



Climate Related Health Adaptation and Resilience in India: Southern Region



A Policy Paper Developed under the HER-CAP Project



National Institute of Disaster Management

(Ministry of Home Affairs, Government of India)



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Policy Paper



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ISBN: 978-81-956700-0-0

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Edition: 2021

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Published by

National Institute of Disaster Management, Ministry of Home Affairs, Delhi-110042

Citation

Gupta, A.K., Sood, A. and Barwal, A. (2021) Climate Related Health Adaptation and Resilience in India: Southern Region, Environment and Climate Disaster Risk Management Division, National Institute of Disaster Management, Delhi, pp 22

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FOREWORD

Climate change is known to have deleterious effects on human health and wellbeing. India with a diversity of agro-climatic systems suffers climate risks like temperature extremes, precipitation extremes, cyclones, windstorms, hails, frost, etc. and other disasters including secondary ones like forest fire, landslides, pest attack, disease outbreak epidemics, etc. Social and livelihood marginalization as consequences of climate change are known contributors of people's vulnerability.

In Southern states, social and demographic factors such as population growth, urbanization, immigration, changes in land use and sea level rise, international travel, and breakdown in public health services have been mainly responsible for the recent resurgence of infectious diseases. Public health effects of various disasters include diseases and illnesses associated with the loss of clean water, hygiene, and sanitation, loss of shelter and belongings, population displacement, toxic exposures, and hunger and malnutrition risk due to food scarcity.

I complement Prof. Anil K. Gupta and the HER-CAP project team for this important contribution. I also thank WHO-India for supporting this endeavor. The efforts of the authors are praiseworthy, as they meticulously brought in the context of this policy paper which covers all these existing and forth coming problems and their mitigation measures and resilience policy after a close consultation with the experts of Southern States & UTs.

Shri Taj Hassan, IPS

आपदा प्रबंधन महाविचार: पूरा भारत भागीदार

Climate Related Health Adaptation and Resilience in India: Southern Region

ABSTRACT

Climate change is identified to have a close relationship with the increase in health issues, causing epidemics and introducing new health problems. Robustness of the health care system is an essential determinant in the risk to human health. Therefore, areas with better access to health infrastructure help the population to adapt to health problems arising out of the adverse effects of climate change. Each region is presented by a different and varying degree of climate impacts. The southern parts of India, except Telangana, are located along the coastline in the peninsular region of India. Due to the geographic location, climatic conditions and other factors, the climatic impact on these regions and human health differs from other parts. However, there are some commonalities, as well. Simultaneously, the adaptive capacity of each region and State is different due to many parameters like the availability of health care infrastructure, education, social structure. Therefore, better health infrastructure and access to health increase the resilience of the State and region to climate-related health impacts.

Keywords: Climate Change, Health Adaptation, mitigation, resilience, Disaster, Health Impacts

I. Introduction

Climate Change has many direct and indirect negative impacts on human beings, animals, nature and the ecosystem. The worst of all these is the effect climate change has had on the basic components of climate like the temperature, rainfall pattern etc. giving rise to more dry spells and heavy rainfall events in short intervals. Also, the geographic distribution of the rainfall and temperature has shown a marked change.

Climate change is identified to have a close relationship with the increase in health issues, causing epidemics and introducing new health problems. Robustness of the health care system is an essential determinant in the risk to human health. Therefore, areas with better access to health infrastructure help the population to adapt to health problems arising out of the adverse effects of climate change. Each region is presented by a different and varying degree of climate impacts. The southern parts of India, except Telangana, are located along the coastline in the peninsular region of India. Due to the geographic location, climatic conditions and other factors, the climatic impact on these regions and human health differs from other parts. However, there are some commonalities, as well. Simultaneously, the adaptive capacity of each region and State is different due to many parameters like the availability of health care infrastructure, education and social structure. Therefore, better health infrastructure and access to health increase the resilience of the State and region to climate-related health impacts.

In view of the above, this policy paper has been drafted to highlight the climate impact on human health, resilience and capacity building existing and further developments needed in the southern region of India.

The southern region comprises of five states and three union territories (UT's). All states in the southern region are coastal states except for Telangana. The UT's of Andaman and Nicobar Islands (ANI) and Lakshadweep are islands and have island climate. The extensive coastline and islands experience coastal climate which is hot and humid, with temperatures ranging in between 22 to 35 degree Celsius. Telangana is a semi-arid region and experiences dry and hot climate. Several parts of Andhra Pradesh (AP) and Northern Karnataka also experience very high temperatures. The entire region receives southwest monsoon. Drought conditions impact several parts of Telangana and AP, with a drought occurrence of twice in 5 years. The eastern coast is more vulnerable to natural disasters like cyclones and Tsunamis. Sea level rise, storm surge, lightning, heatwave and drought are other climatic hazards experienced by the region.

The prominent health impacts experienced in these states are vector and water-borne diseases and heat and thermal stress. Pulmonary infection and viral fever are diseases of concern in ANI. Generally, the health care system in the southern region is better developed than many parts of the country. While Kerala stands as one of the best states in terms of health care coverage, the Union Territory of Lakshadweep (UTL)

faces a crisis in terms of medical staff and supplies and has high health vulnerability in times of disaster. Some of the critical interventions identified for enhancing the effectiveness of managing climate-related health risk is to enhance the health surveillance mechanism, increase public awareness on health-related issues, and to enhance the reach and understanding of paramedical and medical staff on the issues of climate change related health impacts.

2. National Action Plan for Climate Change & Human Health

This indicates number of steps for India's development and climate change related objectives for adaptation and mitigation. It has introduced 12 national missions on climate change as global climate change is going to affect the morbidity and mortality rates especially in developing country like India. Therefore, pilot testing of new approaches through case studies are undertaken for climate sensitive locations or hotspots to achieve disaster resilience.

2.1 Objectives of National Mission on Climate Change And Human Health

- To create awareness about the impact of climate change on health.
- Capacity building of the health system (including infrastructure, resources etc.) to respond against climate induced diseases.
- Analysis of case studies to reinforce preparedness explore new cope up mechanism and reduce vulnerability towards climate change related disasters.
- Assist the states to appraise their respective vulnerabilities and help in building capacity for adaptation and mitigation.
- Develop partnerships with all stake holders to create synchrony and synergy with other missions.
- Strengthen monitoring surveillance & research capacity to fill the gap in health practice and policy.

2.2 National Health Adaptation Plan for Disaster related illnesses

The major objectives of National Health Adaptation Plan (NHAP) for Disaster related illnesses is to create enabling environment, build the capacity of climate resilient healthcare system; help institutions strengthen their preparedness, enhance the health system resilience in terms of universal health coverage; early warning, surveillance and community mobilization in the context of health emergency risk management.

The primary intervention areas to implement HAP are strengthening and expanding health infrastructure, identifying and assessing health hazards and vulnerabilities associated with climate change related disasters, building human resource capacity through policy planning, advocacy, research, training, education and knowledge management, promoting climate resilient water and sanitation facilities, revising

building codes of health facilities, promoting community health insurance scheme, advocating and creating awareness on climate change and health as well as encouraging research and development programmes on health and climate change. The NHAP proposes a seven-pronged strategic approach to achieve its goal of developing a climate change resilient health system (Fig 1).



Figure 1 Seven-pronged strategic approaches to develop a climate change resilient health system

3. Demography of the Region

States of Andhra Pradesh, Telangana, Karnataka, Tamil Nadu, Kerala, and Union Territories of Andaman and Nicobar Islands, Lakshadweep and Puducherry together form Southern India (**Figure 2**). Southern India occupies 19.31% of India's area (635,780 km²). As per the 2011 census of India, the estimated population of South India is 252 million, around one-fifth of the total population of India. About 60% of the population lives in permanent housing structures. 67.8% of South India has access to tap water with wells and springs forming other major sources of water supply. The average literacy rate in South India is approximately 80%, considerably higher than the Indian national average of 74%.

Further taking a look at individual states and union territories provides more insights into the inter-state demographic profile within southern India. The State of Kerala's achievements in human development and social indicators is higher than many parts of the country and globally well-acknowledged and comparable with developed countries in some cases. The state literacy rate was 93.01% in 2011 which is highest in the country and the male and the female literacy of 96.2% and 91.98% respectively. The school attendance rate in Kerala is more for women as compared to men. In terms of the health indicators, Kerala has the highest life expectancy of 76 years at birth, compared to the rest of the states. The State has also experienced a significant decline in the mortality rates. Population density of Kerala is 859 per sq. Km, which is higher than the national average of 382 per sq. Km.

Tamil Nadu, the most urbanized State in India, with a population of 35 million covers about 11 percent of the total area of the Country, i.e. over an area of 13,755 sq.km.

The sex ratio in 2011 is estimated to be 987 females per 1000 males, which is well above the national average in 2011. Tamil Nadu has been at the forefront of introducing social reforms and implementing a range of welfare schemes to empower the marginalized sections of the society. The State performs well in Human Development Indicators. According to the National Human Development Report 2001, the State ranked third behind Kerala and Punjab. Tamil Nadu has been very successful in reducing poverty.

Telangana is the youngest State in the southern region of the country and has one of the lowest literacy rates in the region at about 66%. Karnataka has a literacy rate of 75%.

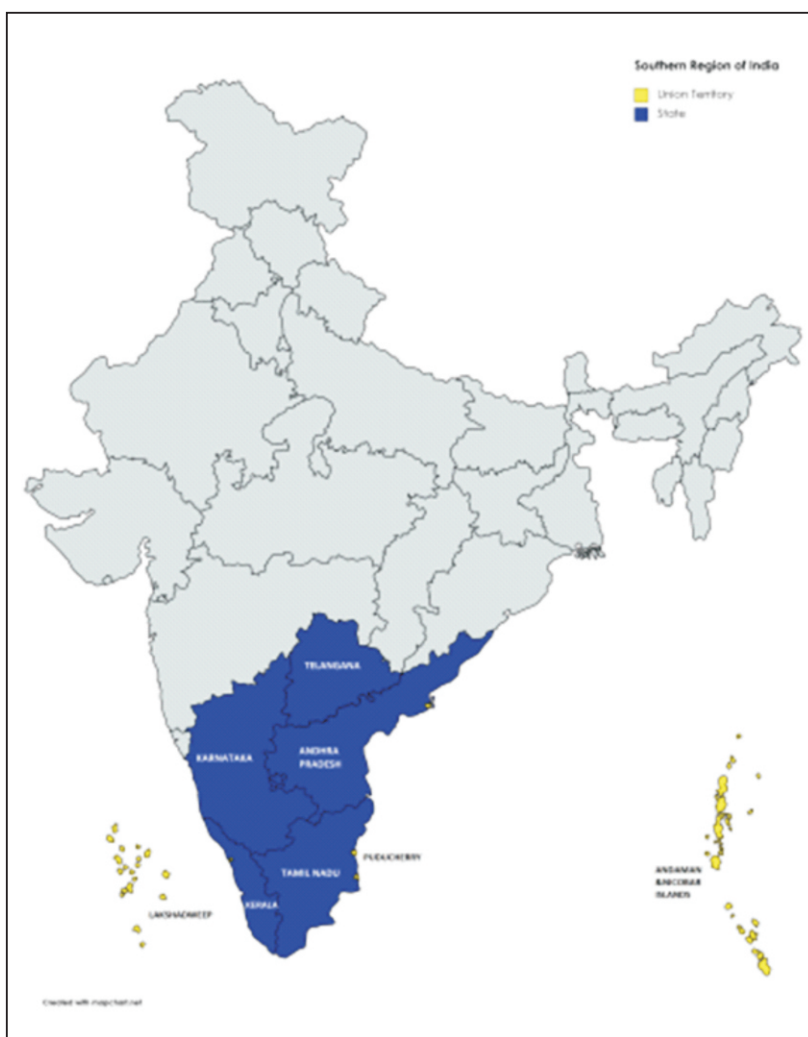


Figure 2. States and Union Territories covered in Southern India

3.1 Union Territories of Southern India

Kavaratti, Andrott and Minicoy are the most populous islands in the union territory of Lakshadweep (UTL). 95% of the total population in UTL is classified as Scheduled Tribes because of reasons like socio-economic backwardness, geographical isolation. Economic inequality and the poverty index in UTL are low. Women education, awareness of rights and responsibilities in UTL is higher than many parts of the country.

On the other hand, Andaman and Nicobar Islands (ANI) is experiencing an increase in the male population by 4.85%, and the growth in the female population is 8.85%. The population density per kilometer increased to 46 in 2011 from 43 in Census 2001. Male literacy rate in ANI is higher than female literacy rate. The birth rate in ANI is amongst the lowest in the country, and the death rate is also reducing continuously. ANI has a relatively high development status.

Table 1. Population distribution in southern region (as per 2011 census)

State	Population	Male	Female
Kerala	33,406,06	16,027,412	17,378,649
Karnataka	61,095,297	30,966,657	30,128,640
Tamil Nadu	72,147,030	36,137,975	36,009,055
Telangana	3,50,03,674	17,611,633	17,392,041
Andaman and Nicobar Islands	380,581	202,871	177,710
Lakshadweep	64,473	33,123	31,350
Puducherry	1,247,953	612,511	635,442

4. Disaster Profile

Natural disasters are consequences of a natural hazard like an earthquake, landslide, cyclone, flood, or Tsunami which affects human activities. More than two-thirds of India's coastline is prone to cyclones and Tsunamis. The entire coastline of Andhra Pradesh and some parts of Tamil Nadu have been classified under very high damage risk zone. Entire UT of ANI also falls under very high-risk damage zone. Other areas, in the southern coastline and UT of Lakshadweep, have been classified as moderate damage risk zones by NIDM. Most of the area in states of Tamil Nadu, Karnataka and Telangana fall under low damage risk zones for earthquake- related disasters. Whereas UT of ANI has been categorized as zone V (i.e. very high damage risk zones). Remaining areas of southern India fall under zone III, i.e. moderate damage risk zone.

Tamil Nadu is also subjected to annual flooding, including flash floods, cloudburst floods, monsoon floods of single and multiple events, cyclonic floods, and those due to dam bursts or failure. The Tsunami of 2004 affected the coastal areas of Tamil Nadu, impacting people, marine biology, and severely damaging the ecosystem.

Every year, on average thousands of people, are affected by natural disasters, a few hundred lives are lost, thousands are rendered homeless, and several hectares of crops are damaged. Severe flooding has been experienced in Kerala in recent years. Certain areas of Andhra Pradesh and Telangana are also prone to floods. On the other hand, several areas of Southern India like Telangana are prone to recurrent droughts. Urban flood, flash flood, hail storm, and high-speed wind (during cyclonic activity) are also experienced in southern India.

5. Climatic Profile

Southern India has a tropical climate with most of the states and UT experiencing hot and humid weather except for the State of Telangana. Telangana is semi-arid and generally experiences hot and dry weather. Some parts of Andhra Pradesh as well experience very hot climate with summer temperatures remaining above 40 degree Celsius. Peak summer temperatures, in some parts of Andhra Pradesh, Telangana and Karnataka, reach 45 degree Celsius. While moving further south, the temperatures become more moderate and usually remain in the range of 25 to 35 degree Celsius.

In the winter season as well. Many parts of the southern region experience coastal climate. Kerala has tropical monsoon climate with seasonally excessive rainfall and hot summer. The Western Ghats plays a significant role in the climatic conditions that prevail all along the State. Generally, Kerala has a very humid climate, with the period of March to the end of May being the hot summer month. This is followed by South West Monsoon season that continued till the beginning of October. The State has an average rainfall of about 3000mm. Karnataka's annual rainfall is 1,151 mm on average. Around 80% of it is received during the southwest monsoon, 12% in the post-monsoon period, 7% during summer and 1% in winter. Within the State, there are considerable variations. During the southwest monsoon rainfall is much higher in coastal locations on the windward side of the Western Ghats (3,350 mm) which drops sharply on the leeward side (600-700 mm). Northern interior regions, by contrast, have markedly semi-arid climates with low annual precipitation (500-600 mm).

All the three union territories have a tropical, humid and coastal climate. Islands of ANI and UTL usually experience, pleasant climate with little variation in the diurnal or seasonal temperature range. In UTL the humid tropical monsoon climate is governed by cyclonic depressions which occur in south Arabian Sea and Bay of Bengal. Islands such as Androth, Kalpeni and Minicoy lie in a cyclone belt. ANI receives mean annual rainfall of about 3000mm together from the South-west and North-east monsoons between May and December. The mean annual rainfall is about 3000 mm. On analyzing, the mean wind speed (km/h) recorded at Port Blair from 2001 to 2010, the

lowest wind speed was recorded as 5.8 km/h during 2005, and the highest wind speed was recorded as 9.8 km/h during 2008.

Regional Hazard & Risk

6. Climate Risk

6.1 Sea Level Rise

The entire coastline and the islands in southern India face the risk of sea-level rise, salinity intrusion, reduced freshwater availability, and changes in sea surface temperature and pH due to climate change. These changes will have significant impacts on the coastal ecosystems, particularly on fisheries and corals. The impact on the livelihood and ability of the affected population to engage in alternate livelihood varies amongst states and UTs. For example, coastal and marine resources play an important role in the economy of ANI. In ANI it is also predicted that rising waters, frequent and violent storm surges, and more virulent tropical cyclones will lead to inundation of coastal areas and often make them uninhabitable, apart from damaging valuable coastal infrastructure (mostly located along the coast). The projected Sea Level Rise (SLR) along Kerala coast on a conservative estimation is about 100 to 200 mm over the next 100 years. If the sea level rises by one metre, 169 sq. Km of the coastal region surrounding Kochi will be inundated. Backwater banks, islands and filtration ponds/paddy fields and coastal communities living on barrier beaches of the coastal zone are vulnerable to sea-level rise. The impact of accelerated sea-level rise on coastal regions and islands and the ability to adapt to environmental changes of a particular shoreline depend on local topographic characteristics. The UTL islands with a maximum height of 4 m above present mean sea level are most vulnerable to inundation from accelerated sea-level rise.

6.2 Temperature and Rainfall

The temperature along the west coast is expected to rise by 1.7 to 1.8 degree Celsius by 2030, whereas the surface annual air temperature along the east coast may rise by 1.6 to 2.1 degree Celsius. The non-coastal or internal parts of southern India have been experiencing a warming trend during the monsoon season. It is projected that the average temperature in Karnataka may rise by 1.7 to 2.2 degree Celsius by 2030. It is projected that the impact of temperature rise will be more pronounced in the northern districts of Karnataka. It is also predicted that regions that already witness less rainfall and higher temperatures, such as northern Karnataka, will further experience lesser rainfall and increases in average temperatures. Increased temperatures are expected to impact the drought situation in internal parts of southern India. Several parts of Telangana, Andhra Pradesh and Northern parts of Karnataka experience and are expected to experience higher occurrence and severity

of the drought. Telangana as per the drought map of India has a high drought occurrence frequency of two times in five years.

6.3 Heat wave

Heatwaves are prominent in the southern region in Telangana, Andhra Pradesh and in some parts of Northern Karnataka. The intensity of heatwave has increased and is expected to be further exasperated by climate change. 541 deaths due to sunstroke had been reported in the year 2015 (as on 30 May 2015) in Telangana. The maximum deaths were recorded in Nalgonda, Khammam, Karimnagar and Mahabubnagar districts, where the temperatures have crossed 45° C.

7. Disaster Risk

Climate change exacerbates disaster risk. The disasters occurring in southern India:

1. Have the potential to wipe out the population of some of the islands altogether.
2. The geographical location of these islands increases their vulnerability. For example, Bengere, a coastal settlement near Mangalore locked between the sea and river, is completely unprotected. A natural disaster such as a tsunami or typhoon could wipe out its population.
3. Eastern coastal regions are at higher risk of Tsunami as compared to western coastal regions. Though the cause of Tsunami need not always be attributed to climate change, it often works in tandem with climate-related risks. The 2004 tsunami very severely impacted the ANI and coastal areas of Tamil Nadu and Andhra Pradesh. The 2004 Tsunami caused unforeseen damage to the coastal areas. Impact The cyclone of 24 November 1988 was followed by the floods in Diglipur, Mayabunder and other areas on 8 December 1998. About 5,000 people were affected. Increasing occurrence of cyclones, one of the established manifestations of climate change, exacerbates the vulnerability of ANI.
4. The Island of ANI is already under critical risk of tsunami-genic waves. Climate change increases the overall vulnerability in ANI with implications for the well-being of human and natural systems.
5. Cyclones are associated with strong winds, torrential rains, and storm surges, which cause an abrupt rise in sea level at the time the storm crosses the coast. Storm surge is the most destructive phenomena associated with a cyclone. Low-lying areas along the coast are inundated by seawater, which can result in the loss of human lives. Floods Islands such as Car Nicobar are flat and sandy with elevated areas at certain places. Such islands where the drainage is predominantly by seepage are vulnerable to flooding in case of a torrential downpour.
6. Cyclone is accompanied by very high wind speed which the coastal structures may not be designed for. For example, the design wind speed for the whole of

ANI is 44 m/s (158 km/h). Whereas, the cyclone-affected coastal areas are classified to have 50 m/s (Very High Damage Risk Zone - B) and 55 m/s zones (Very High Damage Risk Zone - A). This scenario increases the disaster risk for the island.

7. Lightning related disasters primarily occur pre-monsoon and during monsoon. The lightning-related incidents and life-threatening disasters are on the rise in most of the southern states. Telangana, Andhra Pradesh and Karnataka have recorded a large number of losses due to lightning.
8. Heat wave related health risks and disasters are on the rise.

8. Health Risk

Common health risks which affect and are likely to affect southern India due to climate change are:

1. Flooding associated with increased rainfall and high sea levels coupled with increased surface air temperature, which is likely to cause a higher incidence of vector- and water-borne diseases.
2. The seasonal pattern or temporal distribution of major vector-borne diseases such as malaria, filarial, dengue, chikungunya, and other diseases such as tick-borne diseases, cholera and some other diarrheal diseases also changes with change in rainfall, temperature and humidity. Contaminated water supplies during heavy rainfall and similar disasters are one of the leading causes of diarrhea, cholera, hepatitis A etc.
3. Temperature rise will also be favorable for the spread of vector-borne diseases (malaria, kala-azar, dengue) into new areas by shortening the development duration of vectors (mainly mosquitoes).
4. Procurement and pre-positioning of stocks and giving health prevention messages to communities.
5. Rising Projections for reduced rainfall, for instance, will reduce the amount of available freshwater for human use and consumption, leading to an increased risk of disease.
6. Climate change is affecting the seasonality of some allergenic species as well as the seasonal activity and distribution of some disease vectors.
7. Extreme weather events and the impact of coastal erosion may result in enormous economic and physical damage and is likely to be associated with severe mental distress.
8. High-density populations in low-lying coastal regions experience a high health burden.
9. Flood or drought, by contrast, would affect the primary sector and reduce crop productivity. This, in turn, could reduce food availability resulting in

malnutrition or inadequate nutrition as well as nutrition-related diseases.

9. Specific issues, concerns and developments in states and UT's of Southern India:

- According to the Indian Network for Climate Change Assessment, the southeast coast of India, especially Andhra Pradesh, is likely to experience severe heat stress by 2030. Heatwaves are projected to become more common, resulting in an increased risk of heat stress, stroke and death, particularly in vulnerable populations, such as the very old and very young. The lack of drinking water is likely to precipitate heat strokes and increase mortality. Andhra Pradesh is also projected to experience more frequent and severe floods and hurricanes which may result in deaths disease and injury due to drowning, lack of sanitation and safe drinking water and exposure to dangerous chemical contaminants.
- In states like Karnataka, the transmission window for malaria is already 10-11 months in a year, and a further increase is unlikely.
- Kerala has made remarkable achievements, in specific health indices, which are acclaimed, all over the world. However, Kerala has many unresolved problems in the health sector, including that of the issue of the emerging and re-emerging communicable diseases. Since the early 1990s outbreaks of new diseases like Nipah virus, Leptospirosis, Japanese Encephalitis, Dengue Fever etc. was reported from some part of the State. The incidence of these diseases has been gradually increasing, and the area of occurrence also become more widespread.
- Diseases such as gastroenteritis, cholera, malaria and pneumonia are common in UTL. The lack of adequate sanitation facilities is one of the reasons for these problems. During cyclones and droughts, these constraints can cause havoc to the island population causing more damage than the disaster itself.
- Apart from vector-borne disease, acute respiratory infection, pyrexia, viral fever, accompanied by anaemia and vitamin deficiency are some of the critical health concerns in ANI. Malaria has been endemic in ANI for nearly a century, and *Anopheles epiroticus* is the incriminated vector.

10. Regional Consultations

To understand the regional health issues of India five Workshops were organized. One National Workshop “National Programme on Climate Change and Health Sector Resilience” was organized in Delhi. After that four regional workshops were organized. All states of India were divided into four regions such as Northern, Eastern & North Eastern, Southern and Western region and for these regional workshops were organized in Lucknow, Kolkata, Hyderabad and Ahmedabad respectively. Objective of conducting the regional consultations (**Fig 3**):

- To understand the regional impact of climate on health

- To get familiarized with the nature and characteristics of regional health issues
- To conceive possible mitigation and adaptation pathways

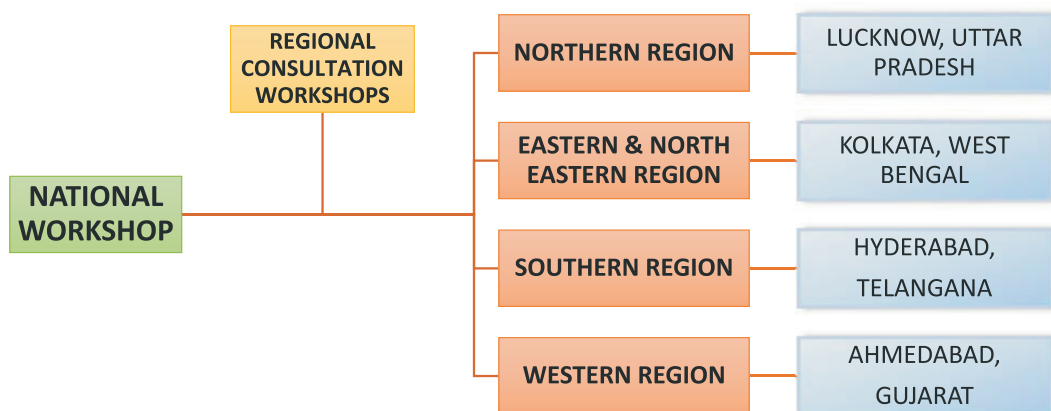


Figure 3: Details of the Consultation workshops organized in national and regional level.

10.1 Southern Region Consultation

For Southern regions of India, Hazard Risk Vulnerability and Capacity Assessment (HRVCA) Workshop had been organized on 14th November, 2019 at Hyderabad. 23 Experts from all Southern States had joined this workshop to discuss the present health scenarios and challenges in of their respective states in relation to the disasters and changing climate and has given their valuable views on the mitigation process. All the experts were fairly represented from Health, Disaster Management and Climate Change sector (**Fig 4**).

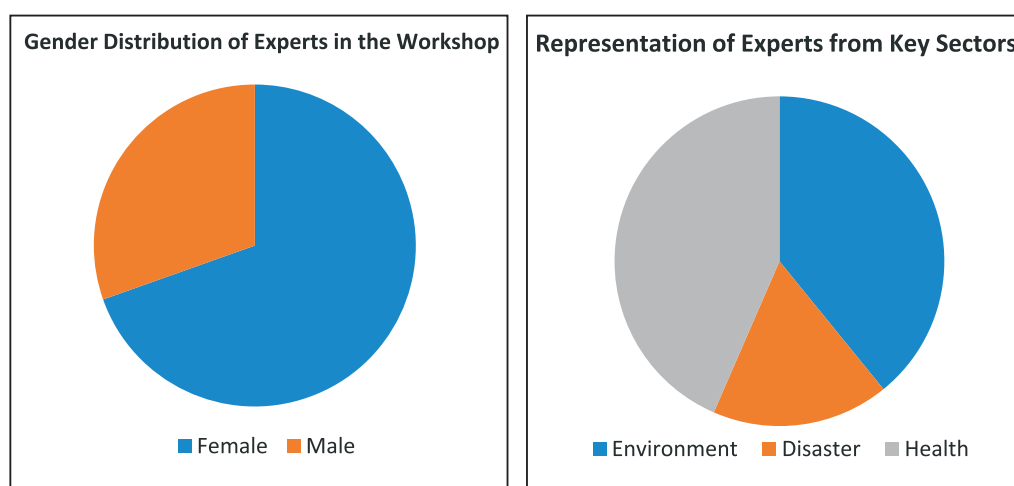


Figure 4: Percentage of Male and female experts in the workshop (Left). Percentage of experts from Climate, Disaster and Health sector (right). Drawn by author.

10.2 Key Stakeholders

The experts were from several renowned institution and State government authority like Department of Community Medicine VMMC & Safdarjung Hospital, Administrative Training Institutes, Directorate of Health Services, Department of Disaster Management and Civil Defence, Armed Forces Officer Commanding Station Health Organization, State Disaster Management Authority, Department of Environment, Directorate of Health & Family Welfare Department, Indian Institute of Social Welfare & Business Management, School of Water Resources Engineering, Regional Meteorological Centre and Indian Council of Medical Research, All India Institute of Hygiene and Public Health, World Health Organization, National Centre for Disease Control and many more.

Experts were divided into four groups named Godavari, Kaveri, Krishna and Tungabhadra. Each group had equal representation of experts from climate, disaster and health sector. They were given a framework for discussion that included topics pertaining to Hazard, Risk, Vulnerability and Capacity Assessment of health conditions of the various states of Southern region of India. The discussion included but was not limited to the following issues:

11. Key Questions

During the consultation, following key questions were put forward to the experts for their views and feedback.

- Spatial and temporal shifts in climatic and weather patterns including events in the Southern states/region
- Changes in disaster patterns and seasonality, spreads
- History of outbreaks and other important cases of health episodes in past 20-30 years, and particularly in the past 15 years
- Region-specific emerging health challenges, vulnerability of health systems and health resources, health infrastructure
- Opportunities, possible approaches, programmes, local and regional solutions, to protect health and respond effectively
- How and what type of coordination and interrelations with other sectors and departments is envisaged for health adaptation from climate change and disasters related illnesses
- Any other aspects of importance, including role of ecosystems, agriculture, food, water, energy etc. and relationships with health protection

After the HRVCA activity experts came up with valuable suggestion for building health resilience and adaptation.

11.1 Health Issues for Adaptation and Disaster Risk Reduction

Health Problems and issues	Consensus of the Experts
Air Pollution	Vehicle: 1. Air pollution levels are increasing 2. 90-95 % commercial vehicles run on diesel. Therefore, this is the major cause of line source of air pollution 3. In some places Pollution might be less but exposure is higher
Drinking Water Quality	1. Natural recharging of water has got affected. 2. TDS, chloride content has increased in ground water. 3. Salinity of ground water has risen 4. As per NitiAyog per capita water quality has reduced. This Leads to many chronic diseases
Extreme Natural Events	Numbers and intensities have increased resulting in higher number of deaths
Increased Cyclone Intensity	Crops and other resources are destroyed
Delayed Onset of Monsoon	Monsoon is being delayed by 40-45 days. Many districts are facing drought situation leading to crop failure
Scarcity of Reliable Data	Problems in proper forecastingCreates problem in assessing the real situation and restrains from making necessary strategies
Rising Temperature	Vector borne diseases like dengue and chikungunya are rising.
Lack of proper infrastructure	1. Hospital sanitization post flood must be done. 2. Govt. Health Care bodies are flooded with patients.Even today there is overcrowding on health facilities. In case of disasters this increases many folds.
Lack of Awareness campaign	1. Easy mechanism of saving life in disaster situation is not known to people. 2. People do not know where to approach during the disasters 3. People are not aware of the govt. schemes and policies

Health Problems and issues	Consensus of the Experts
Increasing Population	We are unable to channelize the population resource
Lack of waste management	Pre-and post-disaster waste management can restrain from the water contamination and other vector borne diseases
Lack of trained multipurpose doctors	Specialized doctors are unable to help people in disaster condition
Heat wave events have risen	Heat strokes are rising and along with it the extreme events are increasing
Decrease in rainfall	1. Shift in rainfall pattern is unpredictable and drastic. 2. Minimal rains in Chennai.
River course change due to flood and increased soil erosion	Loss of resources and life
Water pollution	Harms the entire ecosystem
Reverse temperature change livestock productivity	Food industries are getting affected

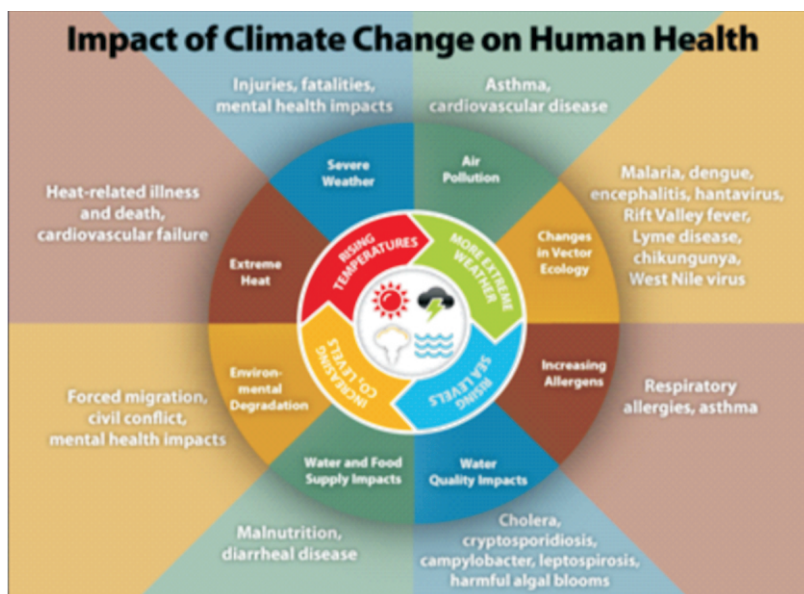


Figure 5: Impact of Climate Change on Human Health Source - National Centre for Environmental Health, 2019



Figure 6. Snapshot from HRVCA workshop at Hyderabad for building Health Resilience

12. Interventions

To adapt to the health risks being posed by climate change, a multi-level effort is needed across states and UT. Infrastructure, research, capacity building and public awareness are the critical elements of adaptation to climate change by the health sector. Disaster preparedness of health care facilities is also an essential element.

12.1 Policy Intervention

At the national level, several interventions like National Vector Borne Diseases Control Programme, Revised National TB Control Programme, Maternal and Infant deaths control programme and Education and literacy programs have been taken up to increase the health-related resilience.

The Rajiv Aarogyasri health insurance scheme, which aims to improve equity of access to healthcare for the poor may experience increasing demands for healthcare services resulting from climate-related ill health. Government of Andhra Pradesh is monitoring these trends which will enable the Government to develop preventive measures such as heat wave warnings which would enable the vulnerable population such as outdoor workers to take appropriate precautions against heat stress.

Heat wave action plan has been formulated to ensure a structured response to emergencies arising out of severe heat waves. Heat wave action plan has been developed and deployed by the southern states. Despite the formulation of a heat wave action plan, there lie several challenges in its effective implementation at the grass-root level. Structural/infrastructural deficiencies, understanding of paramedical staff and appropriate capturing of patient-related data under the head of heat stress are some of the common challenges. Often heat stress-related mortality

data is well captured, but the information on morbidity associated with heat stress is not captured effectively.

Though the **health insurance coverage** in southern India, specifically in State like Telangana is higher than in other parts of the country, there is significant scope and need to increase the coverage further.

Post-disaster, it is essential to develop the capacity to monitor mental health, reproductive health, make provisions for special needs of females apart from the provision of emergency shelter, sanitation, food and water. It is also essential that disease surveillance is followed appropriately post-disaster.

12.2 Infrastructure and facilities related interventions

Some of the common interventions needed are:

- Increasing the number of hospitals and improving facilities in existing hospitals
- Improving sanitation conditions to curb the spread of water-borne disease like cholera, typhoid.
- Allocating a dedicated fund for training and awareness programs of health professionals, policy makers etc.
- Curbing pollution due to industries and vehicular emissions.
- Increased access to health care for vulnerable populations through the development and staffing of new health care facilities.
- Percentage of the population served by Primary Health Centers and Hospitals.

Access to health care improves the resilience of the population to withstand any outbreak of diseases as an effect of climate change.

Infrastructure availability and concerns of UTL vary from other states. The infrastructure and facilities at UTL include:

- Tele-medicine facilities are available in 5 islands and are being extended with the help of ISRO to other islands.
- Ayushcentres being created in all the islands.
- A Medical Officer attached to a community health centre on each of the inhabited island and the First-aid center at Bitra Island.
- It is served by two Government hospitals, three Community Health Centers (CHCs), four Primary Health Centers (PHCs) and two First Aid Centers with a total bed strength of 200 in 11 islands.
- Lakshadweep has no private hospitals.

Despite these efforts, the availability of well qualified medical personal on a sustained basis continues to remain a challenge, leading to inadequate medical aid

during the time of disaster. For UTL, special efforts are being made to recruit doctors with a mandatory time frame to work on islands are urgently required to address these gaps. Arrangement for extra manpower, doctors, paramedic's as well as storage and distribution of medicines and facilities through ships based mobile hospitals, should be implemented.

Strengthening the system for detection and early warning on the outbreak of diseases is essential in containing the spread of existing diseases in new areas and containing the spread of new diseases. AP has proposed to undertake this activity.

In the southern region, Kerala stands out in its health infrastructure, easy accessibility, coverage of medical care and health service quality. The State is reported to have the lowest rural-urban inequalities in Public Health. The State has many acclaimed outcomes in health care, mainly due to its vast network of public health institutions. Every gram panchayat in Kerala has at least one health institution which belongs to Allopathy, Ayurveda or Homoeopathy. It has a three-tier system of health care, the Primary Health Centres and the Community Health Centres (CHC), Taluk and District Hospitals and the Medical Colleges evenly distributed both in the urban and the rural areas. Its achievement in public health surveillance is also commendable. Health sector development and the illness pattern in Kerala are mostly different from the other Indian states.

Improvements in means of physical access to existing health care facilities at all times are essential. Also, the ability of medical and paramedical staff to reach far-flung areas all through the years increases health resilience - Some islands in particular experience accessibility challenges during monsoon season.

Some states have constituted state-level teams for rapid response to the emergence of Dengue or Chikungunya outbreak in State. Such disease outbreak detection and control teams are established at the state and district level.

12.3 Capacity Building

- Andhra Pradesh has proposed to Undertake longer-term studies to investigate links between climate change and disease patterns, as also between pollution loads and disease patterns.
- Study the regional pattern of climate-sensitive diseases and disease outbreaks such as malaria, dengue, chikungunya, waterborne diseases, heat stress etc. to analyze trends in incidence and prevalence.
- Research on the development of low-cost vaccines, particularly those related to vector-borne diseases.
- Development of rapid response capabilities to handle the impact of climate change-related events.
- Capacity building of health personnel and institutions to integrate climate change concerns in planning and actions.

- Improve the quality of data, periodicity of collection and the extent of coverage in existing systems of surveillance.
- Develop disease profile of communities.
- Maintain a digital health database at fine spatial and temporal scales for both communicable and non-communicable diseases.
- Periodic analysis of data to identify trends, trigger events and regular feedback to state surveillance units.
- Establish specific guidelines for quality control in respect of the data collected and reported. Provide adequate training to health personnel to handle data.
- Provide adequate training to paramedical staff for identifying symptoms and reporting cases related to climate change.
- Preparedness and capacity building for emerging epidemics.
- Procurement and pre-positioning of stocks and giving health prevention messages to communities.

12.4 Community Centric Intervention

- Public awareness of health and climate change especially, public education on the prevention of diseases related to climate change.
- Health Surveillance through public participation.
- Promote health education and awareness concerning climate risks through schools and community-based organizations (CBOs).
- Awareness among local communities on waste disposal, sanitation, public health, etc. and Augment the facilities for the safe disposal and management of bio-medical wastes.
- Community leaders and health mascots to assist with community approach and intervention can be utilized for generating awareness, tracking signs and symptoms related to vector-borne and heat stress.
- At ANI community monitoring of facilities being provided at each health facility has been suggested as an intervention in State Action Plan on Climate Change. Based on the effectiveness of this model, its replication can be planned for other states.
- Awareness of the importance of hygiene is the important to reducing a community's vulnerability to extreme weather events and more long-term changes in average water availability or average temperatures.
- Strengthen short-term weather forecasts and seasonal forecasts for precautionary action related to health hazards.

About CECR and Project

CECR

The National Institute of Disaster Management (NIDM) was constituted under an Act of Parliament with a vision to play the role of a premier institute for capacity development in India and the region. Under the Disaster Management Act 2005, NIDM has been assigned nodal responsibilities for human resource development, capacity building, training, research, documentation and policy advocacy in the field of disaster management.

NIDM has a dedicated division for Environment, Climate and Disaster Risk Management (ECDRM) which has been designated as a Centre of Excellence on Climate Resilience (CECR) under the National Action Plan for Climate Change and Human Health (NAPCCHH). The CECR is implementing six research projects namely Climate Adaptive Planning for Resilience and Sustainable Development in Multi-hazard Environment (CAP-RES) with support of DST-Govt of India, National Agriculture Disaster Management Plan (NADMP) funded by the Ministry of Agriculture & Farmers Welfare, Health Resilience and Capacity Building (HER-CAP) with WHO, Crisis Management Plan for Dealing with Contamination of Water Bodies (CMP-WB) funded by CPCB, Disaster Management Plan for Ministry of Environment, Forest and Climate Change (NEFC-DMP) with the support of MoEFCC and Disaster Management Plan for the Dept. of Chemicals and Petrochemicals (NCPC-DMP) supported by DCPC, MoC&F. It also collaborates with a number of international and national organizations working in the areas of climate change adaptation, resilience, disaster management and disaster risk reduction.

HER-CAP project

NIDM in collaboration with WHO India has implemented the project “Health Adaptation and Resilience: Advancing Strategic Knowledge and Capacities” (HER-CAP). Under this project, the following documents have been drafted.

- National Health Adaptation Plan for disasters related illnesses' for Ministry of Health and Family Welfare.
- Training Manual on 'Health Adaptation and Resilience to Climate Risks'.
- A compendium of case studies on 'Climate Change related Disasters and Health Resilience'.
- Four Policy briefs on Regional Issues and Opportunities for Health System Resilience to Climatic Disasters. (For Northern, East & North-Eastern, Western and Southern Regions of India).

- Along with this, four thematic papers on key areas are as follows:
 - ❖ Temperature related disasters: Heat and Cold Wave - Implications for Health Adaptation and Resilience.
 - ❖ Water related disasters: Floods and Drought - Implications for Health Adaptation and Resilience.
 - ❖ Air Pollution and Public Health Emergencies.
 - ❖ Environmental services for health protection in disasters and emergencies.

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About the Institute

National Institute of Disaster Management (NIDM) was constituted under an Act of Parliament with a vision to play the role of a premier institute for capacity development in India and the region. The efforts in this direction that began with the formation of the National Centre for Disaster Management (NCDM) in 1995 gained impetus with its redesignation as the National Institute of Disaster Management (NIDM) for training and capacity development. Under the Disaster Management Act 2005, NIDM has been assigned nodal responsibilities for human resource development, capacity building, training, research, documentation and policy advocacy in the field of disaster management.

NIDM is proud to have a multi-disciplinary core team of professionals working in various aspects of disaster management. In its endeavour to facilitate training and capacity development, the Institute has state-of-the-art facilities like class rooms, seminar hall and video-conferencing facilities etc. The Institute has a well-stocked library exclusively on the theme of disaster management and mitigation. The Institute provides training in face-to-face, on-line and self-learning mode as well as satellite based training. In-house and off-campus face-to-face training to the officials of the state governments is provided free of charge including modest boarding and lodging facilities.

NIDM provides Capacity Building support to various National and State level agencies in the field of Disaster Management & Disaster Risk Reduction. The Institute's vision is to create a Disaster Resilient India by building the capacity at all levels for disaster prevention and preparedness.



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ISBN No.: 9788195670000

