partner and multi-level responses to climate change and the need for collaboration between governments, scientists, and educators, as well as communities

Ultimately, this work reminds us that the greatest cost of inaction will be borne by those with the least responsibility for it: our children. This is both a sobering realization and a hopeful plea to take bold, collective action to re-envision a healthier, more equitable, climate healthy future for generations to come.

John Roberts
Regional Director – South
Child Rights and You

1. INTRODUCTION

1.1. Background:

Climate change is an urgent global crisis impacting ecosystems, economies and human health, and addressing it should be a shared responsibility for everyone. However, it is becoming increasingly evident that climate change poses a significant threat to vulnerable populations worldwide, with children among the most susceptible to its adverse effects. The Global Climate Risk Index 2025 puts India as the 6th most vulnerable nation for climate change. As one of the most populous countries with diverse geography and demographics, India is highly vulnerable to climate change. Its impacts are especially severe on people who are already marginalised due to limited access to resources, further worsening their situation.

In India, the Southern region is considered to be performing better in terms of the Human Development Index indicators with better access to social security, public education, healthcare and other allied services, when compared to other regions. However, the frequency and intensity of climate-related hazards such as landslides, coastal erosion, cyclones, floods and droughts have recently increased in Southern India, exacerbating vulnerabilities in communities (Mohanty & Wadhawan, 2021). These hazards are compounded by unregulated tourism, increased pressure on land due to urbanisation and poor waste management disturbing the already fragile ecosystem.

Climate change is a major threat to coastal populations around the world (McGranahan et al., 2007). India has 640 districts, of which 76 are coastal districts, where about 17 percent (around 250 million) of the Indian population resides within 50 km of the coastline[1]. Population pressure, economic globalisation and natural hazards have made these states more vulnerable to disasters such as rising sea levels, extreme weather events and environmental degradation. The coastal regions of India, as in the rest of the world, are on the front lines of a shifting climate, such as experiencing rising sea levels, coastal erosion and extreme weather events, affecting millions of people. India lost 235 square kilometres of land to coastal erosion between 1990 and 2016, placing people's livelihoods and homes in jeopardy, with flight to safer places occurring voluntarily or, as a last resort, through government intervention. While most of the existing policies in India address displacement from rapid-onset disasters such as monsoons and cyclones under disaster reduction and rehabilitation policies, displacement due to slow-onset disasters such as coastal erosion has yet to find a place at the policy level.

Coastal urban areas such as Chennai are particularly vulnerable to the impacts of climate change, especially when combined with rapid urbanisation. Rising sea levels, extreme weather events and coastal erosion are significantly amplified by human development in these regions, leading to increased flooding, habitat loss and, threats to infrastructure and communities[2]. Chennai, with a population of 4.7 million (Census, 2011), receives monsoon rains between October and January, when the cooler dry northeast monsoon winds from the Himalayas and Indo-Gangetic Plain draw water vapour from Bay of Bengal and then pour it over the south-east coast of India. Since the city

[1] Sharma, M., & Khan, S. (2023). Coastal Resilience and Urbanization Challenges in India. In: Singh, A. (eds) *International Handbook of Disaster Research*. Springer, Singapore. doi:10.1007/978-981-19-8388-7_27

[2] Saleem Khan, A., Sabuj Kumar, M., Sudhir Chella, R., Devdyuti, B. (2020). Chennai City and Coastal Hazards: Addressing Community-Based Adaptation Through the Lens of Climate Change and Sea-Level Rise (CBACCS). In: Leal Filho, W., Nagy, G., Borga, M., Chávez Muñoz, P., Magnuszewski, A. (eds) *Climate Change, Hazards and Adaptation Options. Climate Change Management*. Springer, Cham. doi:10.1007/978-3-030-37425-9_39

is located along this coast, it is prone to cyclones that form over the Bay of Bengal. On 1st December 2015, Chennai received 490 mm rainfall, the highest in 107 years. The downpour literally drowned large areas while displacing thousands[3]. Global warming alters weather patterns with increased intensities of rainfall. The Chitale Committee that assessed the July 2005 Mumbai floods found inadequate drainage system, rapid development, loss of water holding ponds, illegal encroachment and decrease in mangrove/wetlands as major causes for the catastrophe[4]. These causes are similarly applicable to all congested coastal cities of India[5]. Intense development pressure on the coastline threatens natural biodiversity and ecosystem service delivery, such as protection from storm damage. Even though the extent and scale of disasters at the city-level are often localised, the impacts often extend to the national scale, given the critical political, social and economic roles of cities (UN-Habitat, 2014).

According to the map prepared by the Forest Survey of India (FSI), 2020, many places in the western ghats are declared as 'climate change hotspots'[6]. A climate change hotspot is a region that is likely to experience severe climate change impacts. These impacts can include heatwaves, droughts, floods and hurricanes. To worsen the situation, the erratic rainfall patterns in the western ghats have impacted food production, soil erosion and landslides. According to the AR6 Working Group I report, published by the Intergovernmental Panel on Climate Change (IPCC), in parts of the western ghats and peninsular India, data indicate that, with rising temperature, the rate of photosynthesis may have decreased, while the respiration rate keeps on increasing, thus reducing the net carbon uptake[7].

Rising temperatures and changes in rainfall patterns affect the agricultural yields of both rain fed and irrigated crops. For the last few years, areas surrounding the Godavari River in the Bhadrachalam district in Telangana have been facing incessant rains and flooding the surrounding areas. In July 2023, the Godavari River rose menacingly, flooding more than a hundred villages in Bhadrachalam and Manugur. Some local streams were overflowing on roads and causing inundation of residential colonies[8]. In July 2024, the National Disaster Response Force (NDRF) and State Disaster Response Force (SDRF) were deployed to rescue people from low-lying areas and evacuate them to relief centres[9]. Floods impact both individuals and communities and, have social, economic and environmental consequences. These recurrent unexpected floods each year due to erratic rainfall creates devastating impacts on the food, security and livelihood of the people living there, especially children from the marginalised sections, often leading to loss of life. The children are more vulnerable to such disasters as many of them live in hazardous areas in absolute poverty. Floods pose a high risk of water contamination in the affected areas. The settlement of Internally Displaced People (IDP) has a high risk of water contamination as running springs and streams, which are

[3] India contemplates climate change concerns after floods ravaged the coastal city of Chennai doi.org/10.1016/j.ocecoaman.2016.04.017

[4] Gupta, K., 2009. Mitigating urban flood disasters in India. In: Feyen, J., Shannon, K., Neville, M. (Eds.), Water and Urban Development Paradigms. Taylor & Francis Group, London, pp. 237e250

[5] Samuel Roumeau, Aicha Seifelislam, Shazade Jameson & Loraine Kennedy. Water Governance and Climate Change Issues in Chennai. 2015. hal-01144122

[6] Chaturvedi, R. & Jallu, P. & B.V., Shruthi. (2020). Mapping Climate Change Hotspots in Indian Forests based on High-Resolution Climate Model Projections.

[7] https://www.downtoearth.org.in/forests/troubled-woods-how-the-western-ghats-have-changed-due-to-global-warming

[8] https://www.newindianexpress.com/states/telangana/2023/Jul/27/godavari-water-floods-over-hundred-villages-in-bhadrachalam-manugur-2598951.html

[9] https://reliefweb.int/report/india/situation-report-1-flood-andhra-pradesh-24th-july-2024

usually the major source of drinking water, have the risk of contamination, which impacts the health of the affected population, especially children.

Children all over the globe are impacted by climate change, although children from developing nations are the most affected. Developing nations where resilience to shocks is low and livelihoods are often highly dependent on natural resources will be the most affected. Climate disasters lead to the collapse of public services and infrastructure. Without concerted actions, millions of children, due to their developmental stages, are particularly at risk of both direct impacts such as infectious diseases, death, injuries and loss of family and indirect effects including malnutrition, disrupted education and psychological stress (Sanson et al., 2019). Therefore, exploring the specific impacts on children in South India is crucial for providing insights to inform in-depth studies, which, in turn, would guide the development of 'child-centred' interventions and policies to ensure their safety, wellbeing and resilience. It was against this background that the present exploratory study was developed to investigate the various ways in which climate change is impacting children in South India, with a particular focus on the health-related challenges they face and the practices adopted to address them.

1.2. Literature Review:

Studies have shown that climate change can have far-reaching consequences for children's physical and mental health, education and overall development. Children in low-resource settings are especially vulnerable as they often lack access to the resources and support needed to mitigate the effects of climate change (Orłowska, 2018). A survey of primary schools in India highlighted the significant challenges posed by heat stress and discomfort on students, underscoring the need for further research in this area (Lala & Hagishima, 2023).

Existing literature highlights the impacts of climate change on children, including health risks, educational disruptions and psychological stress (UNICEF, 2019; IPCC, 2021). Children have contributed the least to climate change but are already disproportionately affected by its impacts. Although the existing literature on the impacts of climate change on children in South India is limited, several studies have examined the issue in other regions. For instance, a study on the effects of climate change on children in the Maldives revealed that comprehensive data collection and community consultations were essential to understanding the perspectives of children and their families (Orłowska, 2018). Similarly, a review of children's environmental health in South Africa highlighted the vulnerability of children to the ramifications of climate change and the need for urgent action to improve living conditions and other socio-environmental determinants of children's health (Mathee, 2018). In the context of South India, studies have documented an increased frequency of extreme weather events, affecting children's access to education, healthcare and safe living environments (Arpin et al., 2021).

The existing literature on the impact of climate change-related hazards on children, particularly in low- and middle-income countries (LMICs), highlights a pressing and multifaceted issue. Climate change poses a significant threat to children's health and wellbeing worldwide (Helldén, 2021). Numerous studies have documented the various ways in which a changing climate can negatively impact the health and development of young people. For example, rising temperatures and more frequent extreme weather events can exacerbate the spread of infectious diseases, leading to increased rates of vector-borne illnesses such as malaria and dengue fever (Watts et al., 2018). Rising temperatures can lead to heat-related illnesses such as heat exhaustion and heatstroke,

which can be particularly dangerous for young, vulnerable bodies. Moreover, the growing frequency and intensity of extreme weather events like hurricanes, floods and wildfires can cause direct physical harm, disrupt access to essential resources and health services and, lead to mental health issues (Sheffield and Landrigan 2011). Additionally, the increasing exposure of children to allergens and air pollutants associated with climate change has been linked to respiratory problems in children, including asthma and lung development issues (Bignier et al., 2024). For example, due to their physical immaturity, threats such as malaria and diarrhoea, hunger and malnutrition often result in much higher levels of illness and death among children, especially those under 5 years of age. Chennai is one of the biggest industrial hubs in South India, where approximately 3,500 small, medium and large-scale industries operate. The air quality index describes the overall atmospheric condition of the environment. Studies have shown that during the summer and pre-monsoon seasons the concentration 2.5 level exceeded the permissible limit[10]. Decreased exposure to air pollutants significantly reduces the morbidity level among the population.

Climate change-driven disruptions to food and water supplies can also contribute to malnutrition, stunted growth, and other nutrition-related issues in children (Haines & Ebi, 2019). Additionally, the stress and trauma associated with climate-related disasters have been linked to mental health problems in children, including anxiety, depression, and post-traumatic stress disorder (Hayes et al., 2018). A climate change study among poor children in four communities in the mid-west and central regions of Nepal highlights how the lives of children were disrupted due to landslides, floods and hailstones, which destroyed crops and property. The study used children's participatory videos and other participatory techniques such as focus group discussions and individual interviews to gather more evidence from the children involved in making the participatory videos. The study highlights that there is an increase in waterborne diseases during the floods. The children noted that due to the growing population there has been an increase in the number of vehicles; more waste has increased the pollution in Kathmandu; and the building of many new factories has resulted in lack of drinking water, destruction of fertile land and more air pollution. The children shared that due to the pollution, the fog gets thicker and the temperature drops, which makes it difficult for children to attend school and makes them sick. They revealed that during those days, coughs, colds and the swelling of hands are common. In Balaju, Kathmandu, the study cites that the rainfall, wind and heat disrupt study in the classroom due to the school having a galvanised tin roof. During summer it gets too hot and during monsoon the noise of rain on the tin shed disrupts classroom teaching. Education also gets disrupted during landslides as the roads get blocked[11].

With children's bodies and immune systems still developing, they are especially susceptible to the negative health impacts of the changing climate (Sheffield & Landrigan, 2011). Children will experience adverse health effects over a longer duration than adults, primarily because they are often not responsible for the actions leading to these consequences (USEPA, n.d.). This cohort effect is particularly pronounced among disadvantaged children who are already grappling with issues such as poverty, malnutrition and inadequate living conditions. It also emphasises that, while high-income families may have access to protective factors that mitigate the impacts of climate change, children from poorer backgrounds are exposed to a 'double burden' due to both environmental hazards and limited resources to cope with them (Etzel, 2024). There are both direct and indirect

[10] Mariselvam, A.K., M.A. Kumar, C. Dharmaraj, E. Maharaj. N. Dhasarathan and S. Sivanesan: Assessment of air quality index of urban area and epidemiological investigations in Chennai city. *J. Environ. Biol.*, 40, 790-795 (2019). **DOI:** http://doi.org/10.22438/jeb/40/4(SI)/JEB_21

[11] Dhruba Gautam and Katy Oswald (2008). Child Voices: Children of Nepal Speak Out on Climate Change Adaptation. ActionAid

effects of climate change on children's health, with the former including immediate impacts from extreme weather events, and the latter encompassing longer-term consequences.

As the world's climate continues to warm, children are becoming increasingly vulnerable to a range of adverse health outcomes, from respiratory illnesses to mental health challenges. Sharpe and Davison (2022) delved into the mental health implications of climate-related disasters for children in LMICs. Their scoping review reveals a significant gap in the literature regarding the psychological effects of climate change on young populations. Overall, the scientific consensus is clear: the impacts of climate change pose a serious and multifaceted threat to the health and wellbeing of children, particularly in resource-limited settings. Hence, there is an urgent need for more robust research to inform policy and intervention strategies aimed at mitigating these health impacts. This call for improved evidence underscores the necessity of addressing both the physical and psychological dimensions of climate change's effects on children as their futures are more uncertain than before.

1.3. Problem Statement:

Despite the increasing recognition of the impacts of climate change, there is limited research focusing on its specific effects on children. Children should be a central focus for policy and development as our global society strives to meet the Sustainable Development Goals (SDGs). It is against this backdrop that the present study seeks to provide an understanding of how climate change affects children and their communities, thereby aiming to inform in-depth future studies. Children's experiences of climate change and disaster are different from those of adults, yet their experiences are rarely considered. Child-centred participatory research can provide policymakers and practitioners with disaggregated information on the impacts of climate change on children that embrace the different needs and potentials that exist within 'child' groups whilst enhancing their capacity to act.

1.4. Child-centred Approach:

UNICEF and other UN bodies have been advocating for a child-centred approach to climate change adaptation. A child-centred approach to adaptation and disaster risk reduction targets activities that help reduce the vulnerability of children to climate change. This approach can be categorised into two types: programmes that focus specifically on children's needs and programmes that involve children in the design and delivery[12]. A child-focused approach can take place at both levels – community and national. At the community level activities based at school such as classes on disaster reduction or first aid or self-care can be trained. Similarly, at the national level, policy and legislation can be strengthened to build protection for children by integrating children's voices and concerns.

The economic argument for investing in child-centred approaches to adaptation can be summarised as follows:

1. Children are one of the largest groups at risk from climate change. Therefore, measures that specifically target this group can reduce the impacts of climate change across a large proportion of the population and may realise economies of scale. Importantly, child-led measures develop skills across a large segment of the population and over a longer period.

[12] UNICEF AND PLAN (2010). The benefits of a child-centred approach to climate change adaptation

2. Children are also a group most vulnerable to the effects of climate change. Therefore, the losses associated with the degradation of health, education, and protection caused by climate change are high. In turn, adaptation measures to protect children can offset these losses and realise significant economic gains.
3. Many of the interventions that can reduce the vulnerability of children to climate change are some of the lowest cost options and are already well established, such as insecticide-treated mosquito nets, and, water, sanitation and hygiene training

However, there is a dearth of localised studies that integrate community perspectives and document their current practices. This exploratory study will build on the available literature by providing mapping and analysis specific to South India.

1.5. Objectives

The study aims to achieve the following objectives:

1. To document and map climate-related hazards in the selected localities.
2. To explore the impact of climate change on children and communities, with a special focus on health.
3. To document community practices for addressing climate change-related health challenges in the region/locality.

1.6. Research Questions

1. What are the indicators of climate change in the selected study area?
2. What are the prevalent climate-related hazards in selected localities of South India?
3. How do these climate-related hazards or events directly and indirectly impact children and their communities, particularly in terms of health?
4. Are there any factors (physical, economic, social, etc.) that differentiate the impact of climate change on children's health and their coping strategies?
5. What community practices are in place to address climate change-related health challenges?

1.7. Significance of the Study

This study will provide critical insights into the specific impacts of climate change on children's health in South India, a demographic often underrepresented in climate research. By mapping hazards and high-risk areas in the selected localities, exploring the impact of climate change on children's health, and documenting community practices, the study will provide insights to inform in-depth future studies, which, in turn, would guide the development of interventions and policies to ensure better health outcomes, safety, wellbeing and resilience.

2. METHODOLOGY

It is apparent from the introduction that the impact of climate change on children is little understood, especially in the context(s) of India. Keeping this in mind, this study adopted an exploratory research design and employed an inductive qualitative approach. It aimed to investigate an unfamiliar problem about which the researchers had little or no prior knowledge. This exploratory design helped to unravel the nature of the issue by providing opportunities for the study participants to contribute to knowledge-building in this domain (Hunter et al., 2019). This process, in turn, also contributes valuable insights for developing interventions to address the challenges and difficulties encountered by the study participants.

The study was conducted in the following five phases:

1. **Literature review**: A review of the available literature on climate change and its impacts on children, with a special focus on health, was conducted as the first step, thereby establishing that the phenomenon remains largely unexplored.
2. **Developing a suitable methodology and tools for data collection**: The second phase of the study focused on developing a flexible methodology and tools for data collection, keeping in mind its aims and objectives.
3. **Primary data collection**: In the third phase, the study documented climate-related hazards and the experiences of the study participants and stakeholders through key informant interviews and focus group discussions (FGDs) with children, community members and key stakeholders from the selected locations.
4. **Data analysis and interpretation**: Recorded interviews and FGDs were transcribed as **the** first step in this phase. The data, in the form of text, was later analysed, and themes were identified and interpreted under the key findings. Based on the findings, recommendations and conclusions were prepared.
5. **Report writing**: An outline was prepared, and a comprehensive report was developed based on it.

2.1. Study Areas:

The study areas for this exploratory research on the impact of climate change on children in South India were selected based on several criteria. Regions were identified as climate change risk locations (McGranahan et al. 2007), considering areas that have experienced a high frequency and intensity of climate-related hazards such as heavy rainfall, floods, cyclones, and temperature changes in contemporary South India. The selected areas also fall under internationally recognised ‘biodiversity hotspots’. In addition, demographic and socioeconomic factors were considered while finalising the locations, as children from marginalised and economically disadvantaged communities are often the most vulnerable to the effects of climate change (UNICEF, 2021). The selected areas represent the diversity of South India, including urban, rural and tribal settings, to capture the impacts of climate change on children across different contexts.

In short, the regions were chosen considering their varied climatic conditions, biodiversity, highly vulnerable coastal ecosystems, high exposure to climate-related hazards, dependence on natural resources and diverse socioeconomic contexts (see Table 1 below).

Table 1: Locations Covered

SN	Geographical Features	Locality
1	Western Ghats	Kodaikanal (Tamil Nadu)
1.a	Urban[13] and coast	Chennai (Tamil Nadu)
2	Island and coast[14]	Sri Vijaya Puram (Andaman & Nicobar Islands-ANI)
2.a	Island and Tribal[15]	Hut Bay (Andaman & Nicobar Islands)
3	Rural and Tribal [16]	Dummugudem, Bhadrad Kottagudem (Telangana)
4	Rural[17]	Yetapaka, Alluri Sitharama Raju (Andhra Pradesh)

2.2. Sampling Design and Sampling Size:

This study followed a purposive sampling design to identify children and other study participants from the selected locations, in line with the qualitative framework of the study. Besides residing in the geographical locations, demographic characteristics such as socio-economic status, gender, and age were considered as criteria for purposively selecting the respondents. This purposive approach allowed the study to reach participants who could provide the necessary information to meet the research objectives.

A total of 256 study participants were planned to be covered from four different respondent categories: children, women, men/elderly and stakeholders from the selected locations (Table 2 below). The study purposively planned to select boys and girls between the ages of 13 and 17 years (students between 8th and 12th standard) under the category of children, considering their level of understanding and capacity to express themselves. The research proposed to include stakeholders such as government officials, community leaders, subject experts and CSO representatives, with the aim of capturing an in-depth understanding of the phenomena, including state policies and their implementation status in the study locations.

Table 2: Sample Planned

Location	Children	Women	Men/Elderly	Stakeholders	Total
Kodaikanal	16 (2*8)	16 (2*8)	16 (2*8)	0	48
Chennai	16 (2*8)	16 (2*8)	16 (2*8)	4	52
Dummugudem	16 (2*8)	16 (2*8)	16 (2*8)	4	52
Yetapaka (AP)	16 (2*8)	16 (2*8)	16 (2*8)	4	52
ANI	16 (2*8)	16 (2*8)	16 (2*8)	4	52
Total	80	80	80	16	256

2.3. Data Collection Methods and Tools:

The study used focus group discussions (FGD) and key informant interviews as methods for data collection considering the objectives of the research and respondent categories. These qualitative data collection methods offered scope for study participants to share their voices without being restricted to the questions usually designed by the researchers in quantitative studies. Tools such as interview and FGD guides were used to elicit information in detail from the respondent

[13] Urban Heat Island Effect, recurrent flooding, water scarcity, erratic rainfall, health risks (Hegde, n.d.; Jayaraman, 2022; Narayanan, 2020).
[14] Biodiversity hotspot, ecologically fragile, with high dependence on nature, and rising sea levels (Baraik, 2023; Anujan, 2020).
[15] Indigenous population including PVTs (Particularly Vulnerable Tribes) and dependence on nature, rising sea levels
[16] Heavy rainfall, recurrent flooding, and heat waves.
[17] Recurring Flooding & Rainfall

categories. These methods were also found to be useful in reducing the power imbalance between study participants and researchers (Hunter et al., 2019).

Table 3: Categories and Data Collection Methods

SN	Categories	Data Collection Method
1	Children (Boys & Girls)	Focus group discussion
2	Women	Focus group discussion
3	Men/Elderly	Focus group discussion
4	Stakeholders	Key informant interviews

2.4. Fieldwork, Data Collection, and Data Analysis:

Fieldwork was conducted between the first week of January 2025 and the second week of February 2025. As against the plan, the study could cover **290** respondents from different categories. Keeping in view the study's aim to explore the phenomenon, it attempted to cover more respondents from each category. The support received from CRY's field partners helped increase sample coverage and conduct the fieldwork without much difficulty. Facilitators from local contexts assisted the research team in conducting the FGDs and coordinating interviews with stakeholders. Additionally, access to the consultant's network, who supported the study, played an important role in facilitating interactions with many stakeholders, especially state representatives, in each location (Table 4).

Table 4: Sample Covered

Location	Children	Women	Men/Elderly	Stakeholders	Total
Kodaikanal	32 (4*8)	16 (2*8)	16 (2*8)	9	73
Chennai	16 (2*8)	16 (2*8)	16 (2*8)	5	53
Dummugudem	32 (4*8)	16 (2*8)	16 (2*8)	6	70
Yetapaka (AP)	8 (1*8)	8 (1*8)	8 (1*8)	2	26
ANI	16 (2*8)	24 (3*8)	16 (2*8)	12	68
Total	**104**	**80**	**72**	**34**	**290**

FGDs and interviews were recorded wherever possible with the consent of the participants, and the recordings in Tamil, Telugu and Hindi were transcribed into English. Based on the codes, themes were identified from the text. The finalised themes were then analysed and interpreted in line with the research objectives. Although not in a strict sense, intersectionality was adopted as an analytical framework while analysing the data. This approach asserts that people are often disadvantaged by multiple sources of oppression or discrimination based on their race, class, gender, region, religion, caste, etc. In this study, gender and caste or community background were considered to understand the situation and perspectives of the study participants.

2.5. Ethical Considerations:

There were no potential risks for the children and other study participants while participating in the study. An ethical protocol for the study was developed at the proposal stage and strictly followed throughout the research process. The protocol included the following points:

1. Voluntary participation: The respondents were not forced to participate in the study, and their participation was entirely voluntary.
2. Informed consent: The research team obtained written consent from all study participants. They were informed of the purpose of the study and its intended use. Informed consent also included their right to withdraw from the study at any point.

3. Confidentiality: The protocol ensured the anonymity of the participants by replacing their original names with pseudonyms in the report. It also mandated the secure storage of data.
4. Non-interference: The investigators did not unnecessarily interfere within the respondents' lives or work. The protocol provided clear guidelines against giving unnecessary advice, making false promises, or interfering in respondents' personal matters.
5. Safe spaces for data collection: The research ensured that data collection was conducted in safe environments for children and other respondent categories.
6. Plagiarism: The final report was ensured free of plagiarism, and an accurate presentation of the results.

2.6. Limitations:

Since the study is a qualitative exploratory inquiry dealing with a small sample population, generalising the findings is a limitation. Due to the limited timeframe, especially for fieldwork, the research could not delve deeply into the issues in question. The limited number of female researchers on the team made it challenging to cover all gender-related aspects of the study.

Although the research team was able to schedule appointments with a few senior bureaucrats from different states, they could not provide adequate time to share their experiences and views due to their busy schedules. This, in turn, limited the scope to explore their perspectives in detail.

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3. TELANGANA

3.1. Context:

Telangana is located in the south-eastern part of India and is bordered by Maharashtra to the North, Karnataka to the west, Andhra Pradesh to the east and south and Chhattisgarh to the northeast. The State of Telangana was formed in June 2014; before this, it was part of Andhra Pradesh. This state is situated in the Deccan Plateau. The terrain is characterized by hills and valleys, and it is home to several rivers and streams, including the Godavari and Krishna rivers. The Godavari is the most significant river that flows through Telangana, contributing greatly to its irrigation and water supply. The Krishna River also has a significant presence, especially in the southern parts.

The climate in Telangana varies from semi-arid to tropical, with three distinct seasons: summer, monsoon and winter. The climate has a significant influence on agriculture in the state, with crops such as rice, cotton, groundnut and maize being common. The monsoon season is crucial for irrigation, especially in dry areas. Overall, Telangana's geography and climate make it a region of contrasts, with both arid and fertile landscapes, and a climate that can range from scorching heat to pleasant winter days. The average annual rainfall is about 906 mm, and the climate is hot and dry. The monsoon season starts in June and ends in September. Summer starts in March, with a peak in May when the average high temperature is 46 °C. The winter starts in late November and lasts until early February.

As of the 2011 Census, Telangana's population was approximately 35.2 million, out of which the SC population is 54.09 Lakh, and the ST population counts for 31.78 Lakh. However, the population has grown since then, and estimates suggest it is around 39–40 million as of 2021-23. Around 28-30 percent of the population is in the age group and 0-6 Years. The gender distribution was quite balanced, with a slight male population edge (50.5 percent).

Health profile with special reference to children's health:

Telangana faces significant public health challenges, highlighted by a neonatal mortality rate of 27 deaths per 1,000 live births, accounting for 65 percent of all infant deaths. Malnutrition is prevalent, with 43 percent of children under six and over 80% of adults affected, increasing the vulnerability to these diseases. An increase in childhood anaemia from 60.7 percent to 70.0 percent in children aged 6-59 months has been reported in NFHS 5. Vector-borne diseases like malaria, dengue, filariasis and chikungunya are notably present, especially in semi-arid regions such as Hyderabad and surrounding districts. Malaria is prevalent due to water pollution and climate sensitivity, with transmission occurring year-round and potentially increasing with rising temperatures.

3.2. Profile of the Study Area:

Climate change has had a significant impact on any community around the world, however marginalised communities like tribals and Dalits (SC) are often among the most vulnerable. In Telangana, tribal and Dalit communities are particularly affected by climate change due to their reliance on agriculture, forest resources and traditional livelihoods. Telangana has 10 SC-ST-dominated districts named Mahabubabad, Bhadradri-Kothagudem, Adilabad, Kumuram Bheem, Jayashankar, Mancherial, Nagarkurnool, Jangaon, Khammam and Jogulamba Gadwal. For this study,

data was collected from six villages[18] of the Dummugudem Block in the Bhadradri-Kothagudem district. Most villages had a tribal-dominant population, while one village had an SC-dominant population. There were 2425 households in six villages. Of these, 1524 were tribal households; 293 were SC households; and 608 belonged to other communities. The principal occupations of these households are agricultural labour, and very few are involved in agricultural practice. The child demographic profile of these villages revealed that there were 162 children in the 0-5 age group, 163 in the 6-14 age group and 142 in the 15-18 age group. The dropout rate in these villages is higher among the boys' age group (6-14) and almost equal in the 15-18 age group. All the villages have an Anganwadi centre, and only one village in the study area does not have a school.

Focus group discussions (FGDs) were conducted with children at schools and in villages. In-depth discussions were conducted with both male and female community members from the villages. In the study location, the researchers interacted with key stakeholders, including medical doctors, Anganwadi workers, teachers, Panchayat members and community leaders. They also interacted with district-level officials. These interactions helped to understand the practical experiences of communities during disasters, particularly the impacts of climate-related events such as floods. By engaging with various stakeholders at the state level and analysing policy documents, the study assessed both the immediate effects of such disasters and how well the policies and response strategies have been working.

3.3. Key Findings:

The findings, derived from the personal accounts shared by the children and other participants, are presented below, emphasising how their lives were impacted by the climatic events that occurred in this area in recent years. The key insights from the exploratory analysis are outlined as follows.

- Human activities contributing to climate change in the area: Bhadradri Kothagudem district in Telangana is rich in minerals, particularly coal, and is the headquarters of the Singareni Collieries Company Limited (SCCL), a government coal mining company. SCCL operates both opencast and underground coal mines in the district and surrounding areas. Many industries are unauthorised and without proper inspection these industries are contributing to air, land and water pollution. Interaction with the communities revealed that mining led to large-scale deforestation disrupting local ecosystems, reducing biodiversity and exacerbating soil erosion. Coal mining and burning contribute significantly to air pollution, which accelerates climate change such as high summer temperatures.

  The Sita Rama Lift Irrigation Project is a major irrigation initiative in the state of Telangana**,** India. It aims to lift water from the Godavari River to provide irrigation and drinking water to the drought-prone areas of the Khammam, Bhadradri Kothagudem, and Mahabubabad districts. It is located in the Dummugudem Block of Bhadradri-Kothagudem district. Though it is expected to irrigate 9.36 lakh acres and provide drinking water to nearby villages and towns, the other side of it is that it would impact the environment due to deforestation and habitat disturbance and tribals lose lands under this project, which results in displacement.

  Another significant thing to note here is that, although the Polavaram dam is in Andhra Pradesh and seven Blocks to be submerged under that were merged into Andhra Pradesh already, there are another five Blocks currently in Telangana viz. Bhadrachalam, Dummugudem, Ashwapuram,

[18] The villages are - Laxminagaram, Sunnambatti, Gowraram, Mulakanapalli, M. Kasinagaram, and Managattu

Manuguru and Cherla which will also be affected when the water in Polavaram reaches its full potential, as per the information given by the local people.

- Climate-related hazards: Erratic rainfall, floods and cyclones: Over the last two decades, deforestation coupled with heavy rainfall has led to increased rainfall, flooding and damage, affecting infrastructure, agriculture and livelihoods. All the villages we visited were affected by erratic rainfall, floods and cyclones, which hindered their access to health and education.

  Extensive visits and in-depth discussions with the residents of Laxmi Nagaram, Sunnambatti, Gowraram and Mulakanapalli villages explored numerous challenges impacting their daily lives. The primary source of these hardships is the Godavari River, which significantly influences their living conditions. The Godavari River, one of the major rivers in India, has been a source of sustenance for communities living along its banks. However, recurrent floods have caused widespread devastation, severely impacting the lives and livelihoods of the local population. The floods of 2014 and 2022–23 were particularly destructive, displacing families, disrupting education, and leading to economic instability. In September 2024, Telangana experienced severe flooding due to heavy rainfall from a depression over the Bay of Bengal. The state recorded up to 298 mm of rainfall in some areas, leading to widespread devastation[19]. The floods resulted in the tragic loss of 29 lives, with 29 of 33 districts declared flood affected. These areas also experienced extensive floods in the previous years 2022 and 2023, which were also destructive, displacing families, disrupting education, and leading to economic instability.

  The floods have periodically affected the areas such as Laxmi Nagaram, Sunnambatti, Gowraram, Mulakanapalli and in the town of Bhadrachalam. The residents of these villages recalled July 2022 as a time of severe devastation, and the town of Bhadrachalam experienced significant flooding as the Godavari River's water levels rose to 70 feet, marking the first occurrence of such a level in 30 years. This event led to the inundation of several colonies within Bhadrachalam and disrupted the road networks on three sides of the town. The villages from the study area became inaccessible during the rainy season. “When thirty years ago, when I came here, rain used to come regularly throughout the crop season now it doesn’t”, remarked an old man from a village. It was shared by other people that in the last ten to fifteen years, rain has reduced during the monsoon season and attributed deforestation as the cause. It was shared by the people that the cyclone also affected their lives. Last year, a cyclone came, and it rained for 10-15 days. It usually comes in the summer season. Due to changes in climatic conditions, the frequency of cyclones has increased.

- Impact on resources and communities, and government response: The community has been facing floods every year for the past 20 years. It was shared that in 1986, they faced massive devastating floods, and everything washed away. Villagers were relocated to another location for one month, but they had not received any rehabilitation or compensation grants from the government. In 2004, a devastating

> **Case 1:** A person named Dakuri Chitti Babu, a 35-year-old youth, died during the 2022 flood. He was trying to manage his buffalo, and suddenly floodwater entered the village; no one was there to rescue him. He was married and had two children. His legal heirs received only Rs 10,000 in compensation. The town was submerged in the morning, and the National Disaster Response Force (NDRF) arrived late at the flood-affected M. Kashinagaram village.

[19] https://www.downtoearth.org.in/natural-disasters/catastrophic-flooding-in-andhra-pradesh-telangana-triggered-by-bay-of-bengal-depression?utm_source=chatgpt.com

flood of the same kind hit the villages, affecting all the villagers. In the years 2021 and 2022, they were also affected by floods. In 2022, due to heavy rain, Godavari overflowed and inundated several villages. The people had to leave the villages, leaving everything at home, and lost everything, including livestock. After a month, when people came to their villages, and found that they were full of mud, and they slept under the trees, not receiving any concrete help from the government. Some NGOs helped them with food items and other utensils. Government organised relief camp for one month and gave monetary relief of Rs 10000 to some people. It was revealed during our FGD that out of 27 people, only 15 have received monetary relief. When asked why the rest did not receive the monetary compensation, the affected people shared that they had some discrepancies in their bank account, but even after correcting those discrepancies and making multiple visits to the government office, they are yet to receive the compensation. Every year, during the rainy season, the rising waters of the Godavari cause severe crop losses, leading to financial hardships for families and pushing many into poverty.

Another negative impact of regular flooding is reduced accessibility. The boat is available only during the flood period, but accessibility is an issue even after the water has receded. Post flood, from July to September children cannot or find it difficult to go to schools. During the community discussion, people shared that in the 2022 flood, 42 houses were washed away, and mud and grass were everywhere in the village. “Based on the support from the government and voluntary agencies, we started to rebuild our houses, but we lost our utensils and other stuff”, said a villager.

In the village of M Kashinagaram, most of the people do not have their own land and they work as agriculture labourers. The villagers mentioned that in the last 20 years the cropping pattern has changed as earlier people used to cultivate Sorgham (Millets, green gram) and they got good yield, but now they cultivate only paddy and rice, and the quantity of yield has also decreased. This has affected their livelihood, and they are forced to migrate to other locations in search of work.

- Impact on livelihood*:* Studies have found that climate change manifestations such as high temperatures and erratic rainfall adversely affect agricultural yields and crop variability. For instance, the maximum temperature has a significant adverse effect on the rice, cotton and groundnut yields[20]. A study was conducted in two districts of Telangana to analyse the vulnerability level of farmers to climate change, and it was found that 75 percent farmers belonged to the moderately or severely vulnerable category[21]. Aligning with these findings, this study also found that the community where the study was conducted was also facing the impact of climate change on their livelihood. While talking to people from the study area, they mentioned that earlier they used to see rain for three months and now its frequently happening for more than three months, and there is no fixed rainy season. Furthermore, due to this winter has decreased and summer months have increased. In the village M Kashinagaram, out of 110 families, only 20 families own agricultural land and others work as agricultural workers and are landless. They get Rs 300 as a daily wage for agriculture work and work eight hours a day. Although there were variations in the opinion of equal wage, few people mentioned that both men and women get Rs 300, while others explained that men earn up to Rs 500 and women earn up to Rs 300 only. They get work only for three months, a maximum of Rs 9000 a month,

[20] Guntukula, R., & Goyari, P. (2020). Climate Change Effects on the Crop Yield and Its Variability in Telangana, India. *Studies in Microeconomics*, 8(1), 119-148. https://doi.org/10.1177/2321022220923197 (Original work published 2020)
[21] Sindhu, M.U., et al (2024). Farmers Vulnerability to Climate Change in Telangana State - A Critical Analysis. Mysore J. *Agric. Sci.*, 58 (4): 111-122.

they earn for three months from July to September, and apart from these months, they either sit at home or migrate to nearby cities in search of work. The economic impact of climate change on the agricultural production and livelihood of the marginalised people of this area is summarised in the Table 5 below.

Table 5: Impact of climate change on seasons and livelihood in the study area

Month	*Season 20 years ago*	*Current Season*	*Work/Livelihood*	*Earning by marginalised community*
January	Winter	Winter	Migrating to small cities for daily wage work, they travel around 30 km from their village to Bhadrachalam town for chilly picking	Rs 300/per day
February	Winter	Summer	Chilly picking outside the village	Rs 300/per day
March	Summer	Summer	No regular work	
April	Summer	Summer	No regular work	
May	Summer	Summer	No regular work	
June	Summer	Summer	No regular work	
July	Rainy	Summer	Agriculture work	Rs 300- Rs 500/ per day for men Rs 300/ per day for women
August	Rainy	Rainy	Agriculture work	Rs 300- Rs 500/ a day for men Rs 300/ a day for women
September	Rainy	Rainy	Agriculture work	Rs 300- Rs 500/ per day for men Rs 300/ per day for women
October	Erratic rainfall	Erratic rainfall	No regular work	
November	Winter	Erratic rainfall	No regular work	
December	Winter	Winter	No regular work	

In some villages, people are engaged in fishing for their livelihood. They revealed that earlier they used to catch more fish and varieties of fish, but now due to the change in climate the quantity and varieties have decreased.

- Temporary displacement: Flooding can lead to temporary displacement as people are forced to evacuate their homes due to rising water levels. Flood-induced displacement is defined as the involuntary or forced movement, evacuation, or relocation of individuals or groups of people from their habitual places of residence due to the consequences of a flood[22].

  After the 2022 flood, there was mud on the roads for many days, many families lost their belongings, and 30 families were shifted from nearby villages. Many huts were damaged, cattle died, and trees fell. No electricity for many days. Government people took photos, they shared the photos, but nothing was helpful (S Jyoti, Ex-sarpanch, Interview).

A community leader said, “We are facing double displacement…. every year from flood and also, we are afraid of the construction of dam in Godavari River”. In Sunnambatti village, members were promised by the administration that if they left this place, they would be given a house plot, but people did not want it and refused to move out. Backwater from the Polavaram dam had entered the villages through the Sita Rama Lift Irrigation Project.

Impact on agriculture: Chilli, tomato, brinjal, maize and brinjal are grown extensively in these areas besides paddy fields. Farmers shared that the cropping season of Chilli is September - October and January – February in this area. A virus known as Gemini has affected crops for the

[22]https://iopscience.iop.org/article/10.1088/1748-9326/abc586

last decade. This virus affects both the cold and hot seasons. Due to the change in climate, the temperature has become extreme in both summer and winter seasons, and this Gemini virus came. Villagers shared that some scientists came to the village but could not find the details of this virus. They suggested choosing alternative crops. Scientists have found no solution to this virus. The government recommended not to grow this crop. A copy of the scientist's investigation report was not given to the people.

- Impact on Nutrition and Food security: Flooding in Bhadrachalam has profound implications for food security, especially for those from the marginalised sections. FGDs with men from the community revealed that the immediate impact of flooding resulted in the destruction of their crops, and loss of livestock, leading to reduced food availability. Beyond the immediate aftermath, floods disrupted access to food markets and supply chains, critical in rural areas like Mulakanapalli and Gowraram, where communities depend on local crops (e.g., paddy, pulses), making it difficult for affected communities to access food. This situation leads to increased food prices, further intensifying the challenges for the tribal population in the district. As a compensation, the government only gives Rs 10000 per family, but no extra food grain is given.

  The long-term impacts are equally concerning. Floods led to soil erosion and loss of fertile land, diminishing agricultural productivity. Discussions revealed that to increase agricultural productivity, there has been widespread use of synthetic fertilizers, pesticides and herbicides, which have significantly altered the way food is produced. While these chemicals boosted short-term yields, they degraded soil health over time and reduced biodiversity. The residual chemicals present in the food impacted the nutritional content and safety of the food. In children, exposure to these chemicals is especially harmful as it can affect their developing immune and nervous systems, leading to long-term health issues.

  Discussions with the community revealed that the shift in agricultural practices also affected food availability and affordability. With the increasing reliance on processed foods that often have lower nutritional value and higher amounts of unhealthy fats, sugars and preservatives, mothers in the FGD revealed that children are consuming more calories but fewer essential nutrients, leading to undernourished children. In 2022, over 10,000 people who were evacuated from Bhadradri-Kothagudem and staying in relief camps often struggled to get balanced nutrition.

- Impact on health: Repeated flooding can have significant impacts on the health of people in affected areas. These impacts can be both immediate and long-term, and they vary depending on the severity of the flooding, the preparedness of the community, and the resources available for recovery. Discussion with the community and health officials from the health centres revealed that with repeated flooding, there has been an increase in chronic diseases such as kidney problems as well as acute diseases like malaria, typhoid and dengue. Strong summer heat coupled with air pollution increased the incidences of heat stroke, respiratory issues, and cardiac arrest. The key findings are summarised below:

  Increased Risk of Waterborne Diseases:

  - Contaminated Water: Flooding often led to the contamination of drinking water with bacteria, viruses, and parasites. This resulted in outbreaks of waterborne diseases such

as cholera, dysentery, and typhoid. Many cases of leptospirosis[23] were also reported from the area. White mosquito was found, and fever cases increased.

- Vector-Borne Diseases: Standing water after floods created breeding grounds for mosquitoes, which increased the spread of diseases such as malaria and dengue**,** with the district recording the highest number of cases, making it one of the most severely impacted areas in the state.
- Increase in snake bite cases. "We get snake bite cases daily - around 100 cases in OPD per month, and many times we don't have enough antivenom", said a PHC doctor.

Mental Health Issues:

During the visits, the researchers met people suffering from socio-psychological issues. Displacement, loss of property, and uncertainty about the future are common concerns among people living in the Bhadrachalam areas, such as Mulakanapalli, which lead to grief and emotional distress. Tribal communities, such as the Koya in these regions, face additional stress due to disrupted livelihoods. Moreover, these areas, including Gowraram and Laxmi Nagaram, lack post-flood psychosocial support. Experiencing repeated floods creates significant psychological stress, and people shared that they worry about the safety of their homes, the wellbeing of their loved ones, and the financial burden of recovery. This constant anxiety has led to increased rates of depression and post-traumatic stress disorder (PTSD). Researchers also noted that, after repeated floods, communities may be experiencing social isolation as friends and neighbours move away or struggle to rebuild, leaving individuals feeling disconnected.

- Impact on access to health services: Given that the study area is a rural setting and in close proximity to forests, accessibility and the quality of healthcare are major challenges. Poor road infrastructure, especially during the monsoon, further complicates transportation to hospitals or clinics. The region is surrounded by dense forests and hilly terrain, making it challenging for ambulances or healthcare workers to reach isolated areas in a timely manner. All these issues of access are compounded multiple times during floods and heavy rains. Flooded roads and damaged healthcare facilities complicate efforts to provide care during and after such events, leaving residents without medical assistance for extended periods. Moreover, the health centres have limited infrastructure and inadequate personnel, who are, during normal circumstances, heavily overburdened, thus compromising on quality care. Many times, people had to go to private health care providers, spending their limited earnings.

  I had to pay Rs 500-600 for a simple fever, as the Primary Health Centre in Dummugudem is 15 km from my village. Many times, we are forced to obtain medicine and injections from a nearby private medical store. In the PHC, doctors are not available 24 hours a day, and during night time, only a nurse stays at the PHC. Many people don't have an Arogyashree card, so they have to pay for treatment from their own pocket even at the PHC, said a person from the village.

It was shared by the medical officer that Primary Health Centre was also affected during the flood for 10 days. One doctor was present during the flood in the PHC, but the PHC was inaccessible. The PHC was submerged, and five staff including one doctor were residing at the PHC for 10 days,

[23] Leptospirosis is contracted through contact with water contaminated by infected animals.

and after 10 days one boat came. During the flood, the PHC was not prepared, and no boat was provided to the PHC; therefore, the staff could not able to provide health services.

> During floods, we focus mainly on providing delivery services as we have limited staff. During any disaster and flood, all pregnant women were rescued first and put in a safe place. The phone was working only for two days after that phone connection was also lost (PHC Doctor, Interview).

- Impact on the health of children: Telangana, because of unplanned urbanization, industrialization and deforestation, is facing severe climate change resulting in heat waves, erratic rainfall and flooding. Studies in various countries have reported that children, especially very young children, are particularly vulnerable to heat waves. Children's renal disease is an important consequence of heat waves. Exposure to extreme hot weather can induce heat-related conditions including hyperthermia and heat stress in children, and the renal system can be stressed or compromised by a suite of reflexive thermoregulatory, physiological and circulatory adjustments. Respiratory diseases also increase among children during the heat wave periods. Some effects can differentially impact girls[24]. The study found that the impact of erratic rainfall and flooding due to climate change on children's health in Bhadrachalam is severe and multifaceted, affecting their physical, mental and emotional wellbeing. Here are some major health impacts on children found in the study area:

  Waterborne Diseases:

  - Increased risk of infection: Flooding often leads to the contamination of water sources with bacteria, viruses, and parasites. It was found that children, especially those under the age of five, were more vulnerable to waterborne diseases such as cholera**,** dysentery**,** typhoid and gastroenteritis**.**
  - Dehydration and malnutrition: Flooding disrupted access to nutritious food, leading to malnutrition. Additionally, children suffered from diarrhoea or other gastrointestinal infections are at risk of dehydration, which can be life-threatening if not addressed promptly.

  Increased Exposure to Vector-borne Diseases:

  - Mosquito-borne illnesses: Stagnant water left behind after floods serves as a breeding ground for mosquitoes. Children in flood-affected areas are at a higher risk of malaria and dengue**.** These diseases are particularly dangerous for young children, whose immune systems are not fully developed.
  - Other Vector-Borne Illnesses: Other diseases such as leptospirosis can also spread more easily in flood conditions.

> The Tribal Welfare Ashram High School (Girls) in Gowraram serves as a vital institution for educating and empowering tribal girls in the region. However, the school faces several challenges that affect the quality of education and student wellbeing. During a discussion with the principal and students, it was found that they encounter several difficulties, particularly during the rainy season.
> This is a residential school. During the rainy season, the school became an island surrounded by water. It is completely disconnected from rest of the village.

[24] Xu, Z., Sheffield, P., Hu, W., Su, H., Yu, W., Qi, X. & Tong, S. (2012). Climate Change and Children's Health—A Call for Research on What Works to Protect Children. *International journal of environmental research and public health* . 9. 3298-316. 10.3390/ijerph9093298.

Respiratory Problems:

- Mould and damp environments: After floods, damp and mouldy conditions are common in homes and shelters. Mould growth triggered respiratory problems in children, as reported by mothers during FGDs. Interviews with doctors also corroborated these issues. "Mumps and fever cases increased last year", said the PHC doctor.
- Poor air quality: In the aftermath of floods, the air quality can be worsened due to the presence of pollutants, contaminated debris, and damp materials. Moreover, air quality affected due to open-pit mining affects children's health negatively, leading to new respiratory problems.

Injuries and Physical Harm:

- Drowning risk or death: One of the most immediate threats to children's health during floods is the risk of drowning. Although no child deaths were recently reported from the study villages due to flooding, small children were swept away by the strong currents of floodwaters in other villages. However, children from the study villages reported getting hurt due to sharp objects, fallen trees and other debris being swept away during floods.

Mental Health Impacts:

- Emotional trauma: It was evident while talking to the children that they carried emotional trauma from the flood events. The loss of homes, separation from family members and witnessing destruction caused fear and anxiety, leading to post-traumatic stress disorder (PTSD)**.** These effects can be long-lasting and may manifest in behavioural changes, sleep disturbances and difficulty in concentration in the future.
- It was obvious from the children that they suffered from feelings of insecurity, frustration and confusion due to the disruption of school, regular activities and family life.
- One child shared how one of his friends who lost his family members in the flooding experienced immense grief, which also affected him very much.

Nutritional Deficiencies:

- After the floods, children in those villages faced food shortages, which resulted in under-nutrition among many children in the area. Malnourished children are more vulnerable to infections and chronic illnesses. Prolonged periods of inadequate nutrition can stunt physical and cognitive development in children and a lack of essential nutrients can lead to growth retardation**,** weakened immunity, and developmental delays.

- <u>Impact on the education of children:</u> The impact of floods on children's education in Bhadrachalam was significant, especially when the floods were severe and widespread. The findings are summarised below:
  - Destruction of School Buildings: Floods led to the destruction of school infrastructure, including classrooms and libraries. Rebuilding also takes time. This disruption forced schools to close for extended periods or even relocate to temporary shelters. In most of the areas under study, during floods and the monsoon, some schools were closed up to two-three months.
  - Many students shared that their books, bags and other learning materials were washed away or lost, hindering their educational process.
  - This extended closure for months coupled with the loss of books, significantly disrupted their academic calendar. Many students had to repeat the academic year as they were unable to pass the exams or had a decline in academic performance.

- The temporary displacement faced by many families in the area also made it difficult for many children to attend school.
- Many children also found it difficult to focus on studies due to psychological distress.
- For some children, even if the school building is not affected, due to flooded roads they are unable to attend school, leading to prolonged absences.
- Economic hardships forced some girls to drop out early to support their families or enter into early marriages.

- Climate change awareness: When asked the children about climate change, one girl student said, "Godavari harsaal hamare ghar me aaati hain yahi climate change". This discussion was conducted at Eklavya School during a focus group discussion with children, and it was found that they are aware about the biodiversity, and schools are organising monthly activities on the environment and climate change. We found that children were aware of the relationship between pollution and deforestation and its relation to climate change, such as increased rainfall and health issues. They shared that, factories and the use of plastics are polluting the water bodies. When asked how this can be stopped, they said community mobilisation and awareness is necessary. They knew the importance of protecting nature.

- State intervention and policy gaps: In 2019, Telangana State drafted its State Action Plan on Climate Change and Human Health (SAPCCHH), which was revised on 28th September 2022 and is applicable until year 2027. This action plan covers the climate vulnerability, and the prevalence of climate-sensitive diseases, along with a Health Adaptation Plan for air pollution, heat-related illness and vector-borne disease. This action plan has also mentioned the health adaptation plan for disaster management, green and climate-resilient health care facilities. This highlights organisational structure and various initiatives taken by the State on climate change with specific reference to human health. Although the State Action plan covered various aspects, there was no separate mapping of the impact of children's health or gender dimensions due to climate change.

3.4. Recommendations:

Addressing the above challenges requires a multifaceted approach. The following proactive measures and engagements will support coping, mitigation, and resilience-building among communities in response to the impacts of climate change.

- Investing in flood management infrastructure, such as flood banks, can offer protection against floodwaters. However, it is essential to recognise that relying solely on such structures may create a false sense of security and could have environmental and social implications.
- Given the potential for increased flooding, droughts, or extreme heat events due to climate change, improving disaster preparedness and response systems at the community level is crucial.
- The local population, particularly farmers, may need to adopt climate-resilient agricultural practices to cope with the altered environmental conditions caused by mining and climate change. This could include drought-resistant crops, rainwater harvesting, and the use of sustainable farming techniques.
- Proper rehabilitation: Fishermen feel that the government should provide annual maintenance support for damaged fishing nets.
- The government should provide boats in every flood affected villages.

- During rainy season regular health camp should be organised at the Sub-centre level, as accessing Primary Health Centres (PHCs) becomes difficult. Leveraging technology to provide remote consultations and mobile health services in hard-to-reach areas could help bridge the healthcare gap.
- Expanding and upgrading healthcare facilities, including equipping primary health centres with modern medical tools and increasing the availability of essential medications.
- Training and deploying more doctors, nurses and paramedics, especially in remote areas, would help alleviate the strain on existing facilities and improve the quality of care.
- Initiating more awareness campaigns to educate the population on hygiene, disease prevention and the importance of timely medical intervention.
- Ensuring the development of a women and child health preparedness plan in every climate hazard zone.
- Strengthening transport infrastructure and providing better emergency ambulance services would ensure timely medical care during critical situations.
- Expanding access to affordable public health services, along with better implementation of government health schemes, could ease the financial burden on low-income families.
- Ensuring that women have access to maternal and reproductive health services, especially in remote villages.

Addressing these challenges requires a coordinated effort between the government, healthcare organizations and the local community to ensure that the residents, especially children of Bhadrachalam, have access to quality healthcare services.

4. ANDHRA PRADESH

4.1. Context:

The state covers an area of 1,62,968 sq. km, which is 4.96% of the geographical location of the country. Physiographically, the state can be divided into the coastal region and the comparatively drier Rayalaseema region. Andhra Pradesh has a coastline of around 974 km, the 2nd longest coastline in the nation after Gujarat. Two major rivers, the Godavari and the Krishna, run across the state. Andhra Pradesh is located between 12°41' and 19.07°N latitudes and 77° and 84°40'E longitudes in the southern part of India. The climate of Andhra Pradesh state is generally hot and humid. The summer season in this state generally extends from March to June. During these months, the moisture level is relatively high. The coastal areas experience higher temperatures than the rest of the state. The southwest (SW) monsoons play at the major role in determining the state's climate. Approximately one-third of the total rainfall in Andhra Pradesh is received during the northeast monsoons, typically around October. According to the 2011 census, the total population of Andhra Pradesh is 8.45 crores (for the unified state). The Scheduled Caste (SC) and Scheduled Tribe (ST) populations are 1.38 crores (16.41 percent) and 0.59 crores (7 percent), respectively. Out of the 23 districts before the bifurcation, the top five ST-dominant districts accounted for 47.39 percent of the ST population, and the top five SC dominant districts accounted for 29.50 percent of the SC population in the state (Census 2011, Andhra Pradesh including Telangana).

4.2. Study Area:

This study was conducted in Alluri Sitarama Raju district of Andhra Pradesh, which is prone to various natural disasters, including floods, cyclones and coastal erosion. The district's geographical location along the eastern coast of India, coupled with its proximity to the Godavari River, makes it susceptible to these events. Being one of the nine coastal districts of Andhra Pradesh, Alluri Sitarama Raju is vulnerable to cyclones and coastal erosion. The study covered two villages, Veeraigudem and Nellipaka in the Yetapaka Block of the district.

One village was predominantly tribal, with 475 households. Of these, 187 households belonged to the ST community, 58 to the SC community, and 230 to other communities. The majority were Hindus and worked as agricultural labourers. Both villages have almost equal child demographic status across all age groups, while the dropout rate is higher among boys in the 6–14 and 15–18 age groups. Both villages have schools and Anganwadi centres, and both were affected by floods.

4.3. Key Findings:

- Human activities contributing to climate change in the area: The Polavaram Project is a multi-purpose irrigation project on the Godavari River in Andhra Pradesh. The project aims to provide irrigation, drinking water, and hydroelectric power. It is located in the West Godavari District of Andhra Pradesh. It would provide irrigation facilities to about seven lakh acres. It is estimated to give an irrigation boost to the drought-prone Rayalaseema region, also apart from Coastal Andhra Pradesh. It is expected to enhance agriculture and employment. Another additional benefit of this project is the expected hydropower generation of about 960 MW. In spite of the multi-purpose utility of this project, there are certain downsides to it that are affecting human lives. Seven blocks in Telangana will be submerged once the dam construction is completed. Hence, at the time of the bifurcation of the state in 2014, seven Blocks viz. Chintoor, Kunavaram, Vararamachandrapuram, Yetapaka, Bhadrachalam Rural, Kukunoor and Velerupadu, which

were originally part of Khammam District in Telangana, were merged into Andhra Pradesh. More than 370 villages will be affected and about 2 lakh people, mostly tribals, will be displaced.

Deforestation and land use changes: The Alluri Sitarama Raju district is known for its forests and natural resources. However, deforestation for agriculture, urbanisation and logging can disrupt local ecosystems and contribute to greenhouse gas emissions. Trees play a crucial role in absorbing carbon dioxide (CO_2), and their removal releases stored carbon. Agriculture is a major activity in the region, and practices such as the burning of crop residue and the use of chemical fertilisers and pesticides contribute to greenhouse gas emissions. Emissions from livestock farming (methane) also play a role in climate change.

- Climate-related hazards:
  - While the Polavaram dam may intend to control floods, it can paradoxically intensify them as floods may occur due to intensifying monsoons due to climate change and subsequent sudden surge in Godavari river inflows. If dam operations are not timed well, this can also worsen floods.
  - Land acquisition for constructing the dam will destroy large tracks of agricultural land as well as forest land of the tribals.

In the Polavaram dam project in Andhra Pradesh, heavy upstream monsoon rains produced record inflows, stressing the entire Godavari basin; local geometry, river congestion, and rapid release downstream leading to flooding in 2022-23.

- Impact on resources and communities and government response:

Impact on Agriculture:

- Destruction of crops: Repeated floods in the region resulted in the inundation of agricultural lands, causing extensive damage to standing crops. This led to a loss of seasonal produce, especially during the monsoon months, when rainfall is more intense. Crops such as paddy, which are cultivated in low-lying areas, were inundated, resulting in poor yields or complete crop failure.
- Soil erosion and loss of soil fertility: The frequent floods caused by rains and backwater accumulation in the area led to soil erosion, particularly along riverbanks. This reduced land fertility, making it difficult for farmers to grow crops in subsequent seasons. Soil erosion also leads to sedimentation in rivers, which can further intensify flooding.

> We mostly cultivate paddy, chilli, and cotton. Due to climate change in the past few years, our cropping pattern has also changed. We now cultivate BT cotton, as its yield is better. However, because of BT cotton, we sometimes experience itching and redness in the eyes, as it contains some kind of insects in the flowers. Due to the use of pesticides to control weeds, we also experience itchiness. Earlier, we used natural fertilisers, and the quality of the produce was good. Now, although the yield has increased, the quality has decreased. Currently, we cultivate paddy and chilli, but earlier we used to grow red gram, maize, ragi, etc., without chemicals and pesticides. Climate change has impacted our agricultural practices (Farmer, FGD)

When asked why they had shifted from pulses and millets, which are nutritious foods, they said, “If we go for red gram or other pulses, they won’t survive if there isn’t sufficient rain. But cotton can withstand it, and we can recover our rate of interest (ROI)” (Farmer, FGD).

Impact on livelihood:

- People get agricultural work only for three months, but for other months, they migrate to another village for daily wage work. They earn Rs 200-400 per day. One old community leader said, "earlier, our survival was not so difficult due to the forest, but now, due to the decreasing trend of forests, it has become challenging for people to survive".
- Those who are from the ST community, especially the Koya community, they don't go out for daily wage work. Their main source of income is agricultural work in their own village. The daily wage is also different: for paddy cultivation or chilly plucking work, they get Rs 400/.
- The National Employment Guarantee Act is also not able to provide work for more than two months (between April and June) to people. If there is a family with 3 people, then they can work for 100 days, but people with 2 working family members will be able to work for 30-35 days only. Depending on the season, some time they receive only 15-20 days of work under the national employment guarantee scheme. A person shared, "I received my payment within two weeks only once. They should pay within 2 weeks; otherwise, they have to pay compensation".

Impact on Health:

- As per the SAPCCHH report of Andhra Pradesh respiratory diseases, around 29,000 deaths related to (COPD- Chronic Obstructive Pulmonary Disorders) happened out of 8.48 lakh deaths in India in the year 2016.
- Apart from this, around 6,000 deaths were reported due to asthma out of the 1.83 lakh asthma deaths in India in the same year in the country. It was also found that due to humidity, asthma cases have been increasing in the state.
- The major vector-borne diseases prevalent in the state are malaria, dengue, filariasis and chikungunya. High malaria numbers are attributed to the pollution of water bodies and water logging.
- Extremes heat waves result in excess morbidity and mortality. According to the Indian Network for Climate Change Assessment, Andhra Pradesh is likely to experience severe heat stress by 2030.
- Climate change already has a discernible impact on the burden of diseases, particularly on the health of the most impoverished populations[25].

Impact on the Health of Children:

- Increased vulnerability to waterborne diseases: Floods and heavy rains contaminate drinking water sources, leading to outbreaks of waterborne diseases such as cholera**,** dysentery**,** diarrhoea and typhoid**.** Children, especially those under five years of age, are more vulnerable to dehydration and malnutrition caused by these illnesses.
- Respiratory Infections: The wet and damp conditions following floods led to increased respiratory infections, including pneumonia and bronchitis, particularly among children.
- Malaria and Dengue Fever: Floods create breeding grounds for mosquitoes, which increases the risk of malaria and dengue fever.
- Physical Injuries: In the aftermath of natural disasters, children are exposed to debris, fallen trees, or collapsed structures, leading to injuries such as cuts, bruises, or fractures.
- Limited health care services available in these tribal villages further aggravate the situation.
- Chronic malnutrition remains a significant issue in this tribal region, and children are particularly vulnerable. Many children are found to be undernourished and underweight.

[25] https://ncdc.mohfw.gov.in/wp-content/uploads/2024/05/1.SAPCCHH-VERSION-1-ANDHRA-PRADESH.pdf

Malnutrition and stunted growth weaken the immune system and, make children more susceptible to infections and diseases, affecting their physical and cognitive development.

- Poor sanitary conditions affect children in the area, especially adolescent girls.
- In some villages neonatal mortality was reported due to poor access to antenatal care and delivery services.
- Impact on the mental health of children: The psychological stress of losing homes, loved ones and normalcy can affect their mental wellbeing, leading to conditions such as anxiety, depression and post-traumatic stress disorder (PTSD).

Impact on Access to Health Care Services:

- During a flood in 2022, a one-day health camp was organised, and after a gap of fifteen days, a second camp was organised. The other health check-up was done by ASHA workers. The primary health centre is 1 km from this study area. But people and staff of health centres are afraid that if in coming years floods come then the primary health centre may get submerged. This shows that there is no systematic health preparedness plan in the state. Villagers said that they travel to Bhadrachalam and Chintoor for any serious health-related incidents.
- It was also shared by the people that for simple fever they pay Rs 700-900 to private medical practitioners. Some people shared their experience that IV fluids were given by private practitioners and not in government hospitals.

> They just give us tablets but no other IV fluids… They don't take any money for tablets in the government clinic. People who can talk with confidence can get some medications from the nurse and doctors. But in private clinics they provide the fluids (Community Member, FGD).

4.4. The Policy:

The State Action Plan for Climate Change and Human Health (SAPCHH) for Andhra Pradesh outlines a comprehensive strategy to address the health impacts of climate change, which is crucial given the vulnerabilities faced by regions like Alluri Sitarama Raju.

- The plan acknowledges the vulnerable populations that are most affected by climate change, such as marginalised communities, the elderly, children and people with pre-existing health conditions. This targeted approach helps ensure that interventions are equitable.
- The plan emphasises the development of early warning systems for heatwaves and the spread of vector-borne diseases. Early warning systems are critical for reducing the health impacts of climate extremes and improving public health preparedness.
- The action plan calls for capacity building for healthcare workers and climate change research studies, which is essential for improving the state's resilience to health crises related to climate change.

However, there is still a lot of scope to draft a more comprehensive plan to address climate change in the state. SAPCHHH mentions that training of medical doctors and health care providers should be organised on this Action Plan, but the medical officer of PHC was not aware about any training on climate change. This action plan also outlines a detailed analysis of various illnesses due to climate change in the state. The Action plan recommends many awareness activities with various stakeholders, but there is no mapping of children's health impact and no awareness programme for children studying in schools. Some key strategies that can be adopted to better implement the plan are as follows:

- While the Action Plan outlines various activities and strategies, it lacks clear details on the funding mechanisms required for implementation. Without clear financial commitments, it is difficult to ensure that the strategies will be successfully implemented.
- Although the plan focuses on health, there is a need for better integration with the broader State Action Plan on Climate Change (SAPCC). Health must be a part of broader climate policies that address mitigation, adaptation and, resilience. A more coordinated approach with other sectors such as water management, agriculture and urban planning could lead to more effective outcomes.
- The plan lacks detailed mechanisms for monitoring and evaluating the implementation and effectiveness of health interventions. A robust system for tracking progress, measuring health outcomes and adjusting strategies is crucial for the plan's success.
- While the plan acknowledges the need for strengthening the health system, there could be more emphasis on making the health infrastructure climate resilient. Hospitals, clinics and other health facilities should be designed to withstand climate-related disasters (e.g., floods, heatwaves, etc.). This will ensure the continuity of healthcare services during extreme weather events.
- Andhra Pradesh has diverse geographical regions, including coastal areas, plains and hilly terrain, each with its own climate challenges. The plan would benefit from a more localised approach that considers regional variations in health risks and climate vulnerabilities. Tailored solutions for specific districts and communities will make the plan more effective.
- Climate change impacts human health differently based on gender, with women often being more vulnerable due to socioeconomic factors. While the plan addresses vulnerable populations, there is room for more explicit attention to gender-sensitive health interventions, ensuring that women and girls are provided with adequate resources, health services and support during climate-related health emergencies.
- Mental health is a crucial but often overlooked aspect of climate change's impact on human health. While the Plan acknowledges some of the mental health impacts due to extreme weather events, a more comprehensive focus on mental health services and psychosocial support for communities affected by climate disasters is needed.
- The Plan could make better use of long-term climate projections to better prepare for future health impacts. Incorporating scenarios and modelling of future climate trends will help to better predict and mitigate health risks. This would enable more forward-looking policies, not just reactive measures to current conditions.
- There is a lack of emphasis on the role of indigenous knowledge and community-based adaptation practices. Local communities often have traditional knowledge that can be used to improve climate resilience. Integrating this knowledge into the health response could enhance the effectiveness and cultural relevance of health interventions.
- Greater coordination across sectors (e.g., water, agriculture and urban development) is necessary for comprehensive climate adaptation. The plan should integrate health interventions with climate adaptation efforts in other sectors.

5. ANDAMAN AND NICOBAR ISLANDS

5.1. Context:

The Andaman and Nicobar Islands (ANI) archipelago is located in the Indian Ocean, in the southern reaches of the Bay of Bengal. It comprises 836 small and large islands, islets and rocky outcrops, covering a total area of 8,249 sq. km. According to the latest official data, the Union Territory (UT) is divided into three districts - South Andaman, Middle and North Andaman, and Nicobar - and had an estimated population of 434,192 in 2019 (Andaman & Nicobar Administration, n.d.). As per the 2011 Census, the urban and rural populations constituted 62.30 percent and 37.70 percent, respectively.

ANI is home to six indigenous aboriginal tribal groups: the Jarawa, Sentinelese, Great Andamanese, Onge, Nicobarese and Shompen, who collectively make up 7.61 percent of the total population. The UT has a coastline of 1,962 km and a significant fisherfolk population, totalling 26,521 individuals across 169 fishing villages (CMFRI, 2016). Although English and Hindi are the official languages of the UT, Bengali is the most widely spoken language (26 percent), followed by Hindi (18.23 percent), Tamil (17.68 percent), Telugu (12.81 percent), Malayalam (8.11 percent) and Nicobarese (8.05 percent), as per the 2011 Census.

5.2. Study Areas: Locations and Background Characteristics of the Respondents in ANI:

As mentioned in the methodology section, the locations and respondents for the research in the Andaman and Nicobar Islands were selected based on climate change risk areas (Abhilash et al., 2025), as well as demographic and socioeconomic factors. Following this framework, data was collected from children, parents and community members, including the fisherfolk population and farmers at Fairy Farm, as well as from the Ranchi community living in the Tsunami rehabilitation shelters at Sri Vijaya Puram. Additionally, data was gathered from the Nicobarese tribal community and the Ranchi community at Hut Bay in the Andaman and Nicobar Islands. A total of 68 respondents, including 56 study participants (children, parents and community members) and 12 stakeholders (primarily government representatives), were interviewed during the data collection process. Although the study could not delve deeply into the experiences of children and adults from all the indigenous tribal communities in the isles, a focus group discussion with women from the Nicobarese tribal community shed some light on their lives in the context of geological (tsunami) and climate hazards/events. As mentioned above, bearing in mind the socioeconomic background of the study participants, the research specifically collected primary data from children, adults and community members from marginalised social groups such as marine fishing and Ranchi communities. The inclusion of their experiences and perspectives in the research offered insights into understanding the impact of climate hazards or events on the most vulnerable populations in the UT.

5.3. Key Findings:

The findings, based on the accounts shared by the children and other respondents, are presented below, focusing primarily on their experiences rather than the structural factors that shape those experiences. Different patterns and themes emerged from the narratives of the children, parents and stakeholders. The following are the key findings of the exploratory analysis.

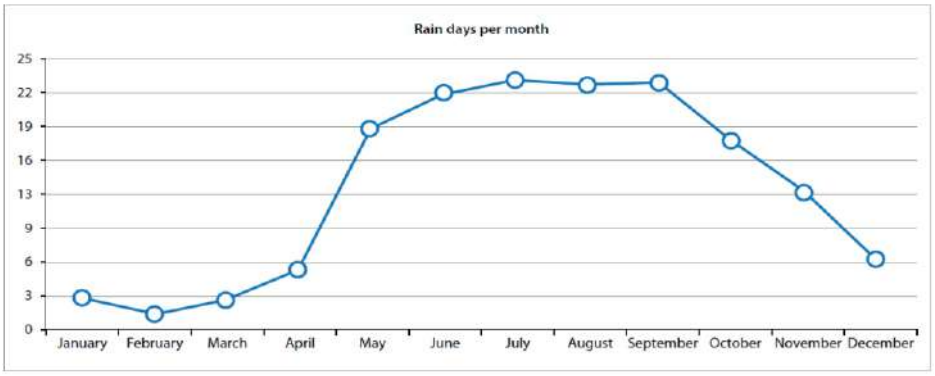
- Climate-related hazards/events: According to the United Nations Framework Convention on Climate Change (UNFCCC), "climate change is the long-term change in observed weather patterns over long periods of time in any particular location or over the entire globe" (UNFCCC as cited in the Department of Economic and Social Affairs, Statistics Division, 2024, p. 9). In addition to natural climate variability, changes in climate are attributed directly or indirectly to human activity that alters the composition of the global atmosphere. Confirming these observations, FGDs with children, parents and community members, along with interviews with stakeholders in the selected locations, explored climate-induced hazards or events in the islands. Additionally, these discussions brought attention to the geological disasters in the UT.

***Erratic Rainfall*:** One of the research questions was to map the climate-related hazards/events in the locations. Insights shared by children, parents and stakeholders revealed that erratic rainfall is one of the major climate-related hazards in ANI. A child summarised the experience:

> Sometimes it rains, and sometimes it gets hot… Earlier, from January to June, it used to be hot, and from July to October, it used to rain. But for the past 2–3 years, we have been noticing a difference. Now, it even rains in January, it can rain at any time now! We cannot predict when it will rain anymore… (Child participant, FGD).

The sharing was further elaborated by other stakeholders. The interview with the Pradhan of Mithakhari echoed what the children said, "the monsoons have also become unpredictable; sometimes they arrive in the first week of May, and other times in June. Occasionally, we even get rain in January or February" (Mohammed Shafique, Pradhan, Interview). This account aligns with findings that unpredictable rainfall patterns are closely linked to climate change (Leitch, 2024). FGDs with adults, interviews with stakeholders and the State Action Plan for Climate Change and Human Health of ANI also acknowledge rainfall pattern changes as a significant climate-related hazard in the UT (National Centre for Disease Control, 2022)

Illustration 1: Rain days per Month in the ANI



Source: Andaman & Nicobar Islands, State Action Plan for Climate Change and Human Health, p. 7.

The State Action Plan finds that the normal rainfall pattern (see Illustration 1 above) has been changing, impacting water resources for drinking and household use, livelihoods and human health. In addition, an analysis by Velmurugan et al. (2018) found an increase in heavy to very heavy rainfall events, ranging from 6.5 percent to 8.8 percent, compared to the climatic normal (6.5 percent) during the period from 2013 to 2016 in the UT. The researchers cautioned about the increasing unpredictability of rainfall and its potential consequences for the islands in the coming years.

Sea Level Rise (SLR): In addition to erratic rainfall, respondents, particularly those from the fishing community and stakeholders, shared that sea level rise is another significant climate-related hazard in the islands. Sea level rise can be defined as the long-term increase in the average height of the ocean due to climate change. According to the United Nations Office for Disaster Risk Reduction (n.d.), this occurs due to melting ice and the expansion of seawater as it warms, impacting coastal areas and ecosystems. Children reported noticing this change during their visits to beaches, while fishermen observed sea level rise as part of their daily work and lives. Interviews with stakeholders also confirmed these observations. A key informant interview with one of the Gram Panchayat Presidents in Mithakhari further elaborated on this issue: "The sea I have known since childhood looks different now. I feel like the sea level has risen. The coastal land in South Andaman has gone down" (Mohammed Shafique, Pradhan, Interview).

The insights shared by the study participants aligned with the findings of research papers on sea level rise (SLR) in the Indian context in general, and the Andaman region in particular. In a paper based on an analysis of secondary data, Das and Swain (2024) report sea level rise in the Indian Ocean at a rate of 1.06–1.75 mm per year from 1874 to 2004, and about 3.3 mm per year from 1993 to 2015. The authors elaborate that SLR impacts agriculture and communities, especially vulnerable groups such as fishing and indigenous communities in coastal areas. The article by Mageswaran et al. (2021), which addresses the impact of sea level rise and shoreline changes in the tropical island ecosystem of the Andaman and Nicobar region, reports sea level rise between 1 and 5 metres in the islands. The authors further caution that Little Andaman Island is particularly vulnerable to SLR in the Union Territory. The State Action Plan on Climate Change and Human Health (SAPCCHH) 2022-2027 of ANI also identifies sea level rise as a significant climate-related hazard in the UT, highlighting its effects on water resources and livelihoods, particularly in agriculture, fisheries and tourism (National Centre for Disease Control, 2022).

Cyclones: As per the Cyclone Hazard Map of India, ANI is located in a severe damage risk zone for cyclones. Situated near the cyclogenesis area, the islands have experienced severe cyclones in the past, making them vulnerable to high winds, waves and storm surges (Varikkodan et al., 2024). Discussions with children, adults and stakeholders explored their experiences of various cyclones. One child elaborated: "In 2016, we suffered a lot. Our houses were made of bamboo mats, and due to the cyclone[26], those were completely destroyed… In our settlement, at least 20 houses were destroyed". (Child participant, FGD).

Children, farmers and fishermen/women also shared various challenges they faced due to cyclones, including loss of life and other hardships. During an FGD with fishermen, participants recalled an incident of a cyclone that led to the death of a community member: "It happened a few years ago, but we don't remember the exact year. Some fishermen went deep-sea fishing, but a cyclone hit[27], and their boat broke apart. They fell into the water, and one fisherman lost his life" (Male participant, FGD).

Fishermen further highlighted how their livelihoods and incomes were affected, as they were unable to go deep-sea fishing due to repeated cyclones, sometimes occurring more than once a year. Similarly, farmers recounted instances where cyclones, followed by heavy rainfall,

[26] The cyclonic storm, VARDAH, hit the islands in 2016 and caused extensive damage to properties (Giles, 2017).
[27] The cyclone, Thane, hit the islands on 22nd December 2011 (See, Andaman Chronicle, 2012).

resulted in significant crop losses. Reports on Cyclone Yaas in 2021 (Giles 2021) and Cyclone Asani in 2022 (Giles 2022) published in Andaman Chronicle, a daily newspaper in the UT, corroborate the experiences shared by fishermen and farmers. Key informant interviews with stakeholders, along with the State Action Plan on Climate Change and Human Health, also identified cyclones as extreme weather events in the islands, emphasising their impact on communities (National Centre for Disease Control, 2022).

Earthquakes and Tsunami

According to the Seismic Zoning Map of India, the Andaman and Nicobar Islands are classified as high-risk seismic zones, meaning they fall within a very high damage risk earthquake zone. A significant number of mild to moderate earthquakes occur in the islands every year without causing major destruction, except for the catastrophic event in 2004. FGDs with adults and interviews with stakeholders revealed instances of earthquakes; however, apart from the 2004 earthquake and subsequent tsunami, no one reported any direct harm caused by earthquakes in their lives. All the adults interviewed shared that they would never forget their experience of the 2004 tsunami. One of them recalled his experience:

> It (the tsunami) came early in the morning, around 7.00 to 7:30. I keep thinking, if it had come at night, no one would have survived. Because it was morning, people were awake and had a chance to run. But all my cattle were tied up, and when the tsunami came, they were swept away, and I lost eight to 10 cattle. Nothing was left; my house was gone, and everything nearby (shops, statues, buildings) was destroyed. Only the people survived… The water came in waves. The first time, it didn't cause much damage. The second wave did some. But the third wave washed everything away. In total, the water hit seven times. It was the third wave that destroyed everything (Male participant, FGD).

The stakeholders also elaborated on incidents related to the tsunami from their professional experiences. A doctor from the state-level referral hospital recalled a case of trauma experienced by a child due to the tsunami.

> There were a lot of psychological problems among the survivors. I remember one child in particular- he was very young. His mother had left him at home to try to save her husband during the tsunami. The child was left alone, and he couldn't understand what was happening… The child had lost his family. The emotional toll was immense. We kept him under observation for about seven to 10 days before referring him to the Social Welfare Board, who then took over his care. He was clearly suffering from severe trauma. We had to administer medication to help him sleep and manage his anxiety. He couldn't eat properly. He couldn't sleep. He kept showing signs of extreme fear… (Paediatrician, GB Pant Hospital, Interview).

During the interview, an ANM of the urban health and wellness centre explained that although there was no major mortality during the cyclone in 2004, many houses were affected. Furthermore, observations during fieldwork indicated that many still struggle to recover from the damages and losses caused by this geological disaster. Although no major tsunami events have been reported since 2004, the State Action Plan on Climate Change and Human Health highlights that the absence of coastal plantations/mangroves and the lack of high-altitude grounds or buildings increase the vulnerability of the UT's population to future tsunamis (National Centre for Disease Control, 2022).

- Climate change awareness: Theoretically, awareness is believed to lead to desirable action by bridging individuals' knowledge gaps (Zagzebski as cited in Manchanda 2024). Therefore, exploring the level of awareness among children and adults is crucial, as knowledge about climate change and its impact can inspire people to address various issues arising from changing weather patterns.

  Interviews with children, parents and community members explored their understanding of changing weather patterns, such as erratic rainfall, sea level rise and cyclones in the islands. A child remarked: "The weather is changing; sometimes it rains, sometimes it is sunny. There is no permanent climate. The weather can change at any time... If it is hot here, then on another island, it is raining" (Child participant, FGD). Other FGDs with children echoed similar sentiments. Expanding on this, they discussed their knowledge of the causes of climate change, citing factors such as industrial expansion, vehicle emissions, pollution and deforestation for commercial purposes. They associated these activities with greenhouse gas and carbon dioxide emissions, which, in turn, disrupt the Earth's natural balance.

  The interviews revealed that all respondent categories were familiar with the concept of climate change (*Jalvayu Parivartan* in Hindi) and its anthropogenic (human-induced) causes. The children articulated their understanding, primarily acquired through radio, social media, newspapers, and television, as well as through personal observations. Meanwhile, the adult respondents shared their perspectives based on their lived experiences. However, as noted by Shelar et al. (2023) and Manchanda (2024) in their studies in different contexts in India, familiarity with the concept does not necessarily translate into clarity on what actions should be taken to address climate-related issues. The findings, therefore, highlight the need for continued interventions to enhance awareness of climate change and the necessary steps to address its effects, keeping the local context in mind.

  Although stakeholders associated with the state system are familiar with the idea and issue of climate change, interviews with them—including bureaucrats, healthcare professionals, AWWs, and PRI members—revealed that an overwhelming majority have not even heard of, clearly understood, or studied the State Action Plan. This category even includes senior bureaucrats and doctors. This lack of awareness among these groups is an important issue that needs to be addressed immediately.

- Impact on resources and communities: Except for a few general articles (Velmurugan et al., 2015; Velmurugan et al., 2018; Anujan, 2020; Baraik, 2023), no research study specifically focusing on the impact of climate change on marginalised communities and children's health has been found in the context of ANI. In addition to this knowledge gap, the present study recognises the linkage between the quality of children's lives, including their health, and resources, particularly the livelihoods of parents and communities. Against this backdrop, this inquiry explores the impact of climate hazards or events on resources and communities.

  It is important to note that, alongside community members involved in farming and fishing, children also shared their experiences regarding the impact of climate change on resources and livelihoods. A farmer elaborated: "I have been living here since my childhood. Now, just think about it, December has ended, right? I have never seen a year like this, where there was no break in the rainfall…. rainfall continued for all 12 months. The rain that came was disastrous. There are no fruits on the trees—areca nut, coconut—nothing…. We are farmers, so we are speaking from experience…" (Farmer, FGD). Another participant added to this based on his

experience with vegetable farming: “I planted many crops; okra, cowpea, bitter gourd…but everything got washed away. I planted them three or four times, but they kept getting destroyed due to rainfall. There is no certainty with the weather now” (Farmer, FGD).

These experiences clearly highlight the impact of climate change on crop loss, reduced agricultural productivity, and the difficult situations faced by farmers and their families in contemporary times. They further explained how these changes also affected their livestock. A farmer elaborated: “I have 30-40 animals, if there is water everywhere, where will the animals find grass? We, somehow, manage to eat from here and there, but where will the animals go? I have so much land, but after just four or five days of rain, it turned into a sea. So how will there be any grass? It will drown and rot, right? I had to beg for grass to feed them...” (Male participant, FGD).

Besides children and parents, stakeholders echoed the same sentiment. Pradhan from Mithakhari shared his observations related to farming and livelihood.

> After the tsunami, the lands got submerged, and people shifted from paddy fields to hilly land. Only 25 to 30 percent of the paddy fields remained, as the rest got submerged. Additionally, most people from the remaining paddy fields shifted to the hilly areas. The hilly lands had coconut, betel nut, bananas, spices, etc. However, when the weather became very harsh, most of these trees, especially the betel nut trees, died, and the people suffered heavy losses’ (Mohammed Shafique, Pradhan, Interview). His remarks on livestock are also relevant. He added: ‘See, the buffaloes can adapt to any climate. However, the crossbred cows are not able to withstand very high temperatures. Many animals died as well. The crossbred cows are very costly here, and they give a lot of milk. One cow can produce approximately 8 to 10 litres of milk. If you have two crossbred cows, you can easily provide for your family. Hence, people were affected a lot (Mohammed Shafique, Pradhan, Interview).

Discussions with men further revealed the consequences of climate change on sea levels, fish stocks, livelihoods through fishing, and the income of the fisherfolk. Summarising the points, one fisherman said:

> “Over the years, we have seen so many changes... In our view, about 70 percent of the fish stock has disappeared. We hardly see many varieties anymore... It’s nothing like before. In the past, with our traditional knowledge, we could predict the weather, find the right fishing spots, and know the best time to fish. But now… we cannot. Earlier, we used to fish within a 50 to 60 KM radius. That was enough. But now, we are forced to travel 100 to 200 KM… and even then, we don’t catch enough fish to make a living. Some have left fishing altogether” (Male participant, FGD).

These changes also affected the involvement of fisherwomen in the UT. Although women from the fishing community engage in various fishing activities, the majority in the islands are involved in selling fish. During the FGDs, they agreed with the observations of the fishermen and elaborated on the challenges they faced in their work. A woman explained:

> Most women here sell fish. But these days, we can only go out three or four times a month because there just are not enough fish. It wasn’t always like this... Things were different before. We leave around 2:00 or 2:30 in the morning, and if we manage to get fish, we come

> home, freshen up, and then head out to sell it. Earlier, we did not always need money in hand to buy fish, we could take it on credit and pay after selling it. But now, that is not possible. For the past two or three years, things have changed... We must have cash in hand to buy fish from the boats. It is getting very difficult for us... (Female participant, FGD).

Changes in the climate have therefore posed challenges to the ongoing employment of many men and women, forcing some to shift to other sectors due to these issues. Like fishermen, farmers shared that many of them had also recently left farming. All those who left their previous employment are now working as unskilled labourers in the unorganised sector. This shift has consequently affected their income and expenditures on food, children, education and overall wellbeing. It was shared in the FGDs that, because of this situation, a few children discontinued their education and started working, including in fishing and unskilled labour, to support their families.

It was shared by the fishing communities that due to the cyclones many people lost their lives while they were out in the ocean for fishing. They have to go further into the sea to get a good catch, and that is difficult with small boats. The situation has aggravated in the last few years for the fishing community, especially those having small boats to survive, and this occupation has been slowly taken over by companies that invest money and have big fishing boats.

The FGDs also revealed the effect of climate change on the water resources in the islands. Adult men, women, children and government officials unanimously highlighted water scarcity as a significant problem in both rural and urban areas in the UT. As a result, most of them now depend on the government water supply for drinking water and household use. The state action plan also acknowledged how erratic rainfall and a decrease in available surface water, lower water tables and slow aquifer recharge rates, affect drinking water resources (National Centre for Disease Control, 2022). The issue becomes particularly severe during the summer. An interview with one of the Gram Panchayat presidents revealed the challenging situation. He elaborated: “Last year, even the animals suffered. The gardens and plantations, including the betel nut trees, were burned and damaged in the summer. The ponds and wells dried up completely…” (Mohammed Shafique, Pradhan, Interview).

Although water scarcity is a problem for all communities in the islands, the study finds that the Nicobarese tribal communities in Hut Bay experience more serious issues. A focus group discussion with the women explored that they pay for drinking water, as the government supply cannot meet their needs. A participant explained:

> Yes, we do face issues with drinking water. We have to buy water that comes from the city. It is delivered to us in cans; each can costs 30 rupees. In my house, there are seven people, and one can be not enough for a whole day. Sometimes, we need at least two cans, which means spending 60 rupees daily just for drinking water. In fact, I currently have 12 empty cans at home because we are constantly trying to keep up with the need. Our debt adds up. For families like ours, paying for safe water every single day is a burden, especially when you consider other daily expenses. (Female participant, FGD).

- Children and health impacts: It is apparent from the above discussion that changes in climate affect resources and communities in the islands, which, in turn, create situations where children face many difficulties, such as a lack of safe drinking water and inadequate support from parents due to livelihood and income-related issues. This study also highlights the effects of these

challenges on children's health. FGDs with children revealed health issues that resonated with their experiences in the context of climate hazards or events. They shared illnesses such as fever, viral fever, cough, cold, dengue and malaria as consequences of the changing climate or weather pattern. One child during the FGD said: “Due to the weather changes, different illnesses start. We get cough and cold, sometimes fever, even dengue, and viral fever” (Child participant, FGD).

Interviews with an Auxiliary Nurse Midwife (ANM) and a Community Health Officer (CHO) from one of the Health and Wellness Centres further corroborated the health issues mentioned by the children. The ANM and CHO elaborated:

> In Andaman, when we talk about climate change, it means that rain can come anytime, suddenly. Just the day before yesterday, it was quite sunny, but out of nowhere, it started raining. And it’s not like it rains continuously; it lasts for a short time and then stops. Because of this, there are a lot of infectious diseases here. Cold is very common, and along with that, cough, fever, diarrhoea and pneumonia cases are increasing. Children keep coming with the same complaints over and over again. Children come with a fever, get better, but within a week, they come back with the same issue. These cases are repeating a lot (ANM & CHO, Interview).

Besides ANM and CHO, a paediatrician from the state-level reference hospital also shared different health issues among children due to climate related hazards or events.

> The weather here is causing a lot of humidity, which is making our children more prone to humidity-related infections, viral infections, bronchitis, and asthma. These issues are very common in our area. Many children are coming in with cold, cough, and breathing problems and nebulisation is often needed to help manage these symptoms. The water stagnation, especially in slums and crowded neighbourhoods, creates an environment for the spread of waterborne diseases like diarrhoea and dysentery (Paediatrician, GB Pant Hospital, Interview).

It is documented that erratic rainfall and changing temperatures create favourable conditions for the spread of vectors like mosquitoes, which, in turn, transmit diseases such as malaria and dengue fever. In addition, heavy rainfall leads to waterlogging and floods, increasing the risk of waterborne diseases like diarrhoea and typhoid. Moreover, increased rainfall results in more indoor activities, consequently leading to greater influenza transmission. As mentioned above, determinants such as water, sanitation, poverty and housing also play a vital role in these situations (Charnley & Kelman, 2024). The findings, therefore, explore the causal relationship between climate change and various diseases, including infectious and waterborne diseases. In Vijaypuram, the study found that in 2024, in one urban health centre 2 cases of heat stroke were diagnosed. Also, cases of respiratory illnesses and vector borne diseases like dengue are increasing. A senior official has stated that the number of dengue cases has increased in the last two to three years. In 2022, the number of dengue cases was 1014 followed by 846 in 2023[28].

Besides diseases, the ANM and the CHO indicated malnutrition among children in the context of climate hazards or events. They added:

[28] https://ncvbdc.mohfw.gov.in/index4.php?lang=1&level=0&linkid=431&lid=3715

> There are a lot of malnourished children here. Actually, we get reports from the Anganwadi. They (Anganwadi workers) measure the height and weight of the children and tell us how many are underweight or malnourished. But we cannot put all of them in the malnourished category just like that. We also have to consider their family background. Many parents are naturally short in height, so we need to analyse the data properly. According to the Anganwadi workers, malnutrition cases are very high. But when the children come to us, and we look into their family background, the numbers seem lower. Still, there are many cases. In this area alone, there are around 20 to 25 cases (ANM & CHO, Interview).

The above accounts highlight malnutrition among children and its relationship with parental biological characteristics. It can also be inferred from the discussion on climate hazards and their impact on the livelihood and income of parents that these household characteristics might have also affected the nutritional status of children. Although the relationship between these variables and malnutrition has been established in India (Ghosh, 2020), in-depth studies should be conducted to examine these aspects in the islands.

- Access to health care facilities: It is equally important to locate the discussion on climate hazards or events and their impact on health within the context of access to health care facilities in the islands, especially focusing on children, parents and communities from vulnerable backgrounds. FGDs with the primary study participants revealed that they face challenges in accessing quality health care in the UT. FGDs with women from the fishing community revealed that they have to visit PHCs for vaccinations, and, the state-level hospital (GB Pant) for treatment and tests related to serious illnesses. Many times, they are forced to visit private hospitals to receive adequate treatment. The situation for children and adults living on other islands is even more difficult. A doctor from GB Pant explained: "For non-emergencies, patients from different islands have to come to GB Pant by ship, even if they are weak. In emergencies, people from nearby islands are brought to Port Blair by helicopter" (Paediatrician, GB Pant Hospital, Interview). Since GB Pant has limited facilities for tertiary care, patients may need to be referred to cities like Chennai or Bangalore. However, the lack of transport facilities often becomes a barrier.

  The doctor added:

  > As a doctor in Port Blair, I find it very difficult to transfer seriously ill patients to cities like Chennai. Commercial flights do not provide oxygen, so we cannot send patients who need it. If we do need to transfer someone, we must request it at least three days in advance, and even then, sometimes it is not always approved. Our hospital offers some secondary and limited tertiary care. We now have a cardiologist, and some heart procedures are performed here. But for serious cases, we still need to refer patients to the mainland… Transport remains a big challenge. We have asked for an air ambulance, but until that happens, patients in critical condition face serious risks during travel… (Paediatrician, GB Pant Hospital, Interview).

***Shortage of Health Staff*:** Manpower has been a challenge in every level of health facility. In the Urban Health and Wellness Centres, the post of three ANMs were vacant, and at GB Pant hospital, which is a referral hospital for the entire islands, out of 190 sanctioned posts of specialists/super specialists, only 91 are filled that too on contract basis as on 22nd January 2025. Due to remoteness and the one-year contract for specialists, the attrition rate is very high. State officials shared that they have requested the Ministry of Health and Family Welfare about creating permanent posts for specialists and are hoping this will be fulfilled soon. This sharing

clearly highlights the urgent issues related to access to quality health care in the islands, which need immediate attention.

- Food security and children's health: In this region, extreme climate events and disruption of the weather cycle have led to children suffering from malnutrition and other illnesses. In Hut Bay Island, the AWW shared that her Anganwadi Centre (AWC) has 18 children. They weighed them regularly, and at present one child was underweight. Last month, the food supply in the AWC was delayed. The Anganwadi worker (AWW) has to spend her own money to purchase food grains (Rice Khichdi). Usually, each child is provided with 200 ml of milk daily along with khichdi. They get eggs twice a week. If the child is severely malnourished (SAM/MAM), the child receives double dose of food items. They shared that in each AWC, at least one month in a year, food grains are not provided to children. There are no Nutritional Rehabilitation Centres (NRCs) in the UT, so all SAM and MAM children are referred to hospitals, that do not have specific nutrition services for these children.

  It was also shared by one of the health care providers and Anganwadi workers in Sri Vijaypuram that as no NRC is functional, they just provide additional nutritional food packets to malnourished children. It was also observed that now children from three to six years old have been shifted to the School's Nursery section, and hence an adequate nutritional diet has not been provided to this age group of children. This is a larger policy issue related to the Integrated Child Development Scheme (ICDS), which aims to provide supplementary nutritional food to children up to six years of age.

- Climate hazards and school disruptions: The impact of climate change is not limited merely to children's health. Apart from school closures due to climate hazard events such as floods and cyclones, climate change often disrupts children's education and affects their learning outcomes. Children shared several instances in which they were absent from school due to repeated illness, which consequently created pressure on them to catch up with their studies. The findings thus underscore UNICEF's observations globally and in South Asia. The report notes that at least 242 million students worldwide and 128 million in South Asia experienced school disruptions due to climate events in 2024. It is also important to note that, although the report documents disruptions to the schooling of 54,784,029 students in India, it only accounts for heatwaves as the climate hazard (UNICEF, 2024). In this context, further context-specific studies should be conducted to explore this issue in greater depth. Although the discussions in ANI did not explore the consequences of climate change on children's psychological wellbeing in depth, conversations with children offered cues suggesting a link between climate change and mental health. As an important area of concern, this aspect needs to be researched further through specific studies in the future.

- Climate education and initiatives in school: FGDs with children and interviews with teachers revealed that apart from a mock drill on earthquake, children had never attended any special training/sessions on climate change and its impact on resources and their health. In other words, as noted by UNESCO and MECCE (2024), the potential of education in climate change adaptation and mitigation was neither recognised nor given the space it deserves in the islands.

Eco Club initiatives, GSSS, School line

It is a well-established fact that climate-related hazards, events, or stressors affect educational outcomes. Many times, climate-risk locations experience school closures and increased absenteeism due to climate-related diseases, which, in turn, result in learning loss and dropouts (UNESCO & MECCE, 2024). Resonating with their lived experiences, a couple of children shared:

> In 2016, we suffered a lot. Our houses were made of bamboo mats, and due to the cyclone[29], those were completely destroyed…Then, the district council arranged for us to stay in the school. We stayed there until the weather improved (Child participant, FGD).

This account clearly corroborates the observations made by UNESCO and MECCE. In relation to climate education, a child elaborated, "No, I haven't attended any session. No one here pays attention to climate issues" (Child participant, FGD). At the same time, the children mentioned that while there is some information related to climate change in their geography textbooks, there is nothing beyond that. However, this does not mean that no initiatives exist in schools. Observations from the fieldwork indicate that routine programmes such as essay writing, quiz competitions and tree plantations are organised under eco-clubs, and World Environment Day is observed in schools (see Image 1). However, beyond these activities, no serious efforts were noticed in schools to generate awareness about climate change, its causes and its impacts on weather patterns, human lives and health. Although the teachers mentioned eco-clubs and school interventions, they also stressed the need for focused efforts to educate and involve children in addressing climate change issues in the region.

The arguments of Nusche et al. (2023) are vital in this context. The authors highlight the need to rethink educational approaches, particularly school education, in response to climate change. They further suggest restructuring foundational science education by fostering scientific literacy, diversifying STEM education, promoting cross-curricular learning and emphasising the potential of place-based approaches[30] in empowering learners for action. In this regard, the authors call for building resilience in the education system. The role of teachers and a focus on teacher training content are also crucial in ensuring education system resilience. The evaluation study by Sonowal (2009) offers positive results from involving teachers in the process. It also highlights the role of NGOs

[29] The cyclonic storm, VARDAH, hit the islands in 2016 and caused extensive damage to properties (Giles, 2017).

[30] Place-based education (PBE) refers to a pedagogical approach that emphasises the connection between a learning process and the physical place in which teachers and students are located (Yemini, Engel and Ben Simon, as cited in Nusche et al. (2023).

in developing educational content in the form of modules and providing training to teachers in the context of climate education in schools.

5.4. State Interventions and Policy Gaps:

In response to the National Action Plan on Climate Change (NAPCC), following the United Nations Framework Convention on Climate Change (UNFCCC), a State Action Plan on Climate Change and Human Health (SAPCCHH) 2022–2027 has been formulated for the Andaman and Nicobar Islands. The UT Task Cell on Environmental Health, established under the National Mission for Strategic Knowledge on Climate Change (NMSKCC), prepared this plan and is responsible for its implementation in the Union Territory (National Centre for Disease Control, 2022).

The plan acknowledges the link between climate change and its impact on human health. As part of disease surveillance, it considers the possibility of an increase in vector-borne diseases, respiratory illnesses, and nutrition-related problems due to climate change, particularly among children. The document further calls for strengthening state health and nutrition interventions such as Anaemia Mukt Bharat and Poshan Abhiyan, as well as the role of the Health and Disaster Management departments in addressing the issue. The 'AAPDA MITRA Scheme'[31] is also indicated in the State Action Plan under preparedness, and interviews with the Director and Associate Director of Disaster Management, ANI, confirmed the implementation of the scheme with training for 300 community volunteers.

Climate Resilient Building and Preparedness

It has been observed that rainwater harvesting systems have been installed in health centres and schools, which is a commendable initiative by the government. According to a stakeholder, there are also plans to install solar power systems, which would be another positive step. However, besides the development of infrastructure, capacity building and active implementation of climate adaptation plan and awareness and action will be equally relevant to deal with any climate crisis.

PRI members attended trainings on disaster management and took part in implementing the AAPDA MITRA Scheme. The Pradhan elaborated:

> I participated in disaster management training and took part in mock drills. There is a scheme called AAPDA MITRA, and 10 to 15 people from my Panchayat have been trained under it. Some were in the warning group, some in the food group, and others in the medical group (Mohammed Shafique, Pradhan, Interview).

However, it is vital to note that, apart from this training, which primarily focused on the tsunami, PRI members have not attended any session specifically dealing with climate change, its impacts and preparedness.

Although the SAPCCHH categorises children as one of the vulnerable groups susceptible to climate-sensitive illnesses, it fails to perceive children within a child rights framework. The Plan defines children as persons between the ages of zero and five years (p. 37), thereby excluding children above the age of five from the discussion. In addition to this is the fundamental issue of definition. There is no clear guidance for data collection on the impact of climate change on children or a monitoring

[31] The Aapda Mitra Scheme is a programme that trains community volunteers in disaster response, enabling them to assist in immediate relief and rescue efforts during emergencies.

plan to track it. The document also lacks consideration of girls and gender issues, including menstrual health and hygiene. “As such, we do not have any specific data about the impact of climate change on children” commented the official from the State Department. It was stated by the senior officials from the Health Department that the major challenge in the UT is malnutrition and drug addiction along with other climate change-related challenges. It was further stated that implementing the Action plan in the Islands where scheduled tribes are concentrated is a challenge and the involvement of all stakeholders should collectively contribute to these locations.

While the Plan acknowledges nutrition issues arising from climate change, it does not propose any specific nutrition intervention to address food insecurity and water shortages. Although it mentions generating awareness among children through schools, there is no discussion on integrating climate education into the school curriculum. The document is also silent on mental health interventions for children and school-based programmes. Other than a reference to Tele-MANAS[32], no specific strategy or plan is outlined for addressing children's mental health. Furthermore, the plan does not provide clear guidelines for safeguarding children after climate hazard events from a protection point of view.

Although SAPCCHH proposes training and capacity building for healthcare professionals and allocates a budget for them (pp. 44 & 79), the present research could not find evidence of effective training sessions organised for the aforementioned cohorts. The interview with the State Nodal Officer on Climate Change apparently underlined the need for specific training on climate change. The Nodal Officer responded:

> Yes, we conduct training sessions to raise awareness and build the capacities of health professionals. Our paramedical staff, including health educators, ANMs and ASHA workers, are being trained. We provide them with updated knowledge on climate change and related issues. These are usually not standalone one-day sessions. Instead, information on climate change is often integrated into other health training programmes. For example, when conducting sessions on malaria or leprosy, we include climate-related content as an additional component. This integration does not happen every time, but it does in most cases. However, dedicated training focused solely on climate and health, as outlined in the Action Plan, has not yet been conducted (State Nodal Officer, Climate Change, Interview).

This sharing overtly points to the need for strengthening awareness generation among professionals and bureaucrats, alongside efforts directed towards children, parents, teachers, PRI and community members.

5.5. Recommendations:

The following are the key recommendations based on the findings in the Andaman and Nicobar Islands:

<u>Strengthening climate-resilient livelihoods</u>

- Develop alternative income-generation programmes for farmers and fisherfolk affected by climate change who cannot sustain themselves through their traditional occupations.

[32] Tele MANAS offers 24/7, free mental health support through phone-based services, ensuring that individuals across India can easily access the help they need.

- Provide financial support to eligible fisherfolk in the aftermath of disasters and climate hazards and, offer skill training, especially for young fisherfolk, to transition to alternative livelihoods due to declining fish stocks and the dominance of large, mechanised boats and trawlers.
- Provide financial support to eligible farmers in the aftermath of disasters and climate hazards and, promote climate-resilient agricultural practices, such as drought-resistant crops and diversified farming techniques, to support farmers.

Addressing water scarcity and resource management

- Strengthen water conservation measures and practices, including rainwater harvesting and watershed management, to counter erratic rainfall.
- Improve access to clean drinking water through enhanced infrastructure and supply chain management, especially in rural and island communities.

Improving health interventions for children

- Strengthen disease surveillance and early warning systems for climate-sensitive illnesses such as malaria, dengue, and waterborne diseases.
- Expand nutrition support programmes, particularly for children from climate-affected and marginalised families, ensuring food security through school meals and ICDS scheme.
- Establish a dedicated air ambulance service or ensure that commercial flights are equipped with basic medical support, including oxygen supply. This would significantly improve emergency referrals to mainland hospitals and reduce the risks associated with delayed or unsafe patient transfers.
- Strengthen ongoing capacity-building sessions for healthcare professionals. Organise regular training sessions on climate-related health risks, their identification, preventive measures, mitigation and adaptation strategies. Integrate climate-sensitive health planning into primary healthcare services.

Strengthening education, interventions in school and child protection

- Integrate climate change education into school curricula, incorporate experiential learning, introduce place-based approaches to empower learners for action, and strengthen eco-clubs and disaster preparedness training beyond earthquakes, considering various climate hazards and their impacts.
- Implement programmes to prevent children from dropping out of school due to the economic distress caused by climate change.
- Provide psychosocial support services in schools to address the mental health impact of climate change on children.
- Ensure that Tele-MANAS services provide special attention to children and facilitate timely referrals to specialists to address mental health issues, including trauma resulting from climate hazards.

Generating awareness and facilitating actions for mitigation and adaptation strategies

- Conduct vulnerability mapping to identify communities at risk of climate change.
- Facilitate sessions using participant-friendly methods to raise awareness of climate change, mitigation, and adaptation strategies.
- Support the formation of children's collectives within communities to set agendas at the grassroots level, strengthen the state action plan within a child rights framework, address climate-related issues, and improve post-disaster services.

- ❖ Foster close coordination between children's collectives and various levels of state mechanisms to ensure meaningful change.

Strengthening climate policy and governance

- ❖ There is an urgent need to educate bureaucrats, government healthcare workers, teachers, other service providers, and government representatives, including PRI members, as many have not even heard of the State Action Plan on Climate Change and Human Health (SAPCCHH).
- ❖ The proposed vulnerability assessment in the State Action Plan should be conducted immediately.
- ❖ The State Action Plan on Climate Change and Human Health (SAPCCHH) should be refined within a child rights framework, defining children as those below 18 years of age.
- ❖ The policy should be gender-sensitive and address the specific vulnerabilities of girls, including menstrual hygiene and education loss due to climate change or disruptions.
- ❖ The plan should outline clear data collection mechanisms on the impact of climate change on children, with a focus on health, education and livelihoods, and establish monitoring frameworks.
- ❖ The plan should strengthen the collaboration between the government, civil society and international agencies to implement and strengthen child-sensitive climate programmes or initiatives. The role of non-profit organisations as well as youth and children's collectives should be recognised, with clear policy directions for their active involvement in addressing climate change.

Conducting future research studies: Further research is needed in the following areas:

- ❖ Longitudinal studies to track the impacts of climate hazards on children's nutrition and health.
- ❖ Region-specific micro studies to explore the patterns of climate-induced illnesses.
- ❖ Evaluation of the effectiveness of government nutrition programmes in climate-affected regions.
- ❖ Qualitative studies on how livelihood loss due to climate hazards increases vulnerabilities, including child protection concerns.
- ❖ Research on child labour and child marriage in families impacted by climate hazards.
- ❖ Studies on climate anxiety and stress levels among children in vulnerable regions and, research on the impact of climate change on children's mental health and wellbeing.

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6. TAMIL NADU

6.1. Context:

Context of climate change in Tamil Nadu:

The south-eastern Indian state of Tamil Nadu is home to a very diverse topography that includes not just large urban centres, but sensitive hill areas. The state has a long coastline. All this makes it experience climate change in very distinct ways. Over the last century, temperatures have increased by around 0.6°C. Projections now suggest we will see an additional increase of 1.7–2.2°C by 2050. The once highly predictable northeast monsoon has become a variable and much more intense phenomenon. Climate change is one of the key problems of the 21st century. It impacts several regions and urban environments, especially at their intersections with social and economic inequalities, that do not have the wherewithal to cope with or prepare for the damage done by climate change and environmental degradation. Chennai city in Tamil Nadu, with its burgeoning population, sits at the hub of these challenges and is a microcosm of the coastal communities that are hit to a greater extent by climate change and by the urban slum populations that are particularly sensitive to climate hazards. Chennai's urban poverty is not limited only to the slum-dwelling population but extends even to those who live in tenements.

Chennai and similar cities are facing compounded, rapidly urbanizing risk expansions. The unplanned informal settlements underline and highlight their vulnerabilities to events like floods and a sustained heat wave or cyclone, which is now becoming an increasingly cyclical climate phenomenon because of global heating. Kodaikanal is facing its slew of climate impacts. There are no less than three major national parks in and around Kodaikanal.

Climate change threatens the state from all sides, and its geography makes it especially vulnerable. The eastern face takes the brunt of cyclone after cyclone, while the west wall sees the most atrociously torrential rain during the southwest monsoon. The central part of the state, with its plain, sees too much sun when the regular set in the east and west has finished its job. In recent years, there has been a marked increase in the number of extreme weather events across Tamil Nadu. The 2015 floods in Chennai, for instance, which resulted in over 400 deaths and economic losses estimated at $3 billion, starkly underscored the city's vulnerability to intense rainfall events. Likewise, the 2018 Gaja cyclone, which hit coastal districts and affected over 3.4 million people, wrought an unbelievable amount of damage to infrastructure and livelihoods. These are, obviously, not the only two extreme weather events to have occurred over the past several years—even the 2019 monsoon was quite remarkable for the rain that various parts of the state received. Still, these two cyclones should suffice to emphasize the urgent need for comprehensive and robust climate adaptation and mitigation strategies.

The survey about the effects of climate change on human health in these development contexts highlights the intersectionality of environmental, social and health problems, and brings into sharp focus the urgent need for targeted interventions that are consonant with local conditions, and which consider the specific demographic profiles, as well as the health vulnerabilities, that exist in these different development contexts. The health impacts of climate change are particularly severe for children, as evidenced by their direct testimonies. Children from both urban and coastal areas report frequent occurrences of fever, throat pain, and skin allergies. “Fever is common. We also get throat pain, skin allergies, and sometimes dengue”, reported one coastal child. The combination of flooding and poor drainage creates conditions conducive to waterborne diseases, while extreme weather

events exacerbate respiratory issues. Children's vulnerability is heightened during disasters, with many reporting inabilities to access healthcare services during floods. Respiratory disorders, including asthma and bronchitis, are exceptionally common in children living in the urban slums of Chennai. These children live in poverty, housing shortages, and pollution, conditions that are known to result in chronic respiratory ailments. At the time of any climatic disaster, there is an emerging health crisis in these slums, where inadequate healthcare and a lack of awareness about the dangers of air pollution leave children to fend for themselves in deteriorating environmental conditions. The World Health Organization (2021) maintains that children living in poor air quality are especially vulnerable to the immediate and chronic harmful effects of that pollution.

In addition to respiratory diseases, malnutrition poses severe public health challenges to children living in urban slum poverty. The intersection of environmental stressors and poverty has perpetuated a cycle of food insecurity and nutritional deficiencies. Severe malnutrition among impoverished children in Chennai's slum communities' results in high death rates and lower life expectancies. Similarly, food security emerges as a major concern in children's climate narratives in coastal areas. "There won't be anything to eat. We will have to stay hungry", reported one child. The impact cascade is clear in their testimonies - when parents can't work due to floods or cyclones, food access becomes precarious, where children expressed "My parents can't go to work during such times, so we won't be able to have proper food as well. Children's suggestions for food security include better relief systems: 'Food should be provided. Save the food also" (Child participant, FGD).

The effects of climate-induced hazards and disasters are projected over the next few decades to exacerbate existing problems related to food and nutrition, such as food insecurity, access to healthy and nutritious foods, and malnutrition, which directly depend on the local contexts of poor families. Meanwhile, recent studies have shown that the types of foods available within local food systems are not only less abundant but also less healthy and more expensive. Consequently, a study led by the National Institute of Nutrition in 2019 revealed that an estimated 54 percent (more than half) of children under the age of five living in Chennai's slum communities are suffering from chronic malnutrition. Failing to meet their basic dietary requirements constitutes a human rights disaster and a public health catastrophe.

The health profiles of the urban poor in Chennai can be viewed as a model for the broader public health disaster that climate change is causing. A recent report from the Public Health Foundation of India shows that climate change will result in an estimated 250,000 additional deaths per year between 2030 and 2050, with the greatest impact occurring in India and other countries throughout South Asia. The report connects the projected rise in deaths to factors such as increased heat waves, which contribute to a rise in fatal heart attacks and strokes; more flooding, which results in waterborne diseases; and a changing ecology that will expand the range and prevalence of many diseases, including those caused by pathogens that thrive in warmer conditions. The coastal communities of fishermen in and around Chennai represent a demographic that is especially vulnerable to the multifaceted impacts of climate change.

With rising sea levels, we are witnessing the salinization of previously freshwater coastal resources. This means the children and their families who live in these coastal flood-prone regions now have access only to salted water, making it dangerous to drink. Understandably, this has resulted in a volatile food security situation for communities that live along the coasts and have few, if any, alternative food sources beyond fishing and farming. Fish are increasingly hard to come by because the formerly productive fishing grounds have been severely degraded. This has made malnutrition the defining characteristic of the lives we shared with the children and their families. According to

reports, children who are malnourished are much more susceptible to disease, exhibit impaired cognitive development, and risk long-term health problems. Moreover, the relentless advancement of climate change shows itself in the swollen number of extreme weather events, which have direct and disastrous implications for public health. For instance, a recent modelling study found that climate change is likely to increase the incidence and severity of the kinds of funnelling storms that whip through low-lying coastal areas, dumping huge amounts of water in just a few hours. The vector-borne diseases that already plague public health are likely to spread into new and vulnerable populations.

No aspect of local fishing ensures community economic wellbeing more than the reliable supply of safe fish to residents. Yet this is precisely what is at risk as climate change brings altered weather patterns, warmer waters, and phenomena such as El Niño. Safe fish are a cornerstone of healthy diets, and unsafe fish are a public health hazard. Meanwhile, parents with unstable incomes and psychological stress are not in a good position to raise healthy children.

Socio-economic landscape and public health:

The socio-economic arrangement of Tamil Nadu is varied. Alongside a significant agricultural base, the state has a strong and growing industrial and service sector. Yet, many of its communities depend on livelihoods that are sensitive to climate change—such as agriculture, fishing, and informal labour—that are becoming more and more vulnerable to an altered climate. Especially in urban areas, high population densities amplify the health impacts of climate change. Economic disparities that are all too prevalent in urban areas add to the problem. Poor people may live in makeshift and unsafe shelters that offer little protection from the elements. They often have no access to the kinds of services—sanitation, health care, and other essentials. And even where services do exist, they may be of poor quality and difficult to obtain. All these factors make the poor more likely to suffer from climate-related health problems.

The state's healthcare system, compared to other parts of India, is quite advanced. Yet, it is facing numerous climate-related health issues that it cannot adequately address. Most rural, primary health centres are too under-resourced and understaffed to deal with an increasingly climate-sensitive disease burden. Even the best urban health facilities suffer from capacity issues and frequent staff burnout during extreme weather events, highlighting the urgent need for a more resilient health system in the face of intensifying climate change.

Economic disparities within the state compound these challenges. Though the 2011 poverty rate of 11.28 percent indicates sharp reductions (from 22.5 percent in 2004-05), half a decade later, in 2016, 30.8 percent of households in rural areas lived below the poverty line. These economically vulnerable communities not only persist in poverty but also lack the resources and the infrastructure to adapt to changing climate conditions or to recover from the disasters that climate change is now inflicting on them.

The agricultural sector, which employs 40 percent of the state's workforce to work, seems particularly susceptible to climate change. When the climate changes, so too do the almost certain rapid and severe shifts in rainfall that are predicted for the future, in addition to the increases in temperature and more frequent extremes of weather that are now the new normal. These kinds of changes threaten not just the yields of staple crops but also the food security of the state and the nation. The increasing vulnerability of the sector and the communities that depend on it is an

obvious cause for concern. However, what is particularly disturbing is that the small and marginal farmers who make up most of the agricultural workforce are also the most affected.

6.2. Study Locations:

A. Urban Challenges in Chennai

- **Climate Hazards:**
  Erratic Monsoon Patterns: Over the last few decades, Chennai has faced a climate evolution. The northeast monsoon, which used to deliver dependable rainfall, has turned increasingly capricious. In this new era, the northeast monsoon has brought both intense urban floods and periods of drought. What used to be reliably wet has morphed into its opposite. One resident of Ennore Kuppam said:

  > We used to be able to forecast when the rain would come and could prepare for it. Now, it's unpredictable. We sometimes get deluges of rain when they're unexpected and are supposed to be in the middle of a long stretch of drought. It's muddled (Male participant, FGD).

  The 2015 Chennai floods highlight the erratic monsoon patterns and the terrible effects they can have. A City of Chennai, in the month of late November to early December, received an unheard-of amount of rain, the direction of which was entirely towards the flooding of the city. Some reports even detail amounts greater than 300 mm in certain parts over a single day.

  Water scarcity has also been affected by rainfall unpredictability. The city's major reservoirs nearly dried up in 2019, forcing the residents to rely on water tankers, with many waiting, sometimes for hours, to get their allocation of water. The crisis was not a one-off event; the city is vulnerable to the kind of rainfall that comes in fits and spurts.

  Cyclones and Storm Surges: Cyclones like Vardah (2016) and Nivar (2020) have shown an increased frequency and intensity, spanned vast areas, and caused extreme infrastructural damage. They have brought about widespread power outages and have thrown many systems of transportation into utter disarray. Despite these problems, which have become far too commonplace, many parts of the city still rely on warning systems and emergency preparedness plans that are, to put it mildly, not up to par. Ennore Kuppam and Mugathuvara Kuppam, coastal communities in Chennai, are vulnerable to the storm surges that accompany tropical cyclones. The combined population of these two coastal communities is around 50,000. These extreme-weather events often hit the homes and livelihoods of people living in these communities the hardest. A fisherman from Mugathuvara Kuppam shared:

  > During cyclones, the sea comes into our homes. We must evacuate and stay in shelters or with relatives. When we return, our homes are damaged, and our fishing equipment is often destroyed. It takes months to recover, and the government support is minimal (Male participant, FGD).

  More frequent cyclones are causing coastal erosion, placing these communities in greater jeopardy. The coastline has retreated several meters in some places, compelling families to abandon their homes and move inland.

Urban Heat Islands: Chennai's swift urban growth has caused urban heat islands to form, in which temperatures soar well above those in the rural areas encircling the city. This effect is especially strong in the city's most crowded, least green portions, like Vyasarpadi and parts of North Chennai. There are 5 significant implications for public health and the increased urban heat in these areas.

1. Temperature recordings in these areas have shown differences of up to 5°C compared to less urbanized parts of the city.
2. This increased heat has significant implications for public health.
3. It particularly affects vulnerable groups.
4. These groups include children and the elderly.
5. These groups also include people with lots of pre-existing health conditions.

A resident of Vyasarpadi noted:

> In the past few years, the heat has become intolerable. Our houses, mostly made of concrete with tin roofs, feel like they're inside an oven in summertime. The elderly in our community is suffering from heat-related illnesses more than ever, and kids are finding it impossible to study or play outside (Female participant, FGD).

In many areas of Chennai, the absence of green spaces worsens the urban heat island effect. The city has one of the lowest green space ratios of any major Indian city, with just 0.46 square meters of per capita green space. The World Health Organization recommends 9 square meters per person. With such a scarcity of vegetation, the heat generated by the buildings and the concrete jungle that is the city can be expected to intensify.

- **Health Impacts**

Waterborne and Vector-Borne Diseases: Chennai's shifting climate is causing a rise in waterborne and vector-borne diseases. Flooding incidents, which are now more common because of unstable rainfall, set the stage for the proliferation of waterborne diseases like diarrhoea, cholera, and typhoid. A healthcare worker from a primary health centre in Chennai reported: “After every flooding event, we see a spike in cases of diarrhoea diseases, particularly among children. The contamination of water sources and the lack of proper sanitation facilities in many areas exacerbate the problem”.

In recent years, the incidence of vector-borne diseases, especially dengue and malaria, has shown a marked upward trend. This is largely due to shifts in temperature and rainfall associated with climate change that have, in turn, affected the breeding cycles of the vectors that carry these diseases. A breeding boon for these disease vectors has meant more cases, and the health department of Chennai reported an astonishing 9,000+ dengue cases in 2017. This was many times the amount in the years preceding 2017. Diseases like these are especially dangerous for children. A teacher at the school in Vyasarpadi observed:

> A lot of our kids miss school because they have malaria or dengue; these diseases are just way too common in our area. Some of our students have been in the hospital for weeks, and it's hard for them to catch up after something like that. It really tries and tests their faith and even ours at times (School teacher, Interview).

A teacher in Chennai remarked, “One student coughs and the next one coughs. They are weak students”. The predicaments are not only restricted to long-term impacts but mortality. A woman in the Chennai slum reported:

> During the last flood, Vardah, there was so much water, and one kid died because of it. There was no possible way for us to evacuate the body of the kid. The kid was 6 years old and had a fever. As the water level rose, the child passed away. There was no way to take the body outside for 2-3 days (Female participant, FGD).

Respiratory and Heat-Related Ailments: The rise in respiratory conditions, especially in children and the elderly, has been fueled by air pollution and climate change. More than 40 industries, including chemical and power plants, as well as petrochemical businesses, call the Ennore area home. The federally mandated National Ambient Air Quality Standards are frequently flouted here, day after day. An Ennore Kuppam mother said, “My son suffers from asthma, which worsens in the summer when the air quality is particularly poor. We take him to the hospital a lot, and it's a huge financial strain on us”.

Heat-related illnesses, such as heat exhaustion and heat stroke, have also seen a rise, especially in the summer months. The urban heat island effect, along with globally rising temperatures, has intensified the summers in Chennai, making them unbearable for many. A Chennai government hospital doctor said, “Heat-induced admissions show a marked rise during summer. Many of our patients, notably the elderly and those with prior health problems, are coming in dehydrated, exhausted, and even suffering from heat stroke in some instances”.

Heat-related illnesses are particularly affecting our children and those who work outdoors. A construction worker from Vyasarpadi noted, “Working outdoors has become increasingly difficult due to the heat. Many of us suffer from headaches, dizziness, and fatigue, which affect our ability to work and earn a living”.

Indeed, outdoor work has become dangerously difficult in certain regions due to the unremitting heat.

- **<u>Educational Disruptions</u>**

  Education in Chennai has been affected significantly by climate events. The impacts seem to be most pronounced for certain types of events, such as heavy rainfall and associated flooding, which might be expected to become more intense and more frequent under climate change. For instance, contemporary academic research has projected a 40 percent increase in rainfall intensity for the Chennai area (Ghosh, 2009; National Institute of Oceanography, 2019). More intense and more frequent rainfall events could lead to more flooding and related school closures. Even without climate change, Chennai is a city that is built to flood (Davies, 2015). If academic projections based on the science of climate change are correct, then severe weather events will happen with greater intensity and frequency. Not only flooding rains, but also tropical cyclones, which have historically impacted Chennai, could be expected to become stronger and wetter (IPCC, 2019; Neumann et al., 2015). The history of education in the region shows that these kinds of climate-related events can lead to widespread learning losses.

  Education emerges as a critical concern even in children's climate experiences. “When a flood comes, students don't go to school... Because of that, we get affected”, explained one child. The disruption extends beyond mere attendance. Children report struggling with studies due to

power cuts, lack of proper lighting, and loss of educational materials during floods. We won't have electricity at home to study, noted a child, highlighting how infrastructure failures compound educational challenges. A teacher in Chennai shared, “In 2015, there was a flood in Chennai. There was a lot of rain. Due to heavy rains, some of these kids' houses also got flooded”. The digital divide became particularly apparent during climate-related disruptions, as one child observed: “During the Corona lockdown... Some students have a phone, some don't. Because of that, studies got affected”.

A principal of a school from North Chennai shared, “Many of our students faced a tough time catching up with the curriculum after the 2015 floods. We had to conduct extra classes and provide additional support to help them recover the lost learning time”.

Many women also mentioned dropouts among their children due to academic stress to cover the school syllabus. Numerous educational institutions, especially those positioned in flood-prone, low-lying regions, sustain substantial damage to their structures, facilities, and educational resources during floods. One instructor affiliated with a support school in Vyasarpadi, recounted how the assets were ravaged during the 2015 floods: “Our school was severely damaged during the 2015 floods. We lost books, computers, and other teaching materials. It took months to restore the school to a functional state”.

When extreme weather occurs, getting to school is safe and sound; the same cannot be said for the other times when it is flooding. A parent from Ennore Kuppam shared this underreporting of the actual amount of time that children are home from school (1/3 of their education). “During the monsoon season, the roads to the school get flooded, making it unsafe for our children to travel. We often keep them at home during these periods, which affects their education”.

Climate-related disasters and their aftermath are not just a threat to physical safety; they also endanger mental health, especially among young people who are at risk of life-altering conditions such as anxiety and depression. A counsellor working with children in flood-affected areas describes the psychological toll of such disasters this way: “Many children exhibit signs of anxiety and stress after experiencing a flood or cyclone. They have nightmares, difficulty concentrating, and some even develop a fear of rain or water”.

- **<u>Socio-Economic and Livelihood Impacts</u>**

  Profound impacts on livelihoods have reached Chennai due to climate change, and among the most affected are those working in occupations that are sensitive to climate conditions. For communities across the vast coastal areas, fishing has become an increasingly tenuous livelihood due to the convergence of several climate-related factors. In Chennai, agriculture is not the mainstay of life; however, it is significant enough that when one of the alternate sites of this study was to be planted, the *tais* (as the women call their hand-woven baskets) were used to plant rice seedlings in the field. A fisherman from Ennore Kuppam stated,

  > There used to be an abundance of many different kinds of fish, but now the species we used to catch are gone and unavailable. Our income has reduced to almost nothing, and I find it impossible to run my family on the pittance I make. And even the little I make is in danger of vanishing with the companies and industries that are causing heavy pollution in the sea (Male participant, FGD).

The economic impacts of climate disasters hit low-income communities hardest. In Vyasarpadi, many families lost everything in the floods – homes, possessions, and livelihoods. A resident told us, “We lost everything in the floods – our home, our belongings, and my husband's auto-rickshaw, which was our main source of income. We had to start from scratch, and it took years to recover”.

Assistance from the government when climate catastrophes occur and afterward is usually deemed insufficient. A leader from the community of Mugathuvara Kuppam expressed it this way: “The government does not do anything when the cyclone is here. When everything is over, and only at the end, there would be some support from the government; and mostly, it is volunteers who extend help to us”.

When climate-related disasters strike, the financial fallout can be severe. Families are often left to resort to negative coping mechanisms to make ends meet. One resident of Ennore Kuppam told us about how he and his family handle things during the three months (October to December) when they could be receiving storm alerts: “During the alert season for three months October to December only Rs. 5000/- is not sufficient to manage the family. We have to borrow money or pawn jewellery to manage during these periods”.

- **<u>Community Perspectives and Participant Voices</u>**

The lived experiences of climate change in Chennai, told in the voices of community members, give us valuable insights into how the forms of expression and representation so crucially relay the realities of everyday life impaired by climate change. It's in these stark contrasts of articulation that we grasp how health, education, and a multitude of other socio-economic factors compound climate change's impacts. A mother from Vyasarpadi expressed her worries about her children's health:

> My children frequently become ill during the hottest months of the year. They suffer from skin rashes, fever, and, on occasion, respiratory issues. The intense heat, combined with pollution, makes it even harder for them to stay healthy. And we can't afford to keep the fan going all day due to our high electricity bills. So, we sweat it out in the stifling heat, hoping that somehow our children will be able to cope with it all. Because in this part of the world, summer can seem endless (Female participant, FGD).

Healthcare access during climate disasters is a major issue for numerous communities. A resident of Ennore Kuppam stated, “We can reach out to the clinic only. There won't be vehicles to reach the hospitals, and we have to manage with the hard situations”.

Disaster occurrences bring difficulties to women associated with menstrual hygiene and reproductive health. A health worker described some of the impacts this way:

> Before menstruation, teenage girls are weak and unable to cope with the pain of the conditions they live in during times of disaster. And more and more, girls are hitting puberty earlier—between the ages of 10 and 11. This affects the physical and emotional health of young disaster-impacted women. And, oh, urinary tract infections! We hear about those a lot from living in close quarters and less-than-hygienic conditions (Health workers, Interview).

The adaptive strategies that residents adopt make clear the presence of resilience in this community. In the Vyasarpadi area, around 450 families have come together to buy a generator for use during emergencies. A community leader explained, “We realized that power outages during floods and cyclones were a major problem. So, we decided to invest in a generator that could provide electricity to our community during these times”.

To conclude, Chennai, as a rapidly urbanizing city, faces acute challenges from both heat and flooding, particularly in urban slums and coastal areas. Interview data reveal that extreme heat is causing significant health issues, especially among children, such as increased sweating, tiredness, skin problems, and difficulty concentrating in school. Flooding events are frequent and unpredictable, leading to major disruptions: damage to homes and schools, loss of educational materials, and increased incidence of waterborne diseases. Vulnerable groups, including the elderly, pregnant women, and children, are disproportionately affected. Residents of urban slums like Vyasarpadi report compounded challenges due to a lack of basic infrastructure, pollution, and limited access to healthcare and relief during disasters. Community members often rely on themselves and NGOs for support, as government relief is delayed or insufficient. These findings underscore the urgent need for targeted interventions in urban slums and coastal communities to address both immediate and long-term climate risks.

B. Hill Region Perspectives: Kodaikanal

- **<u>Climate Hazards in Kodaikanal</u>**
  Irregular and Unseasonal Rainfall: Kodaikanal, a hill station in the Dindigul district of Tamil Nadu, has undergone pronounced alterations in its precipitation patterns in recent decades. The hill station, located 2,133 meters above sea level, typically receives steady rainfall during two well-defined monsoon seasons: the southwest monsoon (May to September) and the northeast monsoon (November to December). However, in recent years, the rains have come at different times and with varying intensities. A local farmer from the Palani Hills region said, “Earlier, we could predict the rains and plan our agricultural activities accordingly. Now, it rains when it shouldn't and doesn't rain when it should. This unpredictability has made farming increasingly difficult”.

  Changing rainfall patterns have resulted in both extended dry periods and intense rainfall events. During the dry periods, water supplies dry up, impacting both agriculture and the domestic water supply. In contrast, during intense rainfall events, the area experiences flash floods and landslides that damage agricultural and infrastructure. A person living in Vattakanal reported, “We now have very intense rain falling in short periods, which the soil can't absorb. This results in runoff and erosion, which affect our farmlands, and sometimes cause landslides”.

  Landslides and Infrastructure Damage: More frequent and intense rainfalls, combined with deforested areas and unplanned construction, have led to an increase in landslides in Kodaikanal. These landslides threaten both human life and infrastructure. A local government official said:

  > There has been an obvious increase in the number of landslides over the last 10 years. Even places that were thought to be safe are now coming apart. Some communities have had to move, and there are now plans in place to try to make the old places safe again (Government official, Interview).

Infrastructure is significantly affected when landslides and heavy rainfall occur. Roads, bridges, and buildings suffer damage or may even be destroyed, leading to serious connectivity issues and reducing access to services that are essential. One resident of the Vilpatti area shared this experience: “During the heavy rains last year, the road connecting our village to Kodaikanal town was damaged by a landslide. It took weeks to repair, during which time we had to take a longer, more difficult route to reach the town”.

The damage to infrastructure also affects tourism, a key economic activity in Kodaikanal. A hotel owner noted, “When roads are damaged or there are landslides, tourists cancel their bookings. This affects our business and the livelihoods of many people who depend on tourism”.

Temperature Fluctuations: The climate of Kodaikanal, famous for its pleasing temperature, has undergone a definite transformation in the past few decades. Unlike the lowland areas where the warming has been severe, in Kodaikanal, this is discernible, but less pronounced. Maximum and minimum temperatures in this hill town have shown an upward trend. A resident for a long time has said:

> Now the summers are warmer than they were in the past. In Kodaikanal, there was never a need for fans, but now several homes and businesses have installed them to deal with the increased heat. I don't remember it being this hot in Kodaikanal as a kid. I guess maybe I was just too young to notice (Male participant, FGD).

Also, shifts in temperature are causing a shift in local flowering and fruiting patterns in plants. Crops and everything else that grows here are affected. There's a lot at stake—the local biodiversity, for one, is intimately tied to the plant community. Increasing temperatures mean everything is blooming earlier. A local botanist says, “We are seeing changes in the phenology of many plant species. Some are flowering earlier than usual, while others are showing delayed flowering. This has implications for pollinators and the entire ecosystem”.

The warm trend has also caused an upsurge in forest fires in the dry season. A forest department official said, “We have observed an upsurge in forest fires in the last few years. The combination of higher temperatures, reduced rainfall, and human activities has made the forests more prone to fires”.

- **<u>Health and Agricultural Impacts</u>**

  Kodaikanal's shifting climate is taking a toll on health and agriculture. The latest report from the Intergovernmental Panel on Climate Change (IPCC) warns that global warming is likely to increase the incidence and intensity of vector-borne diseases (VBDs). As the Earth's atmosphere and oceans warm, conditions are becoming more favourable for the proliferation of insects and other organisms that carry VBDs. Kodaikanal has, in addition to these illnesses, started to witness a few malaria-like cases that have been diagnosed but not confirmed as malaria, carry the same symptoms, and are being treated with the same anti-malarial medications. A worker in primary health care from Kodaikanal noted, “We are now seeing cases of dengue and malaria, which were almost non-existent in this region a decade ago. The warming temperatures have allowed disease vectors to survive and breed at higher altitudes”.

  Respiratory issues, mainly among children and the elderly, have also intensified. A nearby physician stated, “We are observing more instances of respiratory difficulties, especially in the

dry season characterized by greater amounts of dust and, in certain locations, smoke from wildfires".

Livelihoods in the region are heavily dependent on agriculture, which is a cornerstone of the economy. Traditional crops like potatoes, carrots, and beans have seen up to a 30 percent reduction in yield over the last five years. The combination of climate change and farmer (Poombarai) practices has favoured the invasion of pests and other farming challenges that reduce yield. The climate is changing, and this is affecting the pests and diseases that threaten crops. A local officer of the University of California Cooperative Extension said, "We are seeing pests and diseases that were previously unknown in this region. Farmers are struggling to manage these new challenges, and many are switching to different crops or abandoning farming altogether".

The influence on farming holds noteworthy consequences for the region's food security and the people's livelihoods.

> You know, it's not like in the United States, where you get a check from the government. It's direct payments that the U.S. government makes to the farmers. And, in a way, the U.S. government subsidises food prices, because it pays farmers directly, and then farmers don't charge as much for the food. And so, we have a situation here where food is not only abundant, but it's also relatively cheap (Officer, Interview).

An ASHA worker expressed:

> Agriculture is also affected due to which people are not able to have any regular crop, and their nutrition is reduced". This statement reveals the cascading effects of climate change on food security and nutrition, particularly affecting vulnerable populations. These are compounded by other developments. She added, "forest level is also changed, and hence wild animals come to villages and poses threat to villagers (ASHA worker, Interview).

- **<u>Educational and Socio-Cultural Challenges</u>**

  Education and the sociocultural facets of life in Kodaikanal are also being affected by climate change. The educational calendar is frequently disrupted by the school closures that are necessitated by the heavy rains and landslides that seem to be occurring with increased frequency. These are the kinds of events that allow mandatory schooling to be suspended for far too long. A principal of a school in Kodaikanal said, "We had to close the school for almost two weeks last year due to severe rain and landslides. The roads were unsafe, and many of our students come from villages that were cut off because of damaged roads".

  Accessing a good education was already difficult for kids from far-flung villages; then, COVID struck. Now, kids who were barely clinging to pathways that led to schools suddenly find themselves with no pathways to traverse at all, not even the ill-defined routes that sometimes led to the quality education we had hoped for them.

  Traditional cultural practices and festivals are also experiencing the impact of climate change. A surprising number of celebrations across the region are tied to the agricultural calendar. Increasingly, however, communities are finding that, with the climate in flux, their agricultural festival timings and rituals are also suffering from a kind of climate change.

"Our festivals and rituals are closely tied to the agricultural calendar; with the changing seasons and unpredictable rainfall, many of these practices are being disrupted or abandoned", said an interviewee on traditional culture from the indigenous Paliyan community.

Climate change is shifting traditional knowledge systems. "Our ancestors had deep knowledge about weather patterns, which guided our agricultural and cultural practices. This knowledge is becoming less reliable due to the changing climate, and our younger generation is losing interest in these traditional systems", shared a tribal elder from the Paliyar community.

- **Local Narratives and Adaptation Strategies**

  Local communities in Kodaikanal provide invaluable insights into the experience of climate change, along with adaptation strategies that have emerged in response. Their voices add significantly to our understanding of the nature and impact of climate change at the local level. Moreover, their narratives about the lived experience of climate change and the resilience they are demonstrating point to the importance of local knowledge in the face of a global crisis. An adaptation strategy shared by a farmer from Poombarai village is this:

  > I have begun to diversify my crops and to use more organic methods of farming. I have set up a small rainwater harvesting system to catch the water that comes with heavy rainfall events that I can then use during the dry periods (Farmer, FGD).

  The community-based initiatives that have come up to meet the challenges of climate change sure make for some feel-good stories. But they are not all about the communities and the work they do. The efforts often rely on something in short supply in many areas of the world, especially in rural regions: trust. Many people living in communities around the world are forming these initiatives to do something, anything, that might help them and their families not be so vulnerable to the kinds of disasters that the changing climate seems to bring.

  Knowledge held by elders in the Paliyar community is changing with climate conditions. But the community is not letting their traditional knowledge die. "We are combining our traditional knowledge with new information to adapt to the changing climate. For example, we are using our knowledge of local plant species to identify those that are more resilient to the changing conditions", said one elder.

  The key economic activity in Kodaikanal, tourism, is also adapting to the changing climate. A hotel owner explained, "We have installed rainwater harvesting systems and solar panels to reduce our dependence on municipal water and electricity. We are also promoting eco-friendly tourism practices to minimize our impact on the environment".

  Even with these adaptation efforts, a lot of people in the community are worried about the future. A resident of Vilpatti told, "We're doing what we can to adapt, but the changes are happening so fast. We need more support from the government and organizations like yours to build resilience and protect our livelihoods".

To conclude, Kodaikanal, a hill region, is experiencing increasingly erratic rainfall and a higher frequency of landslides. Interviews indicate that unpredictable rainfall has led to more extreme events, causing landslides that damage homes and infrastructure and, in some cases, result in loss of life. These changes have disrupted traditional livelihoods and increased the vulnerability of local

communities. The need for improved early warning systems, resilient infrastructure, and livelihood diversification is evident from the lived experiences shared in the interviews.

C. Stakeholders' Perspective

The stakeholder narratives reveal a significant transformation in environmental risk patterns, characterized by increased frequency and intensity of extreme weather events. This shift represents not just a change in weather patterns but a fundamental alteration of the region's environmental vulnerability profile. The Additional Chief Secretary (Rural Development and Panchayat Raj Department) to the Government of Tamil Nadu, Gagandeep Singh Bedi, articulates, "Cyclones have affected North Chennai severely. Earlier, cyclones used to happen like, once in three years; now almost every year happen and the frequency has increased".

He further added, "Repeated cyclones have affected North Chennai severely and increased rainfall. Rainfall above 100 mm per day is very rare and is happening". Ms. Margaret, an ASHA worker, also shared the position, stating, "The climate has drastically changed in Kodaikanal; earlier it used to be stable, but now we have fog and rain together, and the rainy season is extended".

This observation is particularly significant as it represents a quantifiable shift in disaster frequency, suggesting a new normal in climate-related risks. Dr. Selvakumar, Directorate of Public Health, Government of Tamil Nadu, briefly agreed that there are connections between public health issues and climate change. But stressed the need for joint actions to rectify the problems, and hence called for a plan of action to be carried out along with the department. The health system's response shows evidence of both reactive and proactive adaptation strategies, though these are not always well-integrated. A health worker notes, "During the rainy season, people can't keep themselves hygiene and hence they tend to get diarrhoea, jaundice, chicken pox, and it spreads easily to other members in the village".

This observation reveals the interconnected nature of environmental conditions and public health challenges. The research further shows a complex pattern of community vulnerability that extends beyond direct health impacts to include broader social and economic dimensions. Mr. Netaji S. Ganesan, Chennai Divisional Chairperson, observed, "due to rain and flood, children and women are affected with malaria, typhoid, wheezing and other viral fevers". This was further reiterated by Mr. Bedi, who claimed, "Rain causes diseases like dengue and in fact in 2017, dengue cases were recorded and due to rain, it increased".

Surprisingly, the sexual and reproductive health being impacted was also observed by Mr. Muruganandh, Chief Secretary, Government of Tamil Nadu, during disasters, as he purported, "Girl children at adolescence are at high risk, and menstrual hygiene is the key issue during floods and continuous rain".

The disaster is an event that requires all the stakeholders to act. However, Mr. Muruganandh reported that about 5000 volunteers have been given 12 days of training on disaster management, particularly to protect children and women. He further added that teachers have been trained to handle the physical and psychological complaints of children. Adding to the arrangements and response, Mr. Ganesan informed, "We provide milk, bread, and clothes to affected people, and there are volunteers who support them during the rain".

Additionally, Ms. Margaret said, “We ASHA workers have a first aid kit with which we handle immediate medication”. As for the long-term plans of the state government, Mr. Anurag Mishra, Special Secretary (Environment and Climate Change), Government of Tamil Nadu, informed of ‘One Health Mission’ program to address climate change and health issues, ‘Green Fellows’ - 8000 schools with ‘Green Clubs’ and most importantly ‘Green Schools’, 200 of them with solar energy and functional toilet. However, Mr. Ganesan also pointed to the gaps in the system to respond to disasters. He explained, “There is no separate disaster management team to address the issues at the divisional level, and we have to depend on the orders and guidelines of Chennai Corporation to act upon”. He explained that 32 departments need to work in consonance to address the issues and problems of people due to climate change in Chennai.

6.3. Comparative Analysis: Urban vs. Rural/Hill Impacts:

Chennai and Kodaikanal show how the impacts of climate change can differ across geographical regions in proximity. These two areas have a lot in common. Both are in the state of Tamil Nadu, India, and both are home to a sizable population. But while Chennai is a flat coastal city that is rapidly urbanizing and industrializing, Kodaikanal is a mountain town with a 140-year history as a retreat from the heat, a cool climate, and a somewhat different way of life. In this comparative analysis, we highlight the key similarities and differences in climate change that each of these two cities is experiencing. We do this to shed light on something that climate scientists around the world are increasingly concerned about: the growing unevenness of climate change itself—its impacts and the way we respond to it—across different people and places.

- Both areas are experiencing changed rainfall patterns, but the way that's happening is very different. Chennai is getting intense, much shorter storms; think of monsoon season and what happens during that. The rainfall spread across the region has also narrowed; the areas seeing rain are much more localized. Kodaikanal is watching a slow-motion shift; the mix of rain here has become more protracted, more spread out. These changes throw the farming calendar into disarray.
- Distinct patterns also show in the health impacts. Higher population density and urban pollution in Chennai lead to higher rates of respiratory diseases and heat-induced illnesses. The urban heat island effect, which does not exist in Kodaikanal, makes the residents of Chennai particularly susceptible to certain ailments during the summer months. The Kodaikanal Health and Family Welfare Society has warned that vector-borne diseases are set to rise in the higher altitudes of the Nilgiri Biosphere Reserve.
- The combination of the urban heat island effect and climate change is set to make Chennai's population even more susceptible to respiratory diseases and heat-related impairments. The population in Kodaikanal is vulnerable to other heat-related impairments, especially in the high temperatures that are now sustained over longer periods. High temperature is a public health emergency. Multiple studies (including one by the National Oceanic and Atmospheric Administration) have shown that high heat and humidity can negatively impact human health.
- The regions are marked by unique economic vulnerabilities. The informal workers of Chennai—those in construction, street vending, and daily wage labour—suffer direct income losses during extreme weather events. The city's coastal fishing communities bear the brunt of immediate impacts during storms, but long-term changes to the marine environment threaten their way of life. The agricultural communities of Kodaikanal (and the surrounding district) face slow, steady, almost imperceptible changes that threaten their traditional farming practices: declining yields and a growing period that is more and more unpredictable.

- Adaptation strategies reflect these contextual differences. In Chennai, community-level responses focus on immediate disaster preparedness, such as early warning systems and emergency shelters. Institutional responses emphasize infrastructure improvements like stormwater drainage systems and sea walls. Kodaikanal's adaptation efforts centre on some of the same immediate disaster responses that Chennai has adopted. However, the hill community's adaptation approach is much more focused than Chennai's on the more gradual, but no less significant, climate changes the simulations predict for the hill station over the next few decades.
- Both regions experience school closures due to extreme weather, but the reasons are quite different. Chennai contends with direct hits from floods and cyclones that lead to immediate, often long-term, school closures. Kodaikanal, on the other hand, must deal with landslides and access problems caused by damaged road infrastructure. This is a challenge for the kids who must travel a long distance—12 kilometres or more in some cases—to attend school. In both cases, however, the extreme weather can't be directly blamed for the disruption to education.
- Regional variations exist in government responses and the implementation of policies. Disastrous events first hit urban areas like Chennai in more immediate ways, and the government of Tamil Nadu responds more quickly there. Even so, government action in Chennai is often criticized as being reactive rather than preventive, as the city's increasingly urban landscape continues apace. The hill towns and surrounding regions seem to suffer from what amounts to invisibility in policy frameworks at the state level. When disaster strikes at elevation, the unique vulnerabilities of Kodaikanal and its neighbours aren't always reflected in government responses.

The comparative analysis shows that effective climate adaptation requires regionally customized strategies that consider the precise weaknesses, abilities, and socio-economic settings of each different area. Policies that are meant to fit all types of situations tend not to be very effective when considering the kinds of diverse problems and situations faced by a large urban centre like Chennai, on the one hand, and a hillside community like Kodaikanal, on the other.

6.4. Integrative Discussion and Synthesis:

- **<u>Common Themes and Divergences</u>**
  - Even with the geographical and socioeconomic differences between Chennai and Kodaikanal, the two experiences of climate change have a lot in common. Water is a major concern in both places, but for very different reasons. Chennai is projected to face extreme water scarcity by 2030, while Kodaikanal is seeing rainfall intensify. Climate models predict that rainfall won’t be as intense in the future, but when you live in a place where floods threaten to sweep your house down a hill (as has happened in both places during the last several years), you tend to think of rain, or the promise of rain, as a very good thing. Health, agriculture, infrastructure, and daily life in both areas are affected by what happens to the water.
  - Climate change vulnerability affects people differently, depending on where they live and their socioeconomic status. This is very clear in Chennai, where informal settlements and coastal communities are under a three-pronged threat: rising waters, the sinking city, and increased cyclone intensity—all fuelled by climate change. In Kodaikanal, the indigenous people and small farmers who live on the edge of the forest are struggling to adapt to climate change in ways that are saving their lives and livelihoods. Those who face threats from climate change are not equally insecure.

- Both regions share the same shortcomings in their institutional responses. These responses tend to be inadequate and mainly directed at problems that have already occurred, rather than aimed at what could happen in the future. Coordination between the different government departments that need to be involved is also inadequate. Furthermore, there is insufficient involvement of the communities that will live with the consequences of the decisions made in the planning and implementation stages.
- The differences among the regions are equally informative. The speed of climate change impacts varies—Chennai faces sudden, often devastating events like floods and cyclones, while Kodaikanal endures more gradual (but equally disruptive) alterations in temperature and rainfall that come in stages. These different temporal scales call for different adaptation strategies.
- Chennai, despite its exposure to climate risk, has much better access to the financial resources, technical know-how, and institutional backing that are essential for climate adaptation. Kodaikanal and the adjacent hilly areas frequently have trouble with visibility and the allocation of resources in state and national climate policy. They often lack the very basic components that would enable them to adapt to the climate crisis.
- Distinct patterns are also showing up in cultural and social impacts. In Kodaikanal, traditional knowledge systems, cultural practices tied to agricultural cycles, and indigenous ways of life are under direct threat from climate change. In Chennai, it is the impact on communities and urban livelihoods that's front and centre as the climate crisis amplifies displacement, migration, and social disruption.

- **<u>Emerging Patterns in Health, Education, and Livelihoods</u>**
  - Both regions have the appearance of climate change, and the health impacts show up in emerging patterns that must be attended to. The geographical range of climate-sensitive diseases is expanding. Vector-borne diseases are appearing in new places. Dengue and malaria are showing up in the previously uninformed areas of Kodaikanal. In Chennai, vector-borne and waterborne diseases are on the rise. The flooding and waterlogging create disease-producing conditions that are the perfect breeding ground for outbreaks. Waterborne diseases and diseases spread by insects are becoming much more common. The flooding in Chennai is the maritime abyss of disease. Flooding causes many diseases, and it is a climate-intensive way to push bacteria into people's lives.
  - Often neglected, mental health is a critical dimension of the climate change disaster. In both regions, people are experiencing it. They are under increased stress and anxiety because of the extreme weather events and the uncertain climate we are all shifting toward. Helplessness, a natural by-product of experiencing such severe and long-lasting changes, is bound to affect mental health, both positively and negatively.
  - Disruptions in education manifest in cumulative effects. Although any one school closure can seem temporary, the repetition of these events produces lasting deficits in learning. And it is already marginalized students who pay the steepest price. A teacher in Kodaikanal commented, “Some of our students from remote villages miss school for weeks during the rainy season. Over the years, these absences accumulate, and many fall behind permanently”.
  - The effects on people's livelihoods show a pattern of adaptation and transformation. In both regions, traditional ways of earning a living—fishing in coastal Chennai and farming in Kodaikanal—are threatened by climate change. Some community members have found ways to adapt within their traditional sectors. Others have made the transition to alternative livelihoods. A fisherman from Chennai said, “A lot of the younger guys in our community are

leaving the fishing business altogether. They see the declining catches and the increasing risk and have chosen to get good jobs in the city instead".

- Consistent patterns emerge across both regions regarding the gender impact of climate change. Women often shoulder a disproportionate share of the responsibility during and after extreme weather events. Their caregiving roles become magnified, as do their already substantial challenges related to the procurement of food and water, and the preparation of the same. Medical authorities have long been aware of the health vulnerabilities that are unique to women. A community health worker in Kodaikanal made the following remark, which captures the essence of what's true in both study locations: "Women in rural areas walk longer distances to collect water during dry periods. This physical burden comes on top of their existing household and agricultural responsibilities".

These evolving patterns emphasize the interwoven nature of climate change impacts across health, education, and jobs. They accentuate the necessity for united methods that handle these several aspects at the same time, instead of managing them as distinct areas of action.

6.5. Children's Voice Solutions

Children demonstrate sophisticated environmental awareness and propose solutions. "We should separate decomposable garbage and non-decomposable garbage. "Vehicles should be decreased, and speed should also be less. Avoid plastics", suggested one child. Others emphasized nature-based solutions: "We should not torture animals. We should plant trees". Children in coastal areas specifically identified industrial pollution as a concern: "The Government should close these companies and factories". Their understanding of environmental interconnections reveals both their vulnerability and their capacity for contributing to solutions.

Children also demonstrated remarkable awareness of infrastructure needs and solutions. Their suggestions range from immediate interventions– "Make sure electricity wires don't fall. The road should be paved well. Drainage should be clean"- to long-term solutions– "We can also use solar energy as an alternative source of energy to avoid power cuts". Children in coastal areas particularly emphasized housing vulnerability: "Sometimes I feel like if we also had a good house, it would have been nice. They also proposed practical solutions like 'We can dig wells... At least one or two hand pumps per village may help.

6.6. Recommendations

Subramanian (2000) gives us the information on challenges around development state and community interactions. This is valuable because it underscores the need not only for better governance but also for more engaged communities in development. Both are essential if we are to address the urgent health problems affecting vulnerable communities. In urban slums and among their children, the problems are compounded by climate change as well as the indefensible inadequacies of the health system and community resources.

Climate change, food safety, and health intersect in hazardous ways that elevate the urgency of needed interventions, especially for vulnerable populations like children. Nutrition programs and health initiatives are fundamental to mitigating the impacts of climate change on the health of these communities. Ensuring that children receive adequate nutrition coupled with preventive and reparative health services is vital to improve health outcomes for the long haul and mitigate the powerful forces of climate change on these vulnerable populations. It is a fundamental not only to

ameliorate the preparation for climate-induced catastrophes, but also to enable the community to take part in initiatives for the construction of resilience and the improvement of risk management for catastrophe issues.

Children living in coastal fishing communities bear the brunt of the health consequences tied to the rising sea level and changing fish supplies. The threats to food safety and the fishing means of subsistence are direct ones. Sundari (2007) highlights the commitment of the community as a critical element in successful interventions. To be effective, local knowledge and traditional practices must be integrated with formal health approaches. If the fishing families and children have health problems related to nutrition and the fishing community suffers from food safety problems, then those problems are direct threats to the adaptive capacity of the fishing families and their children. Srinivasan and Turner (2022) underline the urgent need for reforms in urban planning and policy if a community of any kind is to be made healthy. To serve the children of Kodaikanal by promoting their mental health and general well-being, such a community's soil management and green space promotion programs would have to become protective factors.

Strengthening Disaster Response and Early Warning Systems: Both Chennai and Kodaikanal need effective systems for disaster response, preventive mechanisms, and preparedness. For Chennai, we recommend the following:

- Building flood early warning systems at the neighbourhood level that combine technological solutions with community networks so that all residents, including the most vulnerable without smartphones or internet, receive timely and accurate warnings.
- Establishing evacuation routes and emergency shelters in flood-prone areas is crucial, especially for children, the elderly, and persons with disabilities. These vulnerable groups need particular attention when it comes to plans for getting to safety in the event of a flood. Emergency shelters must be accessible, and the routes to them must be easily navigable for these individuals. Routes and shelters must also be comprehensible and reachable for other at-risk groups.
- Establishing community disaster response teams that are equipped with basic training and proper materials. These teams are necessary, especially in informal settlements, because official emergency services are often delayed or stretched too thin.
- Enforcing a building code that resists cyclones in coastal areas and offering subsidies or technical help for retrofitting current structures, with special attention to fishing communities.

The suggestions for Kodaikanal and adjacent hilly areas concentrate on:

- Create mapping and monitoring systems that assess landslide risk. Ensure that the focus of these systems is on areas that have recently experienced deforestation or construction.
- Setting up community-based rainfall monitoring networks that can give early warnings of potential flash floods or landslides.
- Making alternative routes and means of communication to ensure that far-flung hamlets are not completely isolated during extremely bad weather.
- Establishment of systems for the prevention and early detection of forest fires, especially in places enduring protracted dry spells.

In both regions, coordination between government departments and levels- local, state, and national- needs to improve. A unified command structure, clear communication protocols, and regular joint exercises can boost the effectiveness of responses during disasters.

Enhancing Healthcare Infrastructure and Community Outreach: Both the healthcare systems in Chennai and Kodaikanal need boosting to meet the climate change challenges to health. We make the following recommendations:

- Building healthcare facilities that can still operate during severe weather and power outages.
- Setting up backup power systems so that even if the grid goes down, a hospital can keep its main and essential functions running until power is restored.
- Elevating structures in flood-prone areas, not only to pass local building inspections but to protect against an increased risk of flooding.
- Educating healthcare personnel to identify and remediate climate-influenced illnesses. This cohort may include novel or revived health problems in newly emergent areas as temperatures and precipitation patterns shift markedly.
- Setting up mHealth units that can provide care during extreme weather events, particularly to the isolated populations in the villages around Kodaikanal and the flood-prone areas of Chennai.
- Establishing local health surveillance systems that can ensure early detection of climate-related disease outbreaks, such as waterborne epidemics, in the wake of extreme weather events.
- Creating an array of mental health support systems tailored for climate-induced stress, anxiety, and trauma. The array particularly pays heed to the kinds and the mental health shapes that stress, anxiety, and trauma take in children and other groups that can be especially vulnerable.
- Making health education programs that enlighten communities about the health risks that are shifting because of climate change and the relevant protective actions they can take. This covers a range of subjects, from the control of disease-carrying insects (which are proliferating in warming climates) to the right ways to purify water (the safety of which is threatened by extreme weather events) to the management of human occupations and living conditions in dangerously high temperatures.
- Designing distinct healthcare systems for at-risk populations during severe weather occurrences. This includes pregnant individuals, young children, senior citizens, and those with long-term health issues.

These healthcare recommendations must be applied with a clear purpose of ensuring equity and accessibility. They must pay special attention to the communities that have been marginalized—those who are most vulnerable to climate change and its health impacts.

Revitalizing Educational Frameworks: The educational systems in both Chennai and Kodaikanal require adaptation to reduce interruptions and construct climate resilience among students and communities. Recommendations include:

- Creating adaptable academic calendars that can maintain educational quality and coverage despite predictable, climate-related disturbances, such as the monsoon season.
- Establishing school infrastructure that can withstand the impacts of climate change, such as elevated buildings in flood-prone areas, improved drainage systems, and structures that can resist high winds in coastal areas prone to cyclones.
- Putting in place options for distance learning that can be used when schools are closed, and that pay attention to equity in terms of access to technology and the internet.
- Preparing educational materials on climate change, environmental conservation, and disaster preparedness that are relevant to the local context and appropriate for the intended age group.

- ❖ Teachers trained in psychological first aid and basic counselling skills to support students affected by climate-related stress or trauma.
- ❖ Creating dependable ways to get students to school when the weather is bad, especially in Kodaikanal, where children from tough-to-reach villages must navigate treacherous paths to get to class during the monsoon.
- ❖ Developing early warning systems and evacuation plans for schools, with the regular testing that all personnel, including students, know what to do in the event of an emergency.
- ❖ Integrating ecological knowledge, especially in Kodaikanal schools, to preserve priceless local wisdom about environmental management while integrating that with scientific understanding of climate change.

The needs of marginalized students must be particularly considered when implementing these educational recommendations. Marginalized students frequently encounter the most significant obstacles to educational attainment during climate-related disruptions.

Promoting Sustainable Livelihoods: Traditional livelihoods in both Chennai and Kodaikanal are under threat from climate change, making it imperative to both adapt current ways of making a living in these places and to develop alternative, reliable income sources that can withstand the climate crisis. Increased population and economic growth, along with rapid urbanization along the coast, have made Chennai more vulnerable to disasters. Coastal and urban communities face a rising tide of insecurity, not only from recurrent disasters but also from unplanned and uncontrolled development, a mix of industrial and residential expansion that ignores safety and environmental concerns, and the degradation of natural protective infrastructure. For the residents of the coast and riverbanks, the outlook is dire.

Assisting fishing communities in their adaptation to a changing marine ecosystem employing the following:

- ❖ Sustainable fishing and fish farming.
- ❖ Improved storage facilities and low-cost technologies to reduce cooling space (thus minimizing energy costs) and to prolong the life of products, so that post-harvest losses are greatly reduced.
- ❖ Creating options for fishing communities to earn income in sectors other than fishing, especially during those times of the year when cyclone threats and other dangers make fishing impossible.
- ❖ Making climate-resilient infrastructure that is suitable for informal markets and street vendors. This includes covered markets that protect from heavy rainfall and extreme heat.
- ❖ Implementing programs for skill development directed at climate-resilient sectors, with a particular focus on young people from vulnerable communities.

For the farming and hilly communities of Kodaikanal:

- ❖ Helping farmers adjust to climate change through smart agricultural practices. These include selecting crop varieties that are better suited to extreme climate conditions, improving farm irrigation systems and managing water resources more effectively, and using soil conservation and other techniques to maintain safe and productive conditions for crops.
- ❖ Execute forest management programs on a community basis that offer residents a way to earn a living through the sustainable harvesting of products other than timber while also helping to conserve the forests.

Both regions require better access to the financial services they need from the government to adequately mitigate the risks of climate change and its induced ramifications, thereby also increasing their financial resilience. The community must be engaged in identifying priorities and implementing these livelihood recommendations if they are to succeed. Communities know their business better than any outside expert. Therefore, they should rightfully have a major role in the implementation of these recommendations.

6.7. Conclusion:

This thorough study of climate change consequences in Chennai and Kodaikanal unveils the intricate nature of climate vulnerability and resilience in Tamil Nadu. The starkly different conditions in these urban and hilly locales reflect how geographical, socio-economic, and infrastructural features conspire to produce either an audacious or a timid response to climate change. The analysis yields several main conclusions.

- First, the effects of climate change cascade across many different areas and impact health, education, and even our social systems and living conditions. They create intricate problems that call for all-hands-on-deck, whole-of-government, and whole-of-society solutions. The downside is that no intervention can work well if it is focused in a single sector, and it is highly unlikely that any of the many interventions we need can work well if we do not work across quite a few of them.
- Second, climate change most adversely affects the most marginalized communities. Their plight exemplifies the case for climate justice. In both Chennai and Kodaikanal, socioeconomic factors- like income, the type of work one does, the quality of one's housing, and the access one has to basic services- exert a powerful influence on who is affected most by climate hazards. This strongly suggests that adaptation efforts need to prioritize the vulnerable in a much more serious and focused manner than seems true at present.
- Third, the vital elements of climate adaptation are community knowledge, agency, and participation. These elements define a fundamentally different approach to development than the one traditionally imposed from the top down. And failure in this arena, where development seeks to condition human life to be more climatically resilient, means that people who live in the places most at risk will suffer the most.
- The fourth challenge spanning the temporal dimensions of climate change requires immediate response capabilities for disasters as well as long-term transformative adaptation. For that, systems of excellence need to be in place for not just the types of handling emergencies that call for sudden mobilization (robust early warning systems and emergency response plans), but also for the kinds of systemic, long-term planning that can make a difference when we're talking about climate change adaptation.

- Fifth, climate adaptation stands to benefit greatly from the traditional knowledge systems and cultural practices of Kodaikanal's indigenous communities. These knowledge systems were developed over millennia and represent thousands of generations of intimate interaction with local ecologies. Their insights, though often disregarded by mainstream science, offer the promise of adaptation strategies that are both locally and culturally appropriate.

Ultimately, the experiences from both areas highlight the urgent demand for institutional agreements and policy frameworks to back climate adaptation that is specific to both context and community. In the end, addressing the health impacts of climate change on children will necessitate the work of multiple partners, including governmental agencies, civil society organizations, and local

communities. The kinds of interdisciplinary efforts that integrate public health, environmental sustainability, and social equity are what is needed to furnish appropriate climate health solutions. Political reforms that place the health of children at their core, along with a base of community involvement, are our best shot at an integrated response—and one that privileges sustainable development. That is, creating environments in which children can grow up with a reasonable expectation of good health, in the face of unprecedented 21st-century climate challenges.

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7. CONCLUSION AND FUTURE STEPS

Mitigating the negative impact of climate change on children in South India requires a multi-pronged approach that addresses both immediate needs and long-term resilience. Children are particularly vulnerable to climate change due to their physical, social, and emotional development stages. Here are some ways to mitigate the impact:

1. Enhancing Disaster Preparedness and Response

- *Early Warning Systems*: Improve early warning systems for extreme weather events (like floods, cyclones, and heatwaves) to give families time to prepare and evacuate. Ensure that these warnings are accessible to children and families in rural and coastal areas.
- *Disaster-Resilient Infrastructure*: Strengthen schools, hospitals, and community centres to withstand climate-related disasters. This can involve retrofitting buildings, creating safe evacuation routes, and ensuring these facilities have emergency supplies.

2. Improving Access to Safe Water and Sanitation

- *Water Scarcity Management*: With the changing climate, droughts can become more frequent in South India. Ensuring children have access to clean drinking water and promoting water conservation techniques in communities can reduce waterborne diseases.
- *Waste Management and Sanitation*: Proper sanitation and waste management systems help prevent the spread of diseases that can be exacerbated by extreme weather conditions. Improving these systems can prevent additional harm to children's health.

3. Strengthening Health Systems

- *Child-Focused Health Programs*: Establish programs that focus on nutrition, immunization, and disease prevention, especially in areas prone to heat waves, floods, and malnutrition. This includes strengthening healthcare access for children during climate-induced health crises like dengue outbreaks or respiratory diseases due to pollution.
- *Mental Health Support*: Climate-induced trauma can have long-term effects on children's mental health. Providing counselling services and mental health programs in schools and communities is essential.

4. Climate-Resilient Education

- *Green Schools*: Promote climate-resilient schools by ensuring they are energy-efficient, have access to renewable energy, and are designed to withstand extreme weather events.
- *Climate Change Education*: Educate children about climate change, sustainability, and disaster preparedness, helping them understand the challenges they face and ways to adapt. This can include integrating climate change education into school curricula.
- *Adaptive Learning*: Ensure that children can continue their education even in the aftermath of disasters. This may involve using technology, mobile schools, or community-based learning centres that can quickly set up after a disaster.

5. Community-based Climate Adaptation Strategies

- *Climate-Smart Agriculture*: Since many families in South India rely on agriculture, promoting climate-smart farming practices can help ensure food security. Teaching families ways to

diversify crops, conserve water, and use sustainable farming techniques can protect children from hunger.

- *Community Resilience Building*: Encourage community-driven initiatives like creating local networks to share resources, provide mutual aid, and collectively prepare for climate-induced events.

6. Protecting Vulnerable Groups

- *Focus on Marginalized Communities*: Vulnerable children in low-income families, slums, or rural areas are disproportionately affected by climate change. Programs that focus on improving infrastructure, access to resources, and community support for these groups are essential.
- *Child Labour Prevention*: With the impact of climate change, children may be forced into labour or early marriages as families struggle. Strengthening child protection laws and providing alternative livelihoods for families can help prevent child labour.

7. Strengthening Policy and Advocacy

- *Advocacy for Children's Rights*: Advocate for climate policies that protect children, ensuring that the voices of children and their specific needs are part of local and national climate action plans. Engaging in dialogue with governments to create child-centric climate policies is crucial.
- *International Cooperation*: Support and advocate for global and regional collaboration on climate action that recognizes the specific needs of children in the Global South, including access to climate funding and technology.

8. Advocating for Green Spaces and Urban Planning

- *Greening Urban Spaces*: In rapidly urbanizing areas like cities in South India, creating more green spaces (parks, trees, community gardens) can provide cooler environments, reduce heat island effects, and improve children's mental and physical health.
- *Safe Public Spaces*: Ensuring children have safe places to play and learn in urban areas, even amidst the growing impacts of climate change, will help protect their development.

9. Supporting Family Livelihoods

- *Livelihood Diversification*: Help families diversify their income sources, so they are less dependent on climate-sensitive sectors like agriculture. This might include supporting small businesses, skill training, or other livelihood programs that can provide stability for families during climate shocks.

10. Conducting future research studies:

Further research is needed in the following areas:

- Longitudinal studies to track the impacts of climate hazards on children's nutrition and health.
- Region-specific micro studies to explore patterns of climate-induced illnesses.
- Evaluations of the effectiveness of government nutrition programmes in climate-affected regions.
- Qualitative studies on how livelihood loss due to climate hazards increases vulnerabilities, including child protection concerns.
- Research on child labour and early marriage in families impacted by climate hazards.
- Studies on climate anxiety and stress levels among children in vulnerable regions, and research on the impact of climate change on children's mental health and well-being.

By integrating these approaches and studies, South India can better protect its children from the negative impacts of climate change, ensuring they have the resources, education, and resilience needed to thrive in a changing world.

Overall Conclusion: Through this study, we did exploration of various climatic zones and observed that every zone has a challenge. In Andaman and Nicobar Islands, due to the new development initiative, the communities are worried about their natural ecosystem, and as stated by Prof Satya Kumar that without involving the locals and protecting our natural resources, any development may be a challenge on many fronts in the island. In Andhra Pradesh, due to regular flooding in the area, communities are prepared themselves, and through collective efforts, they organise relief camps. In Tamil Nadu- Chennai urban area, heat, water logging during the rainy season, and floods have been impacting the lives of people, especially those who are from low economic strata and fisherman communities in the coastal zone of Chennai, worried about cyclones and other climatic hazards affecting their livelihood and survival. In the Kodaikanal location of Tamil Nadu, deforestation and access have been major issues for the people, and due to the proposed and ongoing infrastructure development, the ecosystem of the area is becoming imbalanced. One tribal community leader from the locality pointed out that we need to protect our land and forest as well as the traditional food system, otherwise it will be a challenge for our next generation to live a dignified life. In Bhadrachalam, Telangana, floods are coming every year, and it takes at least three months for the communities to reorganise their daily lives every year, which has a direct impact on their survival from all aspects.

In this study, it has been observed that children have been affected both physically and mentally, and while discussing with various policy makers, other stakeholders, and communities, it was found that no concrete disaster management plan and climate action plan have been developed focusing on children, and their challenges have been ignored. Children have expressed that they lost a year when climate hazards occurred. In Bhadrachalam, floods came frequently, and children from flood flood-affected area missed their classes for more than two months and not unable to keep up with other children residing in the non-flood zone. In Vijaypuram Schools (ANI), children's eco-club creates awareness among children regarding climate change, but it was missing in Hat Bay Island and other schools.

Govt of India has developed the National Climate Action Plan and Human Health and other relevant National programmes, which have been adopted by States. All four States of South India require a robust strategy and a developed implementation mechanism involving all stakeholders.

Common Thematic Recommendations

Disaster Preparedness and Response:

- Improve disaster preparedness and response systems at the community level and involving local governance.
- Establish early warning systems at the neighbourhood level, combining technological solutions with community networks
- Set up evacuation routes and rescue operational arrangements preparedness; emergency shelters in flood-prone areas
- Establish community disaster response teams with basic training and materials
- Enforce building codes that can withstand climate-related disasters

Healthcare Infrastructure and Outreach:

- Climate-Resilient healthcare facilities that can operate during severe weather and power outages
- Elevate healthcare structures and access in climatic hazard areas
- Train healthcare providers and other health-training institutes in addressing healthcare services during climatic hazards
- Establish local health surveillance systems for climate-related disease outbreaks
- Create mental health support systems for climate-induced stress and trauma
- Prepare and implement a community-adaptable preparedness plan

Education and Awareness:

- Adapt academic calendars to accommodate climate-related disruptions
- Establish climate-resilient school infrastructure
- Implement equitable distance learning options
- Prepare context-appropriate educational materials on climate change
- Train teachers in psychological first aid and counselling
- Develop reliable transportation options for adverse weather
- Integrate ecological knowledge and environmental management

Sustainable Livelihoods:

- Assist fishing communities in adapting through sustainable practices and alternative income sources
- Implement climate-resilient infrastructure for informal markets
- Offer skill development programs for climate-resilient sectors
- Help farmers adopt smart agricultural practices
- Execute community-based forest management programs
- Improve access to financial services and government support

Policy and Research:

- Ensure the implementation of State Climate Action plans.
- Intra and inter-departmental convergence, coordination, and Collective efforts.
- Develop region, zone, till panchayat level climate-specific hazard mapping and subsequent climate action plans.
- Participatory planning process towards advocacy
- Vulnerability assessment of various geographical areas should be done.
- Child-led adaptation strategy should be developed and implemented by integrating children's voices.
- Ensure the Development of a women and Child health preparedness plan in every possible climate hazard zone.
- In Tamil Nadu, Green schools have been developed by the Government, and infrastructure is in place in some schools, which should be expanded to every school in the State with adequate budgetary provisions and an implementation plan. A child-centric climate change action plan should be developed at the school and community level, which will help the children become climate-aware citizens and climate warriors with self-care training during any climate hazards.


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