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Sectoral Resilience: Priorities for Action

District Virudhunagar, Tamil Nadu

Mission Samriddhi
SOCIAL IMPACT ENTERPRISE

GEAG
GORAKHPUR ENVIRONMENTAL ACTION GROUP

Sectoral Resilience: Priorities for Action – District Virudhunagar, Tamil Nadu

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BACKGROUND

Nothing undermines sustainable development like climate change impacts and induced disasters. They can destroy decades of progress in an instant. The continued threat of climate disruption is intensifying at a disturbing pace, with disproportionate impact on the poor and vulnerable. Understanding and managing disaster risk is essential to achieving the Sustainable Development Goals.

Climate change exacerbates disaster risks in a variety of ways. It increases the likelihood, frequency and intensity of climatic hazard events, affecting vulnerability to all hazards due to long-term socioeconomic stresses and impacts such as displacement, and altering exposure patterns as climatic conditions change and hazards emerge in new localities. Emergent climate-related risks will alter most of our current risk metrics. Growth in death, loss and damage will surpass already inadequate risk mitigation, response and transfer mechanisms.

Climate change is the greatest threat facing the world's children and young people, this fact is known for some time. UNICEF's Children's Climate Risk Index reveals that 1 billion children are at 'extremely high risk' of the impacts of climate change. That is nearly half of all children, and it is happening today. Children bear the greatest burden of climate change. Not only are they more vulnerable than adults to the extreme weather, toxic hazards and diseases it causes, but the planet is becoming a more dangerous place to live. The Sixth Assessment Report (AR6) of the United Nations Intergovernmental Panel on Climate Change (IPCC) warns of increasingly extreme heatwaves, droughts and flooding, and a key temperature limit being broken in just over a decade. Important food and water systems will fail and entire cities are expected to succumb to destructive floods. Climate change is the greatest threat facing the world's children and young people.

Disasters and Climate Change are severely impacting the effectiveness of developmental efforts. The impacts on agriculture and allied activities (including horticulture and livestock)- the major livelihood option for majority of Indian population, availability of potable water, natural ecosystem services, health, infrastructure disrupt the quality of life of people especially those who are poor and marginalized.

Climate Change Adaptation and Disaster Risk Reduction needs to be mainstreamed in developmental efforts. The development of resilience plans at the local, national and regional levels, and the assessments that underpin them, must integrate near-term climate change scenarios, and elaborate the enabling conditions for transformative adaptation. Gram Panchayats, being the basic unit of governance and development, are most important institutions to be addressed and capacitated for CCA-DRR mainstreaming.

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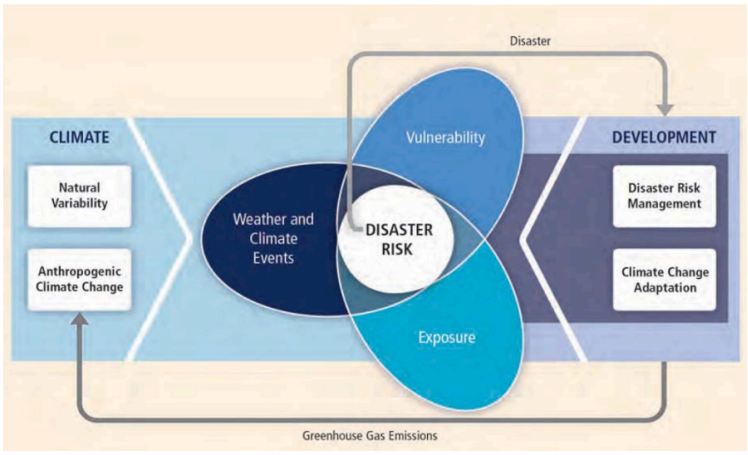
The Special Report of IPCC on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX), 2012 assessed how exposure and vulnerability to weather and climate events determine impacts and the likelihood of disasters (disaster risk). It further considered the role of development in trends in exposure and vulnerability, implications for disaster risk, and interactions between disasters and development. The report explicitly emphasizes on understanding the crucial connect between **climate change, disasters and development** and that integration between these three components is pertinent to sustainable and resilient development.

There is a growing consensus that DRR, CCA and Sustainable Development are synergistically linked to each other and the three global agendas, i.e. the Sendai Framework for Disaster Risk Reduction (SFDRR) 2015-2030, Sustainable Development Goals (SDGs) 2030 and the Paris Climate Agreement 2015, have clear avenues for integration as all of them share a common aim of making the development sustainable.

In recognition of increasing climate and disaster risk, the Government of India has made concerted efforts for DRR and CCA integration. The National Disaster Management Plan (2019) emphasizes on the achievement of the targets set under the SFDRR and also places special focus on achieving coherence with SDGs and Paris Agreement on Climate Change for ensuring sustainable and climate resilient development that will ultimately reduce disaster risks.



Source: Special Report of the intergovernmmental panel on Climate Change, 2012

ABOUT THE PROJECT

The Government of India launched the Aspirational Districts Programme (ADP) in January 2018 to accelerate improvement in the socio-economic indicators of the most underdeveloped districts of the country. Currently, the programme is being implemented in 112 of India's 739 districts, spread across the country. ADP covers 5 sectors, namely, Health & Nutrition, Education, Agriculture & Water Resources, Financial Inclusion & Skill Development and Basic Infrastructure.

IndusInd Bank after implementing a development programme in Aspirational Districts for one to two years realized the need for making planned and organized efforts to protect the development gains and in the processes reached out to CTSI to access DRR capability. The proposed interventions are based as a joint effort by various partners with different expertise in the following Aspirational Districts: Bahraich (Uttar Pradesh), Begusarai (Bihar), Virudhunagar (Tamil Nadu), Baran (Rajasthan) and Dharashiv (Maharashtra).

The aim of the programme is to reach community groups like Mahila sabhas and farmers through Risk Informed Gram Panchayat Development Plans (RiGPDP), mainstreaming developmental resources in DRR-CCA in selected Gram Panchayats as a pilot. In the process, orientation and capacity building of related line departments and local technical institutions like KVKs are important so that the relevant schemes and programmes of government are linked for contributing to resilient development.

The project is being implemented in joint collaboration with Mission Samriddhi, Gorakhpur Environmental Action Group (GEAG), Indian Institute of Technology (IIT), Gandhinagar with technical support from UNICEF and financial support from IndusInd Bank.

Under the project, GEAG is providing technical support in undertaking climate risk analysis of the 5 pilot districts, evolving sectoral resilience action plans around major sectors like Agriculture & Allied, Water and Sanitation, Health, Education and Rural Development.

This report is an outcome of the District Sectoral Workshop conducted in district Virudhunagar, Uttar Pradesh to evolve sectoral resilience action plans. **The sectoral resilience action plan is largely based on the inputs received from communities and PRI members from 25 Gram Panchayats in block Kariappti, Virudhunagar, TN.**

CLIMATE RISK PROFILE DISTRICT VIRUDHUNAGAR

World Meteorological Organization's (WMO) 'State of the Global Climate' report, released in 2023, highlights severe concerns for the human race. It explicitly states that climate-induced risks, both global and local, are emerging as the greatest threat to humanity. The year 2023 has been recorded as the hottest in Earth's documented history, with the global average temperature rising by 1.45°C above pre-industrial levels, within a margin of uncertainty of ±0.12°C. Extremely worrying, this rise is very close to the threshold limit of 1.5 °C agreed upon by different nations during the Paris Agreement in 2015.

The WMO has expressed serious concern over this rise in the global average temperatures, warning that this will significantly affect the occurrence of extreme weather events, such as heatwaves, torrential rains, and tropical cyclones. Such events will undoubtedly have a direct impact on many development sectors including agriculture, health, education, and WASH all around the world. The effects of such extreme weather events have been well documented in numerous reports and research articles, manifesting in human casualties, injuries, homelessness, or distress displacement. Direct economic losses due to climate risks have surged by almost 151% in the last 20 years (UNISDR 2018).

As in other parts of the world, climate induced risks, including extreme rainfall and floods, heat waves are increasing in India too (Guhathakurta et al., 2011). The warming trend over the Indian Ocean has enhanced moisture supply, leading to extreme rainfall due to cyclones in coastal areas in recent decades (Ray et al., 2019). In the country, floods due to extreme rainfall alone cause losses of about $3 billion per year, which is 10% of the global economic loss (Roxy et al., 2017). There has also been a significant increase in the probability of hydro-climatic hazards all over India (Vittal et al., 2020). Therefore, a comprehensive understanding of climate risks and their impact becomes a prerequisite to trigger collective public action at the local level.

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This study report is part of the UNICEF-supported programme entitled "Climate Risk Informed Programming Project - Nature Solves-Nature Resolves," funded by IndusInd. The aim is to reach community groups like Mahila Sabhas and farmers through Risk-Informed Gram Panchayat Development Plans (RiGPDP), and mainstream developmental resources in DRR-CCA in selected Gram Panchayats as a pilot project. In the process, the climate risk profile of three selected districts, namely Virudhunagar, Tamil Nadu; Bahraich, Uttar Pradesh; and Begusarai, Bihar, were developed to guide and shape the mindset of key stakeholders to assess the capacity of related line departments and local technical institutions. The goal is to ensure that government development schemes and programs, at both national and state levels, are effectively aligned to contribute to resilient development.

Methodological framework, Approach and Process

The methodologies followed in this study are as suggested by the IPCC (2014). The IPCC defines two streams of vulnerability assessment—the contextual vulnerability assessment and the outcome vulnerability assessment. The first provides a qualitative overview of vulnerability with the help of survey instruments and case studies, while the index-based outcome vulnerability assessment is done by calculating a score, after quantifying a specific set or combination of indicators.

A score-based approach can be used at any scale such as national, sub-national, district, and sub district level (Gbetibouo and Ringler 2009). And, this study used a score-based approach to analyse the climate hazards risk and sectoral vulnerabilities in selected districts to understand the links between sensitivity of the district and its ability to cope and adapt. Risk causing climate hazards were determined based on Indian Meteorological Department (IMD) norms. The sectoral indicators which directly or indirectly increase vulnerability or resilience to climate risks, were used as sensitivity and adaptive capacity indicators. Data from each district for all identified indicators were collected from authentic sources and categorized into five components: **Climate Hazards Index (CHI)**, **Agriculture and allied sector vulnerability Index (AVI), Health Sector Vulnerability Index (HVI), Education sector vulnerability Index (EVI) and Water and sanitation sector vulnerability Index (WSVI).** The facts related to the indicators were analysed, and weightage was assigned to each as per their influence/ contribution to vulnerability using the Principal Component Analysis (PCA) statistical tool to determine indicator specific scores.

To frame out an adaptive strategy and advocacy at local level for climate risk informed programming, data related to climate risks, climate change policies and impacts across different spatial and temporal scales and sectors is essential. NITI Aayog, the 'Think-tank of India' also recognises comprehensive data gathering at the district level as essential for risk planning, developing coping strategies, and adaptation. The recently developed National Data Analytic Portal by the NITI Aayog is a comprehensive platform that provides a single window for this wide range of data at national, state and district levels.

Identification of indicators

Vulnerability to climate induced risks is multidimensional and determined by a complex interplay of multiple factors (Piya et al. 2012). There are two approaches in the selection of indicators: data driven and theory driven (Vincent 2004); and each approach has its own limitations. Therefore, the best approach is to verify the accuracy of the theory-based indicators with data from authentic sources (Maiti et al. 2015). Theoretically, vulnerability encompasses a variety of perceptions and elements, including sensitivity and the lack of capacity to cope and adapt. IPCC defines vulnerability as "the propensity or pre disposition to be adversely affected" and is determined by the sensitivity and adaptive capacity of the system (IPCC 2014). Sensitivity reflects the extent to which a system is sensitive or responsive to external stress or hazard, such as a drought or flood. Adaptive capacity is the ability of a system (technology, infrastructure, ease of access to resources, wealth, etc.) to cope with the consequences of climate stress, which includes several factors. (McCarthy et al. 2001). Vulnerability to climate change is a function of biophysical and socio-economic factors (O'Brien et al. 2004). Thus, the dynamics of vulnerability are captured through physical, demographic, social, and environmental components to denote sensitivity and adaptive capacity of the system. Considering this, a combined approach was used to select the indicators.

A total of 34 indicators that included climate hazards and four sectors (Agriculture and allied, Health, Education and Water and sanitation) were used in the study to denote the sensitivity and adaptive capacity of the districts (Table 1). The coefficient of variation in annual rainfall, frequency of heavy rainfall events, coefficient of variation in maximum and minimum temperature were calculated from high resolution IMD daily gridded data of the last 30 years (1993-2023). The sectoral indicators, which captured the sensitivity and adaptive capacity of the districts and states, were identified and their data collected from authentic sources. The indicators, the rationale for using them, and their functional relationship with vulnerability are described below in greater detail.

Table 1

	Code	Indicator	Base-line	Source	Relation with climate Vulnerability impact
	CV_A rain(%)	Coefficient of variation of Annual Rainfall in %	1993-2023	IMD daily Gridded data	Exposure (Positive)
	Fre_Hrain	Frequency of heavy rainfall events	1993-2023	IMD daily Gridded data	Exposure (Positive)
	Con_DRY_Mday	Consecutive dry days during monsoon	1993-2023	IMD daily Gridded data	Exposure (Positive)
	CV_MaxT	Coefficient of variation of Daily max Temperature %	1993-2023	IMD daily Gridded data	Exposure (Positive)
	CV_MINT	Coefficient of variation of Daily min Temperature %	1993-2023	Disaster Management Department, Bihar	Exposure (Positive)
	Area_ Flood (%)	% of area prone to flood	2019	Vulnerability Atlas of India , 2019 BMTPC	Exposure (Positive)
	Fre_ E Drought	Frequency of Severe to extreme drought event	1991-2020	District web portals	Exposure (Positive)
Agriculture and allied sector					
	Mar_Small_ LandH	% of marginal and small landholders	2011	Census of India , 2011	Sensitivity (Positive)
	L_HR	No of Livestock per 000 population	2019	The National Data and Analytics Platform	Adaptation (Negative)
	Rainfed_Agri	% Of The Area Under Rain fed Agriculture	2021-22	The National Data and Analytics Platform	Sensitivity (positive)
	Area _Cov_ PMFVY	Area covered for crop insurance under PMFBY in 000 ha	2023	The National Data and Analytics Platform	Adaptation(Negative)
	Empy_MNERGA	Average person days per household employed under MNREGA	2023	The National Data and Analytics Platform	Sensitivity (Positive)
	Y_Vari_ FoodGrain (%)	% of Yield variability of food grains	2021-22	The National Data and Analytics Platform	Adaptation (Negative)
	Wo_ Part_ Labour	Women participation in the workforce (%)	2023	The National Data and Analytics Platform	Adaptation (Negative)

Health Sector

Health_ Infra	No of rural healthcare infrastructure facilities per lakh population	2021-22	The National Data and Analytics Platform	Adaptation (Negative)
Mem_Insurance	HH with any member covered under a health and insurance / financial scheme	2020-21	The National Data and Analytics Platform	Sensitivity (Positive)
Child _Vac	Children age 12-23 months fully vaccinated based on information from vaccination card (%)	2020-21	The National Data and Analytics Platform	Adaptation (Negative)
Child_ Stunt	Children under 5 years who are stunted	2020-21	The National Data and Analytics Platform	Sensitivity (Positive)
Child _ underweight	Children under 5 years who are underweight	2020-21	The National Data and Analytics Platform	Sensitivity (Positive)
IMR	Infant Mortality rate (IMR)	2022-23	The National Data and Analytics Platform	Adaptation (Negative)
Women_ Anaemic	All women age 15-49 years who are anaemic	2020-21	The National Data and Analytics Platform	Sensitivity (Positive)

Education Sector

Women_10_ education	Women with 10 or more years of schooling (%)	2021-22	UDISE Plus	Adaptation (Negative)
ScL_Girl_Toilet	% of schools with functional girls' toilet	2021-22	UDISE Plus	Sensitivity (Positive)
Sch_Drinking	Percentage of schools with functional drinking water facilities	2021-22	UDISE Plus	Sensitivity (Positive)
S&TR	Average Student teacher Ratio	2021-22	UDISE Plus	Adaptation (Negative)
Drop_out	Average dropout rate in secondary level	2021-22	UDISE Plus	Adaptation (Negative)
Sch_approach	% of Schools approachable by all-weather roads	2021-22	UDISE Plus	Adaptation (Negative)
Sch_electricity	Percentage of schools with electricity connection	2021-22	UDISE Plus	Adaptation (Negative)

Water and Sanitation Sector

	HHs_Impr_ Drinkingwater	% of households with an improved drinking water sources	2020-21	The National Data and Analytics Platform	Adaptation (Negative)
	Change_GW	Changes in ground water table during last five years (mbGL)	2021-22	The National Data and Analytics Platform	Sensitivity (Positive)
	State_GW	State of ground water utilisation(in %)	2021-22	The National Data and Analytics Platform	Sensitivity (Positive)
	HHs _improv_ Sani	Proportion of HH that have an improved sanitation facilities	2020-21	The National Data and Analytics Platform	Adaptation (Negative
	Area_water_ Bodies	Area under water bodies (%)	2023	India Wris web Portal	Adaptation (Negative)
	No_ODF	No of ODF village	2023	The National Data and Analytics Platform	Adaptation (Negative

Normalisation of dataset

The identified indicators were from different sources, measured in dissimilar units. Since the Vulnerability Assessment is a rank, all the indicators used in the assessment had to be of common units, for which they needed to be normalized. The normalization process varies depending on the nature of the relationship of an indicator with vulnerability. The following formulae (UNDP 2006) were used to normalize indicators which tend to increase vulnerability with an increase in the values.

For the indicators that had a positive functional relationship with their respective vulnerability index, the normalization was done through the following equation:

$$\text{Normalisation} = \frac{\text{Actual value} - \text{Minimum Value}}{\text{Maximum Value} - \text{Minimum value}}$$

On the other hand, if negative functional relationship occurs, then the following equation has been used for normalization:

$$\text{Normalisation} = \frac{\text{Maximum Value} - \text{Actual Value}}{\text{Maximum Value} - \text{Minimum value}}$$

Assigning weights to indicators through Principal Component Analysis

PCA was used in this study to assign appropriate weights to the indicators (Monterroso et al. 2014). Through this, each indicator was assigned a weight to find out the leading indicator, which further influenced all other indicators. The PCA was carried out using Statistical Package for Social Sciences (SPSS) as detailed in Table 2.

Table 2

Indicator	Virdhunagar	Begusarai	Bahraich
% of marginal and small landholders	5.3	5.1	5.6
Livstock population per 1000 population	5.2	0.2	4.9
% of The Area Under Rainfed Agriculture	0.8	0.9	0.0
%Area Covered into crop insurance Under PMFBY in 000 ha	3.4	1.9	4.6
Average person days per household employed under MGNREGA	5.3	0.2	2.6
Yield Variability Of Food Grains %	5.4	4.9	5.3
Women Participation In The Workforce (%)	0.3	6.1	3.6
No of Rural healthcare infrastructure facilities per lakh population	5.0	1.6	0.0
% HH with any usual member covered under a health and insurance / financial scheme	4.8	5.2	5.4
Children age 12-23 months fully vaccinated based on information from vaccination card (%)	0.4	0.3	4.4
Children under 5 years who are stunted	5.3	5.4	4.8
Children under 5 years who are underweight	5.3	5.7	3.6
IMR	5.3	0.8	4.7
% women age 15-49 years who are anaemic	4.6	5.9	5.6
% Women with 10 or more years of schooling	5.3	6.1	3.9
% of schools with functional girls toilet	4.9	4.3	5.6
% of schools with functional drinking water facilities	0.1	5.4	4.4
Average Student teacher Ratio	5.0	4.9	5.2
Average Drop out rate in secondary level	5.1	6.1	3.2
% of Schools Approachable by All-Weather Roads	1.5	2.6	2.9
% of schools with electricity connection	4.9	0.0	0.1
% of households with an with improved drinking water sources	5.2	5.5	5.4
% State of gound water utilisation(in %)	2.4	2.4	0.1
%Area Under Wetlands in	2.4	2.8	4.8
% of avaialble ground water used for irrigation Purpose	4.1	4.8	0.3
%of HH that has an improved sanitation facilities	0.0	5.7	3.8
% of ODF plus village to total villages	2.7	5.2	5.4

Geographical profile

Virdhunagar district is situated in the south-western part of Tamil Nadu, occupying an area of 4288 sq. km. It extends between 9°10'N to 9°50'N latitude and 77°20'E to 78°20'E longitude. Geographically diverse, the district is bordered by the Western Ghats to the west, renowned for their greenery and biodiversity, which act as a natural barrier, influencing the climate by intercepting southwest monsoon winds. Consequently, the western part of the district receives higher rainfall compared to the east, characterized by fertile agricultural lands and gentle slopes. The Vaigai River traverses the district, providing water for irrigation and supporting the local economy.

As per the 2011 census, the district's population stands at 19,43,309, encompassing nine *taluks* and 600 revenue villages. The district is renowned for its rich cultural heritage and substantial contributions to the state's industrial and agricultural sectors.

Climate profile

The climate of Virudhunagar District is classified as tropical savanna type, characterized by hot summers, mild winters, and moderate to heavy rainfall during the monsoon season. The district traditionally receives its total rainfall from two wings - the southwest monsoon (June to September) and the northeast monsoon (October to December). The intensity and distribution of rainfall during both monsoon periods have undergone noticeable changes over the last 30 years (1993-2023). Already a water-stressed area, changes in rainfall pattern are leading to severe water scarcity and droughts, which ultimately impact directly the agricultural productivity and water availability in the district.

In the present report, the analysis of rainfall patterns, trend and variability have been done based on recent past 30 years (1993-2023) data. This will be helpful to provide valuable insights for climate change adaptation and management for the district authorities.

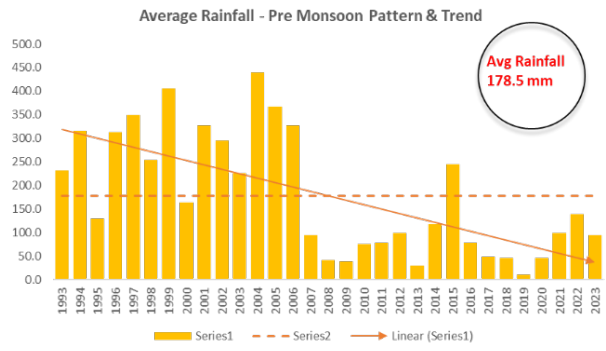
Trend and variability in rainfall

The district receives approximately 750 mm of rainfall annually. **Chart 1** illustrates the time series of rainfall patterns during the pre-monsoon, monsoon, post-monsoon, and annual periods over the past 30 years. The trend lines for pre-monsoon, monsoon, and annual rainfall depict a significant decrease over the last three decades. Although there is a declining trend during the post-monsoon period as well, the rate of decline is less pronounced, remaining close to the average. Chart 1 also highlights that the year 2007 marks a pivotal period in the rainfall pattern, as the district has not received rainfall exceeding the average since then.

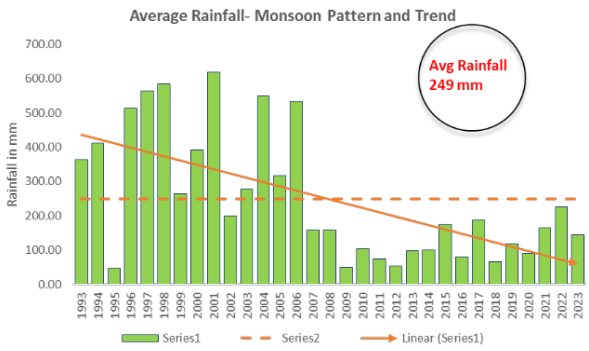
Mean Rainfall and Seasonal Distribution

The 2023 Global Climate Risk Report clearly indicates that climate change has had a significant impact on rainfall variability. The coefficient of variation in rainfall for the pre-monsoon, monsoon, and post-monsoon months, as well as the annual rainfall, has been calculated and analysed for the period 1993-2023 (Table 3). It is evident from here that the district receives the highest rainfall (22.86%) in October during the post-monsoon season, with an average of 171.48 mm. This is followed by the monsoon season, where June sees the highest average rainfall of 67.23 mm, gradually decreasing towards September. The pre-monsoon season experiences relatively lower average rainfall, with the highest mean rainfall occurring in March at 9.03 mm. The average monthly rainfall of the district highlights significant variability, particularly in February and March during the pre-monsoon season, and in October and November during the post-monsoon season. The monsoon season also shows significant variability, especially in June and July. The annual rainfall variability of the district is 45.26%.

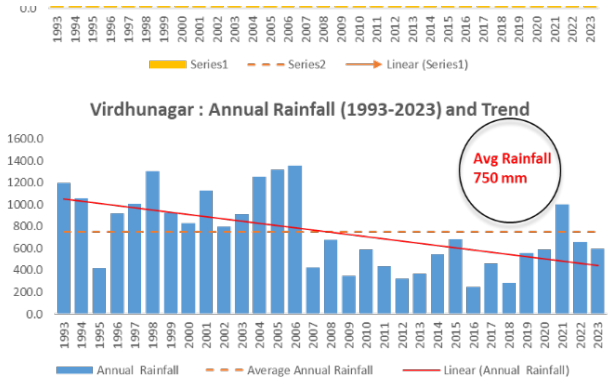
Chart 1

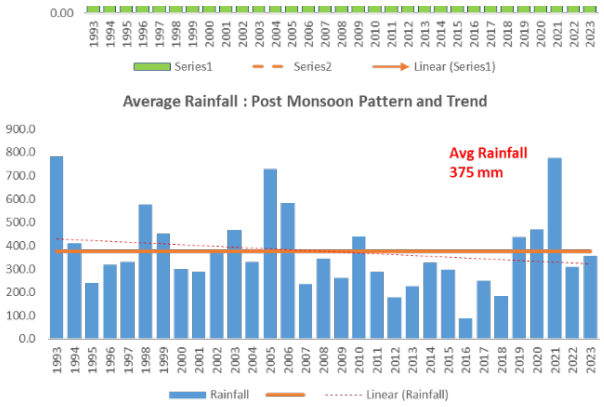


Virdhunagar : Annual Rainfall (1993-2023) and Trend



Average Rainfall : Post Monsoon Pattern and Trend





Potential risks

These rainfall variabilities, as indicated by the CV, may impose significant challenges to agricultural planning and crop management. Farmers may face difficulties in accurately predicting rainfall patterns, which can affect crop selection, irrigation scheduling, and yield projections. Although the region receives low rainfall during the southwest monsoon, higher rainfall during the monsoon and post-monsoon seasons can benefit crops. However, excessive variability may result in waterlogging, soil erosion, and crop damage. Reduced rainfall during the pre-monsoon season may impact crop sowing, particularly crops dependent on early moisture.

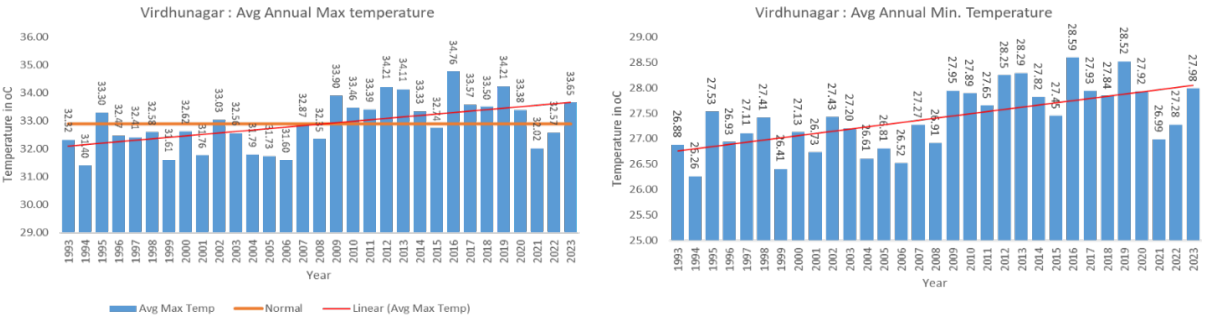
The uneven distribution of rainfall throughout the year highlights the need for effective water management strategies, such as developing storage facilities, promoting rainwater harvesting, and efficient irrigation systems. Variability in rainfall can influence groundwater recharge rates, impacting water availability for agricultural and domestic purposes. During periods of low rainfall variability, there may be increased pressure on water resources, leading to public conflicts over water allocation and usage. Similarly, inadequate rainfall during specific months can affect water availability for sanitation and hygiene practices, potentially posing health risks.

Temperature scenario

The district experiences a warm climate throughout the year, with relatively high temperatures during the summer months. The average maximum temperature during the summer season (March to June) often exceeds 35°C , with occasional heatwaves. The hot and dry conditions during this period exert challenges for agriculture and increase the risk of heat-related illnesses among the population. During the winter months (December to February), temperatures in Virdhunagar district remains milder, with average minimum temperatures ranging between 20°C to 25°C.

Chart 2 represents the average maximum and minimum temperature pattern and trend for years1993 to 2023, along with the normal maximum temperature and its digression from normal. The average maximum temperature of the district is 32.88°C. Over the last 30-years period, the average maximum temperature shows an increasing trend, though it is not very significant. The years 2012, 2013, 2016, 2019, and 2023 stand out with higher than average max temperatures, indicating periods of warmth or heatwaves; while years such as 1994, 1999, 2001, 2004, 2005, 2006, 2008, 2015, and 2021 witnessed temperatures below the normal range, suggesting relatively cooler periods. Overall, the average maximum temperature for the entire period is slightly increasing but indicates no significant long-term trend in temperature deviation.

Chart 3

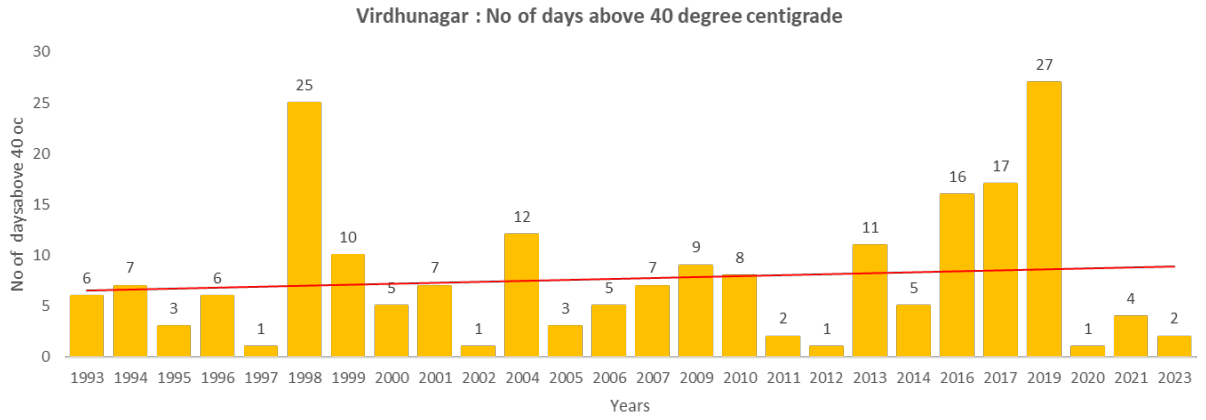


Analysing the data of minimum temperatures over the past three decades reveals a notable trend towards increasing temperatures. While fluctuations occur from year to year, there is an apparent pattern of rising minimum temperatures from the early 1990s to the early 2020s. This trend suggests a potential long-term shift in temperature patterns within the region. However, certain years, such as 2019, stand out with particularly higher minimum temperatures compared to surrounding years, indicating occasional deviations from the overall trend. Increasing minimum temperatures may have various implications, including impacts on agricultural practices, and human health. For instance, warmer nights may disrupt certain plant life cycles and lead to changes in crop cultivation techniques. Moreover, higher minimum temperatures can affect individuals' comfort level and contribute to heat-related health issues, particularly during night-time.

Extreme temperature pattern

Extreme temperature pattern (No. of days above 40-degree temperature) in Virdhunagar district over the last 30 years during the summer months reveals interesting insights. **Chart 3** below indicates the number of days with hot temperatures (above 40 degrees centigrade) for each year. There are noticeable variations from year to year, with some years experiencing significantly more hot days than others. For instance, 1998 had the highest total number of hot days, while certain years like 1997 and 2012 had relatively few hot days.

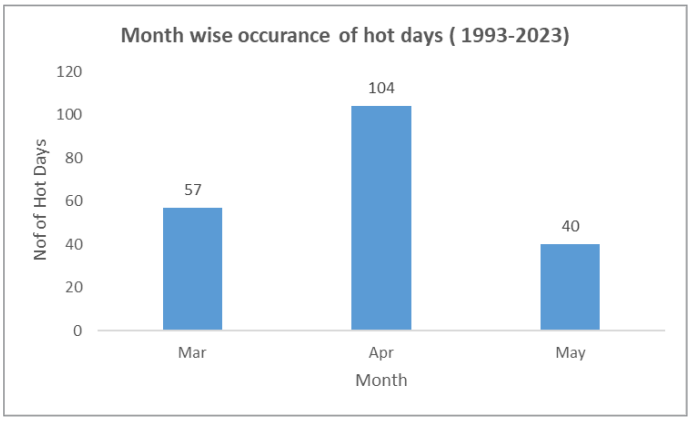
Chart 4



Over the last three decades, there appears to be a visible trend of increasing hot days in Virdhunagar during the summer months (March, April, and May). **Chart 4** shows fluctuations from year to year, but there is an overall pattern of more frequent occurrences of hot days, especially in recent years. In the early 1990s, the number of hot days was relatively low, with occasional spikes. However, as the decades progressed, there is a noticeable uptick in the frequen-

cy of hot days, particularly in April. This trend becomes more pronounced in the 2000s and continues into the 2010s and 2020s. The month wise analysis indicates that the highest number of hot days in the district occurred in April, followed by March and then May. This trend highlights the importance of understanding and addressing the impacts of climate change on temperature extremes in the region, as increased frequency of hot days can have implications for public health, agriculture, and water resource management.

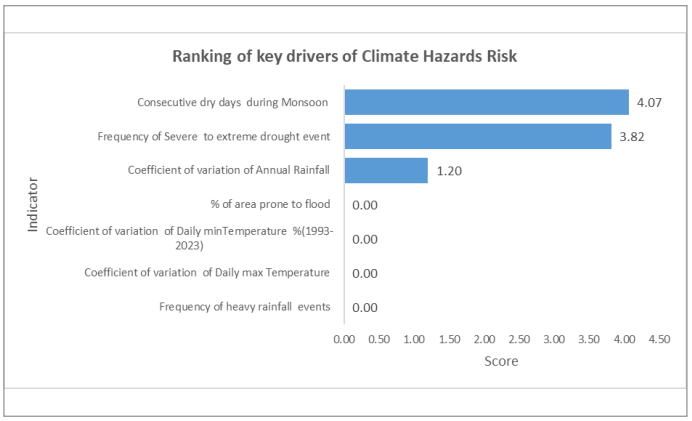
Chart 5



Climate hazards index and ranking of key drivers

Based on the analysis of climate data for rainfall and temperature over the past 30 years, the Climate Hazard Vulnerability Index at the district level has been calculated using seven indicators as tabulated in **Chart 5**. These indicators include the coefficient of variation of annual rainfall, the frequency of heavy rainfall events, consecutive dry days during the monsoon, coefficient of variation of daily maximum and minimum temperatures, percentage of area prone to flood and frequency of severe to moderate drought. The appropriate weightage for each indicator was determined using principal component analysis, and the final score was computed by multiplying the weightage value with the normalized value of each indicator. **Chart 5** above illustrates that in Virdhunagar district, out of the seven climate hazard indicators, indicators of consecutive dry days in summer (4.07), frequency of severe to moderate drought events (3.82), and coefficient of variation in annual rainfall (1.20) have higher scores compared to the state average. Consequently, these indicators play a pivotal role in assessing climate hazard risk in the district.

Chart 6



Sectoral Vulnerability

Agriculture and Allied sector

The comparative analysis of district-level agriculture sector vulnerability indicators in the district, with reference to the state of Tamil Nadu, reveals several key insights:

- **Marginal and Small Landholders**: Though the district Virdhunagar exhibits a lower percentage of marginal and small landholders (90%) compared to the state average (92.5%), it indicates a higher mass of population dependent on small-scale agriculture, potentially increasing vulnerability to market fluctuations and climate risks as they have a poor adaptive capacity to respond.
- **Livestock Population**: The district's livestock population per 1000 population is slightly lower (543) than the state average (573). While this may mitigate some risks associated with animal husbandry, it also points towards the district's limited diversification opportunities for agricultural livelihoods.
- **Area Under Rainfed Agriculture**: Virdhunagar district has a comparable percentage of area under rainfed agriculture (57.15 %) to the state average (42.47%). Reliance on rain-fed farming practices can increase vulnerability to climate variability and water scarcity.

- **Crop Insurance Coverage**: Interestingly, the district shows higher coverage under crop insurance schemes (57.3%), contrasting with the state average (41.46%). From the governance perspective, this gives a good picture of a larger part of the district covered under the PMFBY, however, it also exposes farmers to a higher financial burden of climate risks induced crop failure or damage.
- **MGNREGA Employment**: Virdhunagar district demonstrates a lower average person-days per household employed under MGNREGA as compared to the state average. While this may provide temporary employment opportunities, it also indicates underlying challenges in agricultural employment and livelihoods.
- **Yield Variability of Food Grains**: The district experiences higher yield variability of food grains (28%), higher than the state average (20%). This variability may affect food security and income stability for farmers.
- **Women's Participation in the Workforce**: The district shows 44% of women's participation in the workforce, reflecting potential gender disparities in agricultural activities and decision-making.

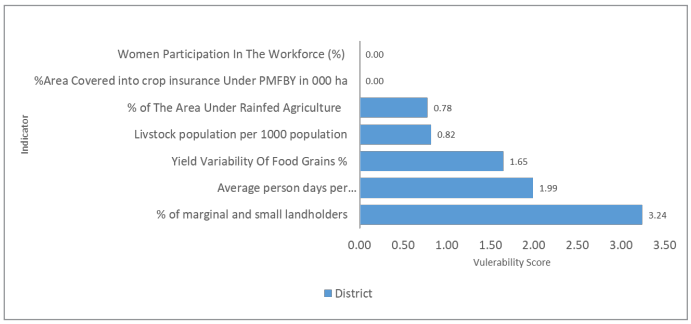
Based on the district's scores, the key drivers of vulnerability appear as the high percentage of marginal and small landholders, significant reliance on MGNREGA employment for livelihood support and yield variability of food grain **(Chart 6).** These factors highlight the importance of targeted interventions to enhance resilience and sustainability in the agriculture sector, including diversification of livelihood options, and gender-inclusive agricultural development programs.

Health Sector

In the district, seven health related indicators have been taken which shed light on various facets of public health. Notably, the district shows a promising infrastructure support, with a relatively high number of rural healthcare facilities per lakh population (18.43) as compared to the state average (18.69). However, there are significant gaps in health insurance coverage, with only 51.3% of households covered under health or financial schemes in comparison to the state average of 66.5%.

Child health indicators reveal concerning trends, with relatively low percentages of fully vaccinated children aged 12-23 months (76.7%) which is lower than the state average and significant proportions of undernourished children under 5 years, indicated by stunting (29.2%) and underweight (23.7%). Additionally, there is a notable prevalence of anaemia among women aged 15-49 years, which is 56.9 % as compared to the state average of 52.9%

Chart 7



Hence, among the indicators, the prevalence of anaemia among women aged 15-49 years emerges as a potential key driver of health vulnerability in Virudhunagar District **(Chart 7).** Anaemia compromises individuals' resilience to climate stressors, exacerbating the health impacts of extreme weather events and environmental changes. Addressing anaemia requires comprehensive strategies, including interventions to improve nutrition, improved access to healthcare, and better women's health services. By prioritizing efforts to reduce anaemia prevalence, increasing health insurance coverage at HHs level and strategy formulation for addressing child nutrition related issues, Virudhunagar district can enhance its capacity to mitigate and adapt to climate-related health risks, ultimately improving the well-being of its population.

Education Sector

In education sector, as per the common framework of district level vulnerability suggested by the Govt. of India , the study have used seven indicators to assess the educational vulnerability to climate risks viz % Women with 10 or more years of schooling, % of Schools with Functional Girls toilet, % of Schools with Functional Drinking Water facilities, Average Student teacher Ratio, Average Drop-out rate in secondary level, % of Schools Approachable by All-Weather

Roads and % of schools with electricity connection. In the education sector, Virudhunagar District exhibits a better position with states average on some indicators. **(Table 4)**

Table 4

Indicator	District average	State average
% Women with 10 or more years of schooling	53.5%	56.6%
% of schools with functional girls' toilet,	98.6%	98.7%
% of schools with functional drinking water facilities	99.8%	97.5%
Average Student teacher Ratio	16.75%	16.5%
Average Drop-out rate in secondary level	5.05%	4.47%
% of Schools Approachable by All-Weather Roads	96.67%	69.46

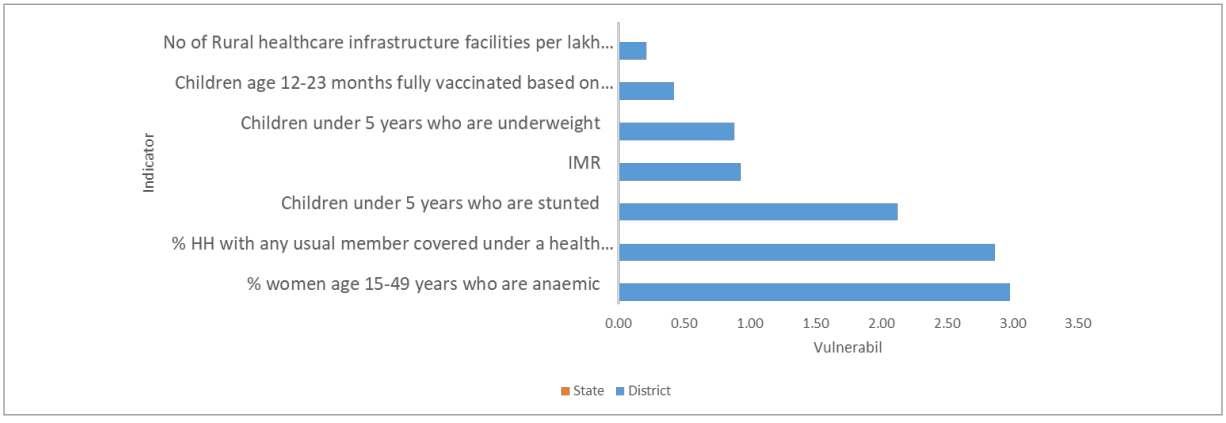
- The comparative analysis between district and state averages in education sector indicators reveals that the district's average percentage of women with 10 or more years of schooling (53.5%) is slightly lower than the state average (56.6%), while both exhibit high percentages of schools with functional girls' toilets and drinking water facilities. The district's average dropout rate in secondary level (5.05%) is marginally higher than the state average (4.47%). Notably, the district surpasses the state average in terms of schools approachable by all-weather roads, indicating better infrastructure resilience. Overall, the district performs well in infrastructure but faces challenges in educational attainment compared to the state average. Based on the score obtained, the key indicators/ drivers of educational vulnerability in the district are (**Chart 8):**

- **% Women with 10 or More Years of Schooling:** The relatively higher score in comparison to state average suggests a potential vulnerability in educational attainment among women, which may impact overall literacy rates and socio-economic development.

- **Average Dropout Rate in Secondary Level**: The higher drop-out rate of students in the district with reference to the state, reflects challenges in retaining students in secondary education, possibly due to socio-economic factors or inadequate support systems.

- **Average Student-Teacher Ratio**: This is the third key driver in education sector of the district which suggests potential challenges in providing individualized attention and quality education to students, which can hinder learning outcomes and academic performance.

Chart 8



Addressing these key indicators should be prioritized to enhance educational resilience and promote inclusive and quality education in the district.

Water and sanitation Sector

This is an important sector which is directly impacted by climate risks. In the study, six indicators have been selected to assess the sectoral vulnerability. The following table shows the comparative facts between the district and the state against the respective indicators **(Table 5)**

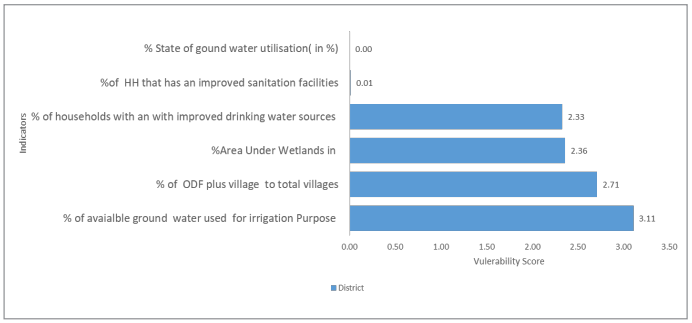
Table 5

Indicator	District average	State average
% of households with improved drinking water sources	97.4 %	98.6%
% State of ground water utilisation(in %)	57.56%	73.91%
% Area Under Wetlands	0.31%	1.38%
% of available ground water used for irrigation Purpose	55.85%	69.0%
%of HH that has an improved sanitation facilities	59.8%	72.6%
% of ODF plus village to total villages	73.45%	82%

From the Table above, it is observed that the district exhibits commendable access to improved drinking water sources, with 97.4% of households enjoying this privilege, though this is slightly lower than the state's 98.6%. However, the district's groundwater utilization rate stands at 57.56%, significantly below the state's 73.91%, indicating potential disparities in water use practices. Similarly, while the district claims 0.31% of its area under wetlands, this figure falls short of the state average of 1.38%, suggesting differing ecological characteristics or land use patterns. Moreover, the district utilizes 55.85% of its available groundwater for irrigation purposes, trailing behind the state's 69.0%, reflecting potential inefficiencies in agricultural practices or water management strategies. Additionally, the district records a lower percentage of households with improved sanitation facilities at 59.8% compared to the state's 72.6%. Despite these disparities, the district demonstrates progress in sanitation initiatives, with 73.45% of villages achieving Open Defecation Free Plus status, albeit lower than the state's 82%.

In assessing the water and sanitation sector vulnerability, several key drivers and indicators emerge, highlighting areas of vulnerability within the district **(Chart 9)**. The district's excessive utilization of available groundwater for irrigation purposes, reflected in its high score of 3.11, poses a significant vulnerability, potentially leading to groundwater depletion. Furthermore, the district's slow progress in achieving Open Defecation Free Plus status contributes to enhance vulnerability by addressing sanitation-related risks.

Chart 9



Moreover, the district's small proportion of area under the wetland coverage, in contrast to the state's coverage, emphasizes the importance of preserving existing wetlands for sustainable water resource management. Access to improved drinking water sources emerges as another critical driver of vulnerability, with the district's high score indicating risk of waterborne diseases and related health risks. Addressing these vulnerabilities through targeted interventions and sustainable management practices is essential to enhance resilience and sustainability in the water and sanitation sector at district levels.

Composite level of sectoral Vulnerability and ranking of indicators

The Composite vulnerability scores provide insight into the status of various sectors within the district and state, highlighting areas of concern and resilience. **(Chart 10)**

- In the water and sanitation sector, the district demonstrates a higher vulnerability score of 1.75. This suggests that the district faces greater challenges in ensuring access to clean water and sanitation facilities, potentially

leading to health risks and environmental concerns. Addressing issues such as groundwater depletion, inadequate sanitation infrastructure, and waterborne diseases is crucial to improve the sector's resilience in the district.

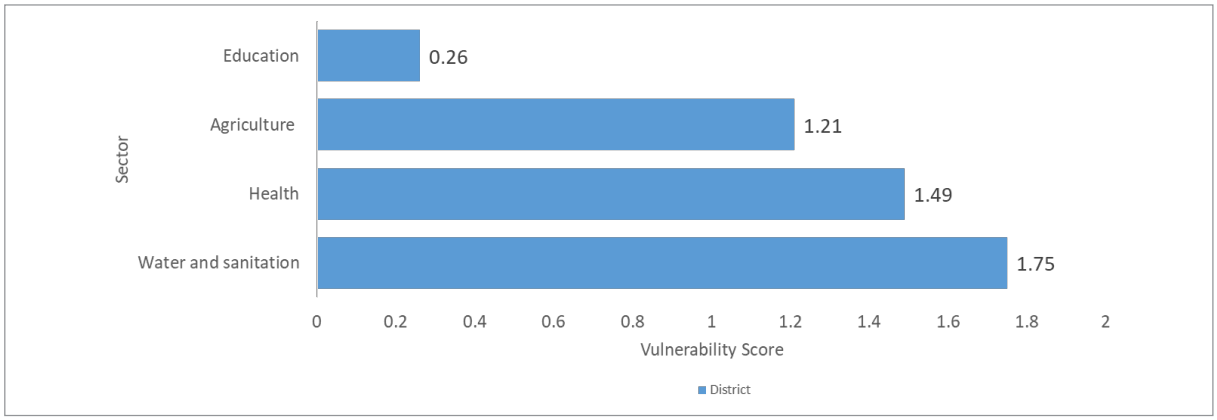
- Similarly, in the health sector, the district's vulnerability score of 1.49 indicates significant challenges. This suggests that the district possesses potential gaps in healthcare access, infrastructure, and service delivery with reference to the state, highlighting the need for targeted interventions to improve healthcare outcomes and reduce vulnerabilities.
- Agriculture sector is the third most vulnerable sector. The district shows a moderate vulnerability score of 1.21. This gives an indication that while there are challenges such as climate risks, water scarcity, and land degradation affecting agricultural productivity, efforts are also being made to enhance resilience through sustainable farming practices, irrigation management, and crop diversification.
- Education sector in the district appears to be relatively less vulnerable compared to other sectors, with reference to the state. However, there is still room for improvement in ensuring access to quality education, reducing dropout rates, and addressing infrastructure gaps to enhance educational resilience and promote human development in the district.

Area of concern

The vulnerability assessment of the district reveals critical areas of concern across multiple sectors. Among the top 10 key indicators, the high percentage of marginal and small landholders' underscores challenges in agricultural productivity, income stability, and livelihood security, indicating vulnerability in the agricultural sector. **(Chart 11)**

Excessive utilization of groundwater for irrigation purposes highlights vulnerability to water scarcity, posing risks to

Chart 10



water resources sustainability. Moreover, the prevalence of anaemia among women of reproductive age points to vulnerability in maternal health and nutritional deficiencies. Low coverage of health insurance or financial schemes signifies vulnerability to healthcare costs and limited access to services. While progress in achieving Open Defecation Free Plus status indicates strides in sanitation, disparities persist, reflecting vulnerability in public health and environmental hygiene.

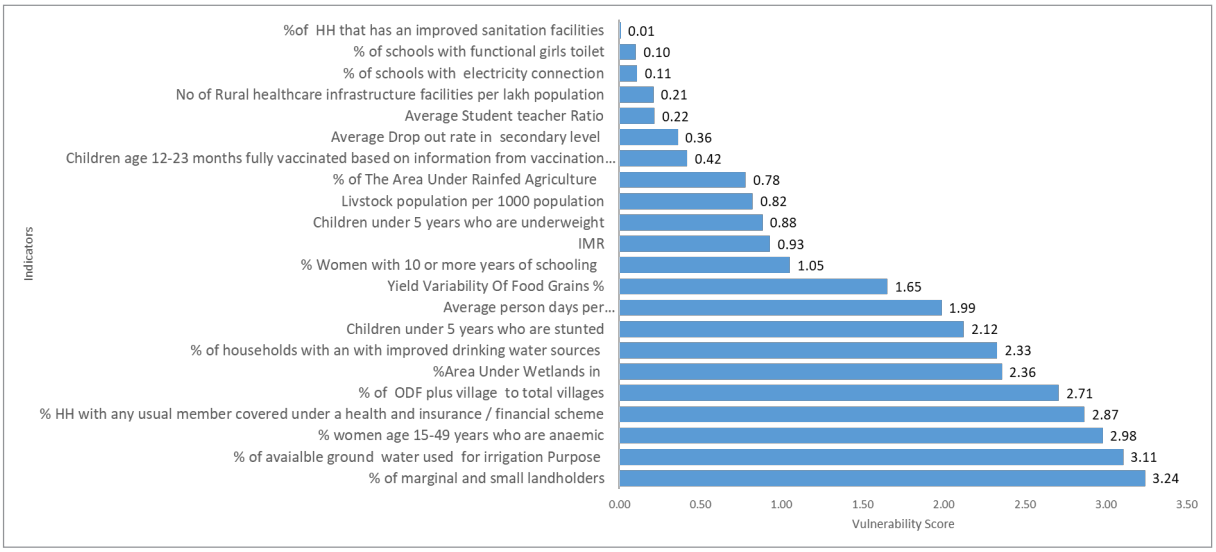
Additionally, the extent of wetlands and access to improved drinking water sources play crucial roles in water conservation and public health, reflecting vulnerabilities to environmental degradation and waterborne diseases. High prevalence of stunting among children highlights vulnerability to malnutrition and long-term health consequences, while higher employment under MGNREGA signifies vulnerability to livelihood insecurity and poverty. Finally, variability in food grain yields signals vulnerability to climate change impacts, affecting food security and agricultural livelihoods.

Key insights for further investigation

Addressing these vulnerabilities requires a holistic approach encompassing socio-economic development, environmental conservation, and public health interventions to enhance resilience and promote sustainable development in the district.

- In agriculture, the variability in rainfall patterns and increasing temperatures can disrupt crop cycles, leading

Chart 11



to reduced yields and economic losses for farmers. Excessive rainfall or drought conditions can exacerbate soil erosion, waterlogging, and crop failures, impacting food security and livelihoods. Additionally, changes in temperature and precipitation patterns may favour the spread of pests and diseases, further compromising agricultural productivity.

- Health outcomes are also influenced by climate-induced risks. Rising temperatures can increase the incidence of heat-related illnesses, vector-borne diseases, and respiratory ailments. Inadequate access to clean water and sanitation facilities, exacerbated by erratic rainfall patterns, can contribute to waterborne diseases and hygiene-related health issues. Vulnerable populations, including children, the elderly, and those with pre-existing health conditions, are particularly at risk.

- The education sector may face disruptions due to extreme weather events, such as floods or cyclones, which can damage school infrastructure and disrupt learning activities. Additionally, heatwaves and poor air quality may impact students' ability to concentrate and participate in educational activities, affecting academic performance and their overall well-being.

- Water and sanitation services are vulnerable to climate-induced risks, with changes in precipitation patterns affecting water availability and quality. Drought conditions can lead to water scarcity, hindering access to safe drinking water and sanitation facilities. Flooding events can contaminate water sources and damage sanitation infrastructure, increasing the risk of waterborne diseases and environmental pollution.

Hence, addressing climate-induced risks in Virdhunagar district requires comprehensive adaptation and mitigation strategies across sectors. This includes implementing climate-resilient agricultural practices, enhancing healthcare infrastructure and services, strengthening disaster preparedness and response mechanisms in education, and investing in sustainable water and sanitation solutions. Collaborative efforts involving government agencies, civil society organizations, and local communities are essential to build resilience and mitigate the impacts of climate change on vulnerable sectors in the district.

SECTORAL CLIMATE RESILIENCE PLAN DISTRICT VIRUDHUNAGAR

AGRICULTURE

Virudhunagar district, situated in the semi-arid region of southern Tamil Nadu, has been increasingly feeling the repercussions of climate change. Rising temperatures, erratic rainfall patterns, and frequent droughts have placed significant stress on the agriculture sector, which remains a primary livelihood source for many rural households. Traditionally, farmers in Virudhunagar relied on monsoon rains to sustain crops such as paddy, millets, and pulses. However, changing weather patterns have disrupted this dependency, leading to unpredictable sowing seasons and lower crop yields.

One of the most critical challenges is water scarcity. Reduced and irregular rainfall has led to a steep decline in groundwater levels, with many waterbodies drying up before the end of the agricultural cycle. This scarcity not only limits irrigation options but also compels farmers to shift to water-intensive cash crops like cotton, which further strains available resources. Consequently, farming communities face recurring crop failures, loss of income, and mounting debts, making agriculture an increasingly risky occupation.

In Virudhunagar, four types of soil are found in Virudhunagar district. These are red loam, lateritic soil, black soil, and sandy coastal alluvium. However, soil degradation is yet another consequence of climate change and unsustainable farming practices. High temperatures and inadequate moisture accelerate soil erosion, reducing its fertility and productivity over time. This degradation often forces farmers to rely heavily on chemical fertilizers, further weakening the soil's efficiency.

Additionally, pests and diseases are proliferating due to shifting climate conditions, posing yet another threat to crop health and productivity. Increasing pest population due to factors like warmer temperature, altered precipitation and change in seasonal timings is creating favourable conditions for pest species to thrive, allowing them to reproduce faster, expand their geographic range and survive harsher winter ultimately leading to larger pest breaks. Insects and pests like Aphids, boll worm and leafhoppers may experience population surge causing significant crop losses.

The impact of climate variabilities as observed in climate risk assessment in Virudhunagar on Agriculture sector was identified around which the causes and sub-causes were understood in a participatory manner during the sectoral workshop. The action points as evolved to address these causes and sub-causes were also shared by the community members on the basis of which this sectoral action plans are developed.

Agricultural Vulnerability and its Causes and Sub-Causes

Climate change impacts	Sectoral Vulnerability	Causes	Sub-Causes
• In the last 30 years, significant decline in average annual rainfall is witnessed. • Rate of rainfall decline during pre and monsoon periods is high while in post monsoon the slope of decline is slight and close to the average/mean • The average maximum temperature during the summer season (March to June) often exceeds 35°C, with heatwaves. • During the winter months (December to February), temperatures in Virdhunagar district remains milder, with average minimum temperatures ranging between 20°C to 25°C.	**Water Stress during Pre-Monsoon and Monsoon months:** Most of 90% small-marginal farmers in the district practice 'Kharif' crop but due to reducing rainfall in monsoon and pre-monsoon period, the resulting water stress impact income and livelihood of farmers	**Sole dependency on rain water:** Water stress due to low rainfall and lack of buffers of surface water. Also, deep ground water table and over use of ground water create situation where irrigation becomes difficult. Hence, crops have to be solely dependent on rain water.	**Efficient (Water conserving) irrigation methods not available** Technology and implements for water efficient irrigation system are not available. Farmers are not aware of such methods
		Storage of rainwater is not done efficiently Mechanisms of rain water harvesting at household, village and institution are not adequate for storing water which can be used during stressed period. **Village ponds are getting dry** Ponds are existing in the village but gets dried quite fast. Due to lesser rains the ponds are not filled adequately causing low water storage and quick drying **Decreasing number of rain days** **Over Use of available ground water** The lower rain fall and demand of high yielding crops cause excessive exploitation of ground water resulting in lowering of ground water table.	**Fewer Waterbodies** Number of waterbodies in the district is low. Only 0.31% of area in the district is under waterbodies (against State average of 1.38%) **Water wells not available** Water wells are getting dry due to lowering of ground water table **Feeding canals getting dry** Canals (natural and manmade) play a major role in filling water in waterbodies from the catchment areas. The feeding canals do not get sufficient water **Feeding canals encroached and chocked** Canals (manmade and natural) have been encroached by local communities. Further proper maintenance and regular cleaning is not done causing choking of feeding canals **Water conservation a low priority** In few villages, water conservation efforts have not been given required priority. **Lack of water budgeting** Scientific ground water assessment and water budgeting are missing in most of the villages thereby not providing idea of water use at village level

Climate change impacts	Sectoral Vulnerability	Causes	Sub-Causes
		Deep ploughing Lack of fertility in upper layers of soil, use of machines for ploughing and requirement of rotation of soil for weed and pest control cause deep ploughing thereby exposing the deeper layer of soil and evaporation leading to reduction in soil moisture content. **Hardening of Soil** Repeated same depth ploughing and loss of organic content and humus in soil, cause hardening of soil thereby reducing water permeability and water re-charge.	**Decreasing organic manure** Decreasing animals/livestock cause less manure going to soil and hence reduced soil moisture. **Increased Use of synthetic fertilizers** Increased chemical fertilizers make soil dry/reduced moisture conservation efficiency. **Heavy water consuming crops** Practicing heavy water demanding crops for higher production, exotic crops not suitable to local ecology and mono cropping cause soil moisture loss demanding more frequent irrigation
		Lack of efficient water retention mechanism in farm fields Rain water retention in farm fields is crucial for its optimum use and ground water recharge. However, such practices are being ignored	**Farm Ponds** Farm ponds have been effective in-situ water conservation methods practiced traditionally. However, the farm ponds are not a regular practice and largely ignored **Water efficient crops/farm practices** Millets and other local crops suitable for dry land ecology have been replaced by high yielding crops. The traditional crops had a lower water demand compared to HYVs. Farm practices like crop rotation, crop diversity, multi-tier farming are not given priority due to increasing labor costs and decreasing interest in farming because of low returns. 'Farm System' with integration of various farm sub-systems (and recycling measures amongst various sub-systems) have been ignored due to mono cropping practices. **Lack of regular soil testing** Regular soil testing and providing test results to farmers is lacking in several villages. The advice based on test results can help farmers for avoiding over use of chemical fertilizers in agriculture fields. **Extension Support** Support like soil testing, advise for adopting farm system approach, lesser water demanding crops, water efficient irrigation systems etc are not adequately reaching to small-marginal and women farmers regularly

Climate change impacts	Sectoral Vulnerability	Causes	Sub-Causes
		Invasive species *Prosopis Juliflora* cause fast evaporation and over use of ground water Once introduced for charcoal making and income generation for local community, the species has become invasive and spread in large areas. The plant consumes high quantity of water because of faster growth	**High returns in charcoal** Charcoal making is a profitable venture compared to low returns in farming although it consumes lot of water. The local community practice charcoal making although plant is adversely impacting local ecology **Policies promoting the species** The current policies do not discourage plant **Income for practicing community** Good income and Alternate livelihood for those dependent on charcoal making
		Increase in hot wind make the soil dry	**Lesser wind breaks** (esp. on farm bunds). **Shrinking natural ecosystems** esp. waterbodies and green areas.

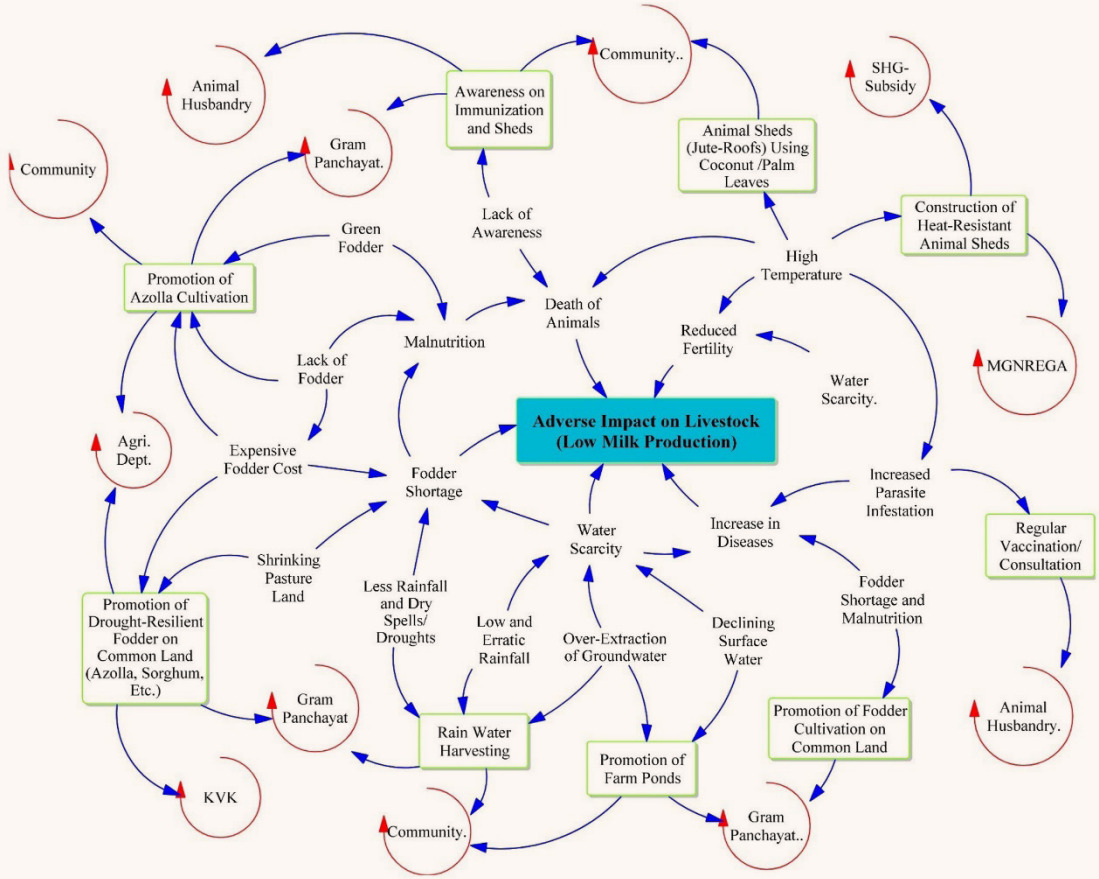
Climate change impacts	Sectoral Vulnerability	Causes	Sub-Causes
	Trends of low rainfall like reducing rainfalls in pre and during monsoon months disrupt nursery raising for *Kharif* (Paddy) crops and hence delayed plantation impacting lower yields of *Kharif* production	**Sole dependency on rains for nursery raising** Nursery raising is totally dependent on rains as there is water constraints and hence irrigation for nursery raising is costly and challenging	**Appropriate irrigation system** with water use efficiency is not prevalent in the area although water efficient irrigation mechanisms are feasible in nursery raising Efficient irrigation system technology for nursery raising not available. **Polyhouse/Green House** Where Controlled (temperature, water) systems for nursery development (Polythene/ Green House) can be made available are not available at village level.
		Resilient Paddy varieties Paddy varieties which require lesser water are not in practice due to non-availability and lacking preferences. Traditional varieties required less water but not practiced by farmers.	**Lesser production** Traditional varieties have low production and hence not preferred **Labour intensive** Traditional varieties are labour intensive. Availability of labour in villages is decreasing and labour is becoming cost intensive making the production cost high **Longer Duration** Traditional varieties require 120-150 days for maturing
		Feasibility of Bore wells With lowering of ground water table and excessive use of ground water, deeper borings are in practice. This required escalated costs. Further, deep bore wells frequently gets dry making it unsustainable and unreliable	• Cost of Bore wells high (approx. Rs. 40,000.00) • Electricity connection is expensive. • Ground water depletion.
		Alternate crops (of Paddy) Other crops requiring less water and as an alternative of paddy are not available and not preferred. Extension services for such replacement is not available.	**Crops like Cotton, Onion** maybe good options but need extension and input support. **Weeding requirement** and labor requirement in commercial crop is more so not feasible for small land holding farmers **Millets** Small grain millets, ragi and Sorghum are nutritious as well as requiring minimal water

Climate change impacts	Sectoral Vulnerability	Causes	Sub-Causes
	Adverse impact on livestock: Heat stress significantly impacts livestock in Virudhunagar district due to its hot and semi-arid climate. Rising temperatures reduce feed intake, milk production, and overall growth rates in cattle, goats, and poultry. Heat stress also weakens immune responses, increasing susceptibility to diseases. Water scarcity further exacerbates dehydration and heat-related illnesses.	• **Water scarcity:** Water scarcity poses a serious challenge to livestock health and productivity. Limited water availability leads to dehydration, reduced feed intake, and lower milk production in cattle and goats. Heat stress, compounded by water shortages, weakens immunity and increases susceptibility to diseases.	• **Low and erratic rainfall** – Limited rainfall, leading to insufficient groundwater recharge. Erratic rainfall results in high water run-off, again impacting groundwater recharge • **Over-extraction of groundwater** –for agriculture, industry, and domestic use has led to a decline in groundwater table • **Declining surface water** – High evaporation rates during summer season leads to drying up of waterbodies
		• **Fodder shortage:** Reduced pasture availability, drying-up of fodder lead to malnutrition, lower milk yield, and weakened immunity in cattle and goats. Prolonged fodder scarcity also affects reproduction rates and overall livestock sustainability.	• **Less rainfall and dry spells/droughts:** Insufficient rainfall reduces the growth of natural grass and fodder crops • **Water scarcity** – Limited water availability affects the cultivation of fodder crops • **Shrinking pasture land** – Expansion of agriculture, urbanization, and industrial projects reduce grazing lands. • **Expensive fodder cost** – Increasing demand and low supply make fodder unaffordable for small farmers.
		• **Increase in diseases:** High temperatures and inadequate water access weaken immunity, making cattle and goats more vulnerable to infections, parasitic infestations, and respiratory diseases. Frequent disease outbreaks lead to reduced milk production, weight loss, and higher mortality rates.	• **Water Scarcity** – insufficient water leads to dehydration and waterborne diseases. • **Fodder shortage and malnutrition** – Nutrient-deficient feed weakens livestock, reducing disease resistance. • **Increased parasite infestation** – Hot and humid conditions favor the spread of ticks, mites, and other disease-carrying parasites.
		• **Death of animals:** The increasing death of livestock in Virudhunagar due to heat stress, water scarcity, and disease outbreaks is a major concern for farmers. The loss of animals not only impacts farmers' income but also disrupts local dairy and meat supply chains.	• **High temperatures**: Animals are unable to cope-up with high temperatures. • **Malnutrition**: Lack of water and fodder leads to malnourished animals resulting in mortality • **Lack of awareness:** Communities lack knowledge and awareness on regular immunization of animals

Climate change impacts	Sectoral Vulnerability	Causes	Sub-Causes
		• **Reduced fertility:** Reduced fertility in livestock is a growing concern due to heat stress, poor nutrition, and water scarcity. High temperatures disrupt reproductive cycles in cattle and goats, leading to lower conception rates and increased calving intervals. Nutritional deficiencies further weaken fertility, impacting herd sustainability and farmers' incomes.	• **High temperatures** - leads to exposure of animals to prolonged heat stress that disrupts normal reproductive cycles, affects hormone levels and reduce conception rates. • **Water Scarcity:** Limited access to clean water, particularly during dry spells, can exacerbate heat stress and overall animal health, indirectly impacting fertility
	Increasing labour cost in agriculture due to high heat stress: High heat stress significantly reduces the work efficiency of farm laborers, compelling farmers to compensate with additional labor and extended work hours. This inefficiency not only slows down production but also increases the overall input costs, as more resources must be allocated to maintain productivity levels.	• **Extreme temperatures:** Prolonged exposure to high temperatures lead to increasing fatigue in farmers and farm labourers, making it difficult for them to carry out physical activity. • **Dehydration:** High heat accelerates fluid loss through sweating, and without adequate water, workers quickly become dehydrated, which reduces their stamina. • **Health issues:** Increased incidences of health issues like stomach problems and kidney stones are seen in farmers exposed to prolonged heat • **Lack of shady trees:** Farm laborers work in open fields with limited access to tree shade, which exacerbates the effects of the heat • **Additional labour:** Due to high heat stress and lower work efficiency, more number of labourers are required to be employed for dry-land agriculture work • **Loss in agricultural production (especially vegetable crops):** Reduced work efficiency leads to additional days engaged in harvesting of crops which also results in loss in production	• **Scarcity of water:** Limited access to safe drinking water • **Lack of awareness:** Lack of awareness in farmers on ill-effects of less water consumption, mechanisms to prevent heat stroke • Enhanced Wage Demands: In response to the physically demanding and potentially hazardous conditions, laborers demand higher wages for working under stressful heat conditions.

Climate change impacts	Sectoral Vulnerability	Causes	Sub-Causes
	Reduced and erratic rainfall causing increased soil degradation - impacting fertility of soil:	Excessive use of plastics reducing water permeability leads to soil degradation and fertility of soil.	More and more commodities are being made available in plastic packages. Even bio fertilizers packages are sold in plastic baggage. Extensive use of plastic reduces water permeability and leads to soil degradation.
	The decreasing organic content in soil and its water retention capacity makes the soil sensitive for degradation	Reduced humus and carbon contents into the soil, because of excessive use of chemical fertilizers rendering the soil less porous leading to to reduced soil fertility.	Reduced livestock numbers are cause for less productions of bio fertilizers/compost making. Hence lack of bio fertilizers may lead to reduce humus making the soil less fertile.
		Heavy rainfall events (though overall annual rain fall decreasing) cause inundation and loss of vegetation by uprooting plants damaging tree branches	Decreased vegetation cover increases exposure of soil for erosion.
		Deep ploughing cause drying of soil and exposure for wind erosion.	Farmers go for deep ploughing to improve soil structure by breaking up compacted layer, allowing better water infiltration and deeper root penetration. Deep ploughing may lead to water logging and disrupt soil structure.
		Increased stone crushing-effect of dust from stone crusher unit has affected the fertility of the soil in specific local areas	Stone crushers are use to break large rocks into smaller manageable pieces. The immense need for building material has increased in demand, although it is out lawed by EPCC (Environmental Pollution Control). Extensive use of stone crusher may cause infertile soil, large amount of dust on the soil, altering physico-chemical composition of the soil.
		Reduced humus and carbon contents in soil is commonly observed. Reduced soil retention contributes to less soil moisture.	Decreased Carbon Content and bio-manure may be the reason. Extensive use of chemical fertilizers may lead to such condition.
		Post monsoon heavy rainfall inundation, causing loss of vegetation.	-Encroachment and blockage of drainage channels - reduced spaces of wetlands - Losing tree cover
		Sheet erosion is caused due to heavy rains conditions seen on plains and cropped areas	Sheet erosion is also caused by heavy rain and deep ploughing.
		Reduced palm tree cultivation effecting soil binding. Govt. control on toddy extractions also discouraged palm tree plantation.	Use of Palm tree leaves are common practice in the area.
		Reduced humus and carbon contents in soil, leads to loss of soil productivity. Soil type and its texture also plays an important role in retaining carbon contents and retain humus.	Soil is exposed to erosion due to reduced vegetation cover. Shift towards chemical fertilizers cause low carbon content in soil

In view of the climate variability and its impact on Agriculture and allied sector in Virudhunagar, a comprehensive discussion and brainstorming session was held with the communities and relevant stakeholders. The goal was to understand the problems that have emerged, their underlying causes/sub-causes, and possible interventions. This exercise was carried out through Causal Loop Diagramming tool. As an example, a CLD illustrating one of the identified problems is provided here.



Sectoral Resilience Action Plan – Agriculture and Allied

Climate Change Variability	Impact of Climate Change on Agriculture/Allied Sector	Actions				Level of Implementation (District/ Block/Gram Panchayat)	Responsible Stakeholders	Time frame Short term (0-6 months) Medium term (1-2 years) Long term (3-5 years)
		Training and Capacity Building	Community level Awareness Programs	On-ground Implementation	Convergence and Linkages			
• In the last 30 years, significant decline in average annual rainfall is witnessed. • Rate of rainfall decline during pre and monsoon periods is high while in post monsoon the slope of decline is slight and close to the average/mean • The average maximum temperature during the summer season (March to June) often exceeds 35°C, with heatwaves. • During the winter months (December to February), temperatures in Virdhunagar district remains milder, with average minimum temperatures ranging between 20°C to 25°C.	**Water Stress during Pre-Monsoon and Monsoon months:** Most of 90% small-marginal farmers in the district practice 'Kharif' crop but due to reducing rainfall in monsoon and pre-monsoon period, the resulting water stress impact income and livelihood of farmers	• Trainings to be conducted for farmers and extension workers on Water efficient irrigation mechanism along with matching crop combinations • Training/Orientation on Efficient farm pond management as part of 'Farm System' • Extension services like climate resilient farming, availability of needed inputs and demo models of resilient cropping (integrated farm management) to be strengthened.	• Popularization of water efficient (drip irrigation) irrigation mechanism • Awareness on importance of Farm Ponds • Low/Efficient use of chemical fertilizers • Organic manure to be popularized and needed subsidy for encouragement • Value addition methods like Vermicomposting to be popularized for addressing decreasing livestock and compost • Community to be made aware of harmful effects of deep ploughing to be • crop combinations and multi-layer crops tobe popularized. • Harmful effects of Prosopis julifera • Need of regular soil testing	• Water efficient (drip irrigation etc) irrigation to be popularized for small-marginal farmers. • Number and area of waterbodies to be increased. Dumping of wastes and plastics in waterbodies to be strictly stopped • Demarcation of waterbodies needed and removal of encroachment of waterbodies • Encroachment on feeding canals to be removed. • Regular cleaning and de-silting of feeding channels to be done. • Village ponds tobe promoted- needed subsidy to be provided for encouragement. • Deepening of village ponds	• R&D support for cost effective irrigation mechanisms • Use of MGNREGA resources for check dams and farm ponds • Implements of shallow ploughing and related crops to be popularized.	Panchayat Level	• TNAU • KVK • MGNERGA • Revenue Department • Irrigation/ Canal Department • Agriculture Department • Horticulture Department • Soil Conservation Department • NGOs • Agriculture Extension • Veterinary Department	Medium to Long Term

Climate Change Variability	Impact of Climate Change on Agriculture/Allied Sector	Actions				Level of Implementation (District/ Block/Gram Panchayat)	Responsible Stakeholders	Time frame Short term (0-6 months) Medium term (1-2 years) Long term (3-5 years)
		Training and Capacity Building	Community level Awareness Programs	On-ground Implementation	Convergence and Linkages			
	Trends of low rainfall like reducing rainfalls in pre and during monsoon months disrupt nursery raising for *Kharif* (Paddy) crops and hence delayed plantation impacting lower yields of *Kharif* production	• Technology for water efficient nursery raising of Paddy require R&D support. • Alternate crops (resilient crops) for Paddy to be promoted which can be practiced in Kharif season. • Suitable sowing methods for Paddy (not requiring nursery raising) to be promoted. • Training on Scientific assessment of ground water and water budgeting at village level	• Awareness on efficient nursery raising alternate crops and direct sowing to be taken-up. • Weed control methods in alternate crops to be popularized.	• Composting of agri-waste tobe introduced at a large-scale. Vermi-composting as value addition in composting for enhanced efficiency • Low external input bio-farming methods tobe popularized. • Mulching methods with local materials/ bio-mass tobe taken-up at large scale. • integrated farm management system (Farm-Pond-Horticulture). • Water budgeting at village level tobe introduced and adopting by Gram Panchayat. • Regular soil testing and reports tobe provided to farmers for rational use of fertilizers (avoiding over dosing) • Resilient varieties of Cattle/livestock to be introduced.	R&D support of research institutions	Panchayat level	• NEDA • Aquaculture • TNAU • KVK • Assistant Agriculture Engineer	Short to Medium term

Climate Change Variability	Impact of Climate Change on Agriculture/Allied Sector	Actions				Level of Implementation (District/ Block/Gram Panchayat)	Responsible Stakeholders	Time frame Short term (0-6 months) Medium term (1-2 years) Long term (3-5 years)
		Training and Capacity Building	Community level Awareness Programs	On-ground Implementation	Convergence and Linkages			
				• Community nurseries for group of 5-10 farmers will be helpful which will require lesser per head costs for needed implements (like Poly-house, efficient irrigation etc.) • Solar energy driven irrigation system for frequent and small quantity irrigation for nursery raising. • Conservation of traditional (resilient) Paddy varieties and developing seed banks of resilient paddy varieties.				

Climate Change Variability	Impact of Climate Change on Agriculture/Allied Sector	Actions				Level of Implementation (District/ Block/Gram Panchayat)	Responsible Stakeholders	Time frame Short term (0-6 months) Medium term (1-2 years) Long term (3-5 years)
		Training and Capacity Building	Community level Awareness Programs	On-ground Implementation	Convergence and Linkages			
	Adverse impact on livestock: Heat stress significantly impacts livestock in Virudhunagar district due to its hot and semi-arid climate. Rising temperatures reduce feed intake, milk production, and overall growth rates in cattle, goats, and poultry. Heat stress also weakens immune responses, increasing susceptibility to diseases. Water scarcity further exacerbates dehydration and heat-related illnesses.	• Training of communities on best practices in livestock nutrition, breeding, and health management specifically adapted to heat stress/ changing climate conditions • Training on climate-resilient fodder crops, cultivation of Azolla, Agatti leaves, green fodder and water conservation techniques	• Raising community awareness on regular and timely immunization in animals • Orientation of communities on constructing heat-resistance animal sheds (jute-roofs) using coconut tree/palm tree leaves • Communities need to be made aware on harvesting crops using traditional methods (and avoid dry ploughing) atleast in some area of their land which can give fodder for animals	• Timely vaccination/ Immunization in animals and poultry • Local Para-vets to be trained and deployed at village level • Promotion of drought-resilient fodder crops such as Sorghum, etc. • Large scale promotion of Azolla cultivation • De-siltation of waterbodies to enhance its water holding capacity • Promotion of farm ponds to increase ground water table and also provide water for animals • Construction of heat-resistant animal sheds under NREGA/SHG Subsidy	Departments of Animal Husbandry and Agriculture along with PRIs (Gram Panchayat) need to align their interventions towards resilient livestock management that includes timely immunization in animals, promotion of drought-resilient fodder crops, promotion of green fodder like Azolla, etc.	Gram Panchayat level Block level	Animal Husbandry Dept; Agriculture Dept; PRIs; NGOs; MGNREGA; Community; Self Help Groups;	Medium term (1-2 years)

Climate Change Variability	Impact of Climate Change on Agriculture/Allied Sector	Actions				Level of Implementation (District/ Block/Gram Panchayat)	Responsible Stakeholders	Time frame Short term (0-6 months) Medium term (1-2 years) Long term (3-5 years)
		Training and Capacity Building	Community level Awareness Programs	On-ground Implementation	Convergence and Linkages			
	Increasing labour cost in agriculture due to high heat stress: High heat stress significantly reduces the work efficiency of farm laborers, compelling farmers to compensate with additional labor and extended work hours. This inefficiency not only slows down production but also increases the overall input costs, as more resources must be allocated to maintain productivity levels.	• Training of farmers and farm labourers on protection during heat stress and heat wave preparedness–measures to stay safe, etc.	• Community level awareness/ orientation programmes on heat wave safety	• Adjust work hours to early mornings or late afternoons when temperatures are lower, reducing heat exposure. • Tree plantation to provide shaded areas in fields to help farm workers to minimize fatigue • Access to safe drinking water to communities • Promotion of drip irrigation in agricultural farms that can help in reducing efforts to work in the fields • Promotion of farm ponds for fulfilling water demands during harvesting		Gram Panchayat level	Agriculture Dept; KVK; Gram Panchayat; MGNREGA; Community	Medium term (1-2 years)

Climate Change Variability	Impact of Climate Change on Agriculture/Allied Sector	Actions				Level of Implementation (District/ Block/Gram Panchayat)	Responsible Stakeholders	Time frame Short term (0-6 months) Medium term (1-2 years) Long term (3-5 years)
		Training and Capacity Building	Community level Awareness Programs	On-ground Implementation	Convergence and Linkages			
	Reduced and erratic rainfall causing increased soil degradation - impacting fertility of soil: The decreasing organic content in soil and its water retention capacity makes the soil sensitive for degradation	• Capacity building of the farmers/ villagers at Gram Panchayat level on the following issues- ➢ Choose the right tree at right place. ➢ Capacity Building in mulching and efficient irrigation • Conserve the soil strata and its fertility • Schemes of forest and tree plantation like GIM, NVY (Nagar Van Yojana), CAMPA (Compensatory afforestation fund), VAN MITRA Scheme, "Ek Ped, Maa Ke Naam", Green Action Plan. • Training on bund plantation with the help of agencies like KAR, KVK, Distt. Horticulture Office, Agro-forestry by forest deptt.	• Transition needs from chemical-intensive methods to organic and sustainable practices. • Community orientation/ awareness on the issue of soil types, its water holding capacity and how vegetation cover can slow down erosion. • Tree plantation awareness campaign is needed, educating community about the benefit of tree plantation and how it helps in restoration of environment. • Community should be made aware of different afforestation programs offered by Central/State and forest deptt. along with Ayush for promotion of Medicinal plants • Campaign against use of plastics and rules regarding use of plastic. Children can play an important role in this regard.	• Horticulture and forest department to identify areas of tree plantation, along with the community or Gram Panchayat • Department of forest and soil conservation will also be involved in planning a joint strategy for the implementation of the program on ground for checking soil erosion • Bund Plantation: Bunds are ridges on the earth that are built in lines to control water runoff. • Bund plantation of medicinal plants can help control soil erosion and water runoff and can also produce commodities for income. Agro-forestry with neem, Arjun etc can also help in various ways • **Responsible Crushing:** Effect of dust from stone crushers unit has effected the fertility of soil. Dust changes the soil pH altering the soil chemical composition. Stone crushing must be undertaken in lawful manner, complying to environmental laws.	Converge the tree plantation program with schools. SMC/ youth along with village Panchayat and sectoral Department (Forest/ Horticulture, Gram Panchayat and soil conservation Deptt.) Convergence with schemes like Green India Mission (GIM), National Mission for green India, a centre sponsored scheme be converged with along with various State/ Central Govt. Mission for forestation Civil societies/ Residents Welfare Committees along with Pollution Control Board to undertake needed advocacy for discouraging irresponsible stone crushing	Panchayat level	• Agriculture dept • Dy. Directorate horticulture, -Forest Deptt. • Distt. Panchayat • Pollution Control Bard • School Management committee • Gram Panchayat • Forest Dept	Long term (3-5 yrs)

EDUCATION

Prolonged droughts and erratic rainfall patterns lead to acute water scarcity, forcing children—particularly girls—to spend considerable time fetching water for household needs. This additional burden reduces their time and energy for schooling, contributing to higher absenteeism and dropout rates. Additionally, many families, facing declining agricultural yields and income due to climate stress, are unable to afford educational expenses, further hampering children's academic progress.

Extreme heat waves, common in this region, pose another challenge for both students and teachers. Overheated classrooms with poor ventilation lead to discomfort, fatigue, and reduced concentration levels, directly affecting learning outcomes. Furthermore, health issues related to climate change—such as the rise in vector-borne diseases—keep students away from school for extended periods. Such interruptions not only disrupt the continuity of education but can also place financial strain on families already struggling with medical costs and lost labor opportunities.

The impact of climate variabilities as observed in climate risk assessment in Virudhunagar on Education sector was identified around which the causes and sub-causes were understood in a participatory manner during the sectoral workshop. The action points as evolved to address these causes and sub-causes were also shared by the community members on the basis of which this sectoral action plans are developed.

Education Vulnerability and its Causes and Sub-Causes

Climate change impacts	Sectoral Vulnerability	Causes	Sub-Causes
• In the last 30 years, significant decline in average annual rainfall is witnessed. • Rate of rainfall decline during pre and monsoon periods is high while in post monsoon the slope of decline is slight and close to the average/mean • The average maximum temperature during the summer season (March to June) often exceeds 35°C, with heatwaves. • During the winter months (December to February), temperatures in Virudhunagar district remains milder, with average minimum temperatures ranging between 20°C to 25°C.	**Lack of infrastructure in schools:** In Virudhunagar, inadequate school infrastructure significantly disrupts education during periods of high heat stress. Classrooms often lack proper ventilation, cooling systems, and even basic amenities like drinking water, leaving students and teachers exposed to harsh conditions. This not only compromises health and comfort but also hampers concentration and learning, frequently forcing adjustments in class schedules or temporary closures, ultimately affecting academic performance and attendance.	• **Lack of drinking water infrastructure in schools:** Without reliable access to clean drinking water, students are at risk of dehydration, especially during high heat periods, which adversely affects their learning and overall well-being.	• **Lack of maintenance:** Poor upkeep of water infrastructure in schools • **Limited financial resources:** Schools suffer from lack of budgetary provisions for maintaining school infrastructure like drinking water facilities, etc.
		• **Absence of toilets or non-functional toilets:** Absence of toilets or functional toilets is a major problem in the schools. Toilets with damaged roofs, no door and water problems is creating discomfort in students, and also leading to absenteeism, especially for girls. Absence of toilets/functional toilets also lead to open defecation, especially boys.	• **Lack of maintenance of toilet infrastructure:** The repairs in the toilets are not carried out from time to time, hence maintenance is a problem. • **Limited financial resources:** Schools suffer from lack of budgetary provisions for maintaining school infrastructure like toilet facilities, etc.
		• **Schools in low lying areas:** Schools near the roads have gradually fallen into low lying areas due to raised construction of roads. In events of erratic rainfall, school compound gets waterlogged hampering attendance of children.	• **Lack of cleaning of drains:** The drain channels are not des-silted to avoid clogging and waterlogging.
		• **Lack of protective/dilapidated school boundary wall:** Lack of protective boundary wall in the schools leads to anti-social elements and animals entering inside the school campus	• **Limited financial resources:** Schools suffer from lack of budgetary provisions for maintaining school infrastructure like boundary wall, etc.
		• **Lack of fans and electric supply in schools:** Schools are struggling with the absence of fans and unreliable electricity. Without proper ventilation, classrooms become unbearably hot, especially in high heat.	• **Budget Constraints:** Limited financial resources often force schools to prioritize basic needs over infrastructure upgrades, leading to insufficient investment in cooling systems and electrical installations. • **Ageing infrastructure:** Deterioration of electrical wiring, technical problems in electrical fans etc.
		• **Lack of Incinerators:** The lack of incinerators creates challenges for proper sanitary waste management, discouraging girls to attend schools during their menstruation cycle.	• **Limited budgets:** Insufficient funding and low priority to waste management infrastructure • **Lack of awareness:** Lack of awareness about the importance of proper sanitary waste management, leading to minimal investment in incinerators despite their critical role in maintaining a healthy school environment.

Climate change impacts	Sectoral Vulnerability	Causes	Sub-Causes
	Damage to school infrastructure especially during post-monsoon (heavy rainfall) Heavy post-monsoon rainfall damages school infrastructure, exposing vulnerabilities in aging buildings and inadequate drainage systems. Waterlogging in classrooms, roof leaks, seepage and wall erosion disrupt regular teaching activities and pose health risks to students and staff.	• **Waterlogging in school premises:** In event of erratic (heavy) rainfall, the school premises get waterlogged. Sometimes, water also enters the classroom making it difficult for regular conduct of classes.	• **Clogged drainage channels:** Due to lack of timely and regular cleaning of drains, the drainage channels get clogged, resulting in waterlogging in schools. • **Raised roads:** Due to raised construction of roads, the level of school is going down because of which the schools get waterlogged during rainy season.
		• **Damage to building/boundary wall in event of tree-fall:** During heavy winds, the trees get uprooted and fall on the school boundary wall or building – causing damages	• **Construction quality:** Use of low quality construction materials
		• **Used as shelter homes:** School buildings are sometimes used as shelter homes or storage houses during disasters and due to poor upkeep, the building is left in an improper condition after the disaster	• **Lack of shelter houses:** In the absence of shelter houses in the area, schools are used as shelter homes
		• **Lack of maintenance:** Low maintenance of school building – cracked walls, trees making spaces in walls – gets vulnerable during heavy rains	• **Lack of monitoring:** School Management Committees are not actively engaged in monitoring the school maintenance and undertaking advocacy as needed.
		• **Services impacted:** During rainy season water and sanitation (toilets) services get impacted in schools	• **Lack of preparedness:** Lack of preparedness in pre-monsoon months, like, cleaning/de-silting of drains, etc • **Lack of post monsoon repairs:** After the monsoon season, the breakages and damages are left unattended/un-repaired
	Low Attendance in Schools Due to adverse climatic conditions like high temperature in summers, inaccessibility of schools during heavy rainfalls and problems faced by communities lesser attendance is observed in schools esp during extreme weather conditions	• **High temperature in school class rooms** make the situation which is not suitable for teaching-learning during summers	• Low ceilings in classrooms. The design of school construction is such that roof of class rooms are low and hence heat is not dispersed
			• Asbestos sheets used for ceilings: cause heat absorption and no dispersal
			• Frequent electricity cuts cause the fans inoperational
			• School Management Committees are not functional and active to take-up the issues related to well-being of children

Climate change impacts	Sectoral Vulnerability	Causes	Sub-Causes
		• **Health problems like 'Madras Eye'** (Conjunctivitis) during hot and humid season and this being a contagious disease, students are not able to come to schools	• Hot and humid weather conditions
			• Lack of awareness on needed care and precautions so that the disease do not spread
			• Scientific Awareness about the problem is lacking so people go for different treatment options not effective
			• Lack of water for frequent hand washing with soap and hygiene measures to be adopted
		• **Viral Fever** during extreme heat	• Communities are not aware of precautions for viral fever and other such diseases
		• **Chicken pox occurrence, jaundice, skin diseases, diarrhea/dehydration increases** in extreme weather conditions	• First aid/health care services in schools are ineffective
		• **Heat stress in children** affecting low turnout and low learning abilities	• Required 'cool food' (food which helps in keeping the body cool) are not consumed due to changing food habits and more interest in junk and processed food. Minor millets are not preferred and consumed.
			• Cool drinking water not available in schools
			• Drinking water facilities in schools are poorly maintained.
		• **Girl students face problems of lack of water in toilets** esp during menstruation period and hence stay at home missing classes	• Water in toilets not adequately available
			• School toilets are not properly maintained and hence not operational.
		• **Long distance of schools** (esp High Schools) with roads without tree cover making it difficult for children to travel during extreme hot weather	• Inadequate Trees on the sides of roads are not able to provide shade for road dwellers

In view of the climate variability and its impact on Education sector in Virudhunagar, a comprehensive discussion and brainstorming session was held with the communities and relevant stakeholders. The goal was to understand the problems that have emerged, their underlying causes/sub-causes, and possible interventions. This exercise was carried out through Causal Loop Diagramming tool. As an example, a CLD illustrating one of the identified problems is provided here.

Sectoral Resilience Action Plan – Education

Climate Change Variability	Impact of Climate Change on Education Sector	Actions				Level of Implementation (District/ Block/Gram Panchayat)	Responsible Stakeholders	Time frame Short term (0-6 months) Medium term (1-2 years) Long term (3-5 years)
		Training and Capacity Building	Community level Awareness Programs	On-ground Implementation	Convergence and Linkages			
• In the last 30 years, significant decline in average annual rainfall is witnessed. • Rate of rainfall decline during pre and monsoon periods is high while in post monsoon the slope of decline is slight and close to the average/ mean • The average maximum temperature during the summer season (March to June) often exceeds 35°C, with heatwaves. • During the winter months (December to February), temperatures in Virdhunagar district remains milder, with average minimum temperatures ranging between 20°C to 25°C.	Lack of Infrastructure in schools: In Virudhunagar, inadequate school infrastructure significantly disrupts education during periods of high heat stress. Classrooms often lack proper ventilation, cooling systems, and even basic amenities like drinking water, leaving students and teachers exposed to harsh conditions. This not only compromises health and comfort but also hampers concentration and learning, frequently forcing adjustments in class schedules or temporary closures, ultimately affecting academic performance and attendance.	• Training of teachers and School Management Committee members on prioritizing hygiene and sanitation infrastructure to improve attendance in schools • Training of teachers and students on Rain Water Harvesting in schools	• Community and school level awareness on ill-effects of open defecation	• Construction of separate toilet infrastructure for boys and girls in schools • Establishment of safe drinking water infrastructure in schools • Repair and maintenance of existing drinking water and toilet infrastructure • Cleaning of drains before monsoon to avoid waterlogging • Promoting green cover with extensive plantation in schools • Repairing of electrical infrastructure • Installation of incinerators in schools for proper disposal of sanitary waste	Block Panchayat, Education Department and Gram Panchayats need to work together towards ensuring proper grey and green (plantation) infrastructure in schools	Block and Gram Panchayat Levels	Education Department PRI Block Panchayat PWD School Management Committee MGNREGA Swachch Bharat Mission (G) NGOs	Medium term (1-2 years)

Climate Change Variability	Impact of Climate Change on Education Sector	Actions				Level of Implementation (District/ Block/Gram Panchayat)	Responsible Stakeholders	Time frame Short term (0-6 months) Medium term (1-2 years) Long term (3-5 years)
		Training and Capacity Building	Community level Awareness Programs	On-ground Implementation	Convergence and Linkages			
	Damage to school infrastructure especially during post-monsoon (heavy rainfall) Heavy post-monsoon rainfall damages school infrastructure, exposing vulnerabilities in aging buildings and inadequate drainage systems. Waterlogging in classrooms, roof leaks, seepage and wall erosion disrupt regular teaching activities and pose health risks to students and staff.	• Capacity building of School Management Committee members on their roles and responsibilities to monitor school maintenance related actions		• Developing efficient drainage system • Assessment of school locations to ensure that schools are not in low lying areas • Pre-monsoon preparedness activities related to cleaning/ de-silting drains etc need to be done • Ensure time to time maintenance of school building and services to avoid any mis-happenings • Post disaster damage assessment and needed repairs to be done • Need-based construction of shelter homes to be taken up • School Management Committees need to be activated • Raised road construction to take into cognizance that the surrounding areas should not get waterlogged	Convergence needed between PWD, TWAD, Education Departments and PRIs to implement on-ground activities as suggested, is needed.	Block Level Gram Panchayat Level	Education Department PRI Block Panchayat PWD Rural Development TWAD DDMA Teachers School Management Committee Forest Dept NGOs	Medium term (1-2 years)

Climate Change Variability	Impact of Climate Change on Education Sector	Actions				Level of Implementation (District/ Block/Gram Panchayat)	Responsible Stakeholders	Time frame Short term (0-6 months) Medium term (1-2 years) Long term (3-5 years)
		Training and Capacity Building	Community level Awareness Programs	On-ground Implementation	Convergence and Linkages			
	Low Attendance in Schools Due to adverse climatic conditions like high temperature in summers, inaccessibility of schools during heavy rainfalls and problems faced by communities lesser attendance is observed in schools esp during extreme weather conditions	• Training on Re-Use of waste water and kitchen gardens in schools demonstrating produce which are helpful in extreme summers • 'Resilience Corners' to be developed in schools for explaining causes and impacts of climate change, extreme weather situations, do's and don'ts during extreme weather events, precautions for saving from extreme events, food items which are helpful during heat stress etc. Needed IEC materials to be developed and disseminated.	• Awareness on causes and precautions of problems like 'Madras Eye', Viral fever, skin diseases, jaundice etc • Scientific awareness on 'cool foods (millets, greens etc)' which can keep the body cool	• Ceiling of class rooms to be higher in future school constructions • Adequate ventilation in class rooms to be ensured. • Asbestos roofing to be avoided and replaced with other methods • White paint on school roofs for refraction of sun light and making the class rooms cooler • Toilets to be properly maintained, esp for the girls • Cool water supply to be ensured in schools • Water supply system in schools to be repaired and maintained • 'Cool Food' to be provided in Mid-day meals • School times to be changed during extreme heat months	• Solar arrangements to be ensured for un-interrupted supply for fans during summer/ monsoon months • Rainwater harvesting and water storage mechanisms to be ensured in schools so that water availability during water scarce period is available • Road side plantation of trees with good canopy cover to be ensured esp. the village roads leading to schools • Popularizing minor millets by agriculture dept • School Management Committees to be made functional and active for taking up measures which can help in dealing with extreme weather events (esp heat stress)		Education Dept School Management Committees Gram Panchayat TN Electricity Board TWAD Dept of Education/ BEO Forest Dept	Short to Medium term

HEALTH

Virudhunagar faces significant health challenges due to the increasing impacts of climate change. Rising temperatures and erratic rainfall patterns have intensified water scarcity, leading to poor sanitation and hygiene in many communities. As a result, waterborne diseases such as diarrhea, typhoid, and cholera are on the rise, straining local healthcare facilities and disproportionately affecting children, the elderly, and economically vulnerable groups.

Additionally, altered climate conditions have contributed to the proliferation of vectors like mosquitoes, increasing the incidence of dengue, malaria, and chikungunya. Frequent outbreaks of these diseases place further pressure on already limited healthcare infrastructure, creating a cycle of recurring public health crises. Extreme heat events also pose a serious threat, with cases of heat exhaustion and heatstroke becoming more common during peak summer months.

The district's agricultural sector, which underpins local diets and incomes, has also been adversely affected by climate variability. Decreased crop yields and higher food prices reduce access to nutritious foods, resulting in anaemia in women and adolescent girls and lack of nutrition and weakened immune systems, particularly among women and children. These nutritional challenges, compounded by the stress of declining livelihoods, can contribute to mental health issues that remain largely under-addressed.

The impact of climate variabilities as observed in climate risk assessment in Virudhunagar on Health sector was identified around which the causes and sub-causes were understood in a participatory manner during the sectoral workshop. The action points as evolved to address these causes and sub-causes were also shared by the community members on the basis of which this sectoral action plans are developed.

Health Vulnerability and its Causes and Sub-Causes

Climate change impacts	Sectoral Vulnerability	Causes	Sub-Causes
In the last 30 years, significant decline in average annual rainfall is witnessed. Rate of rainfall decline during pre and monsoon periods is high while in post monsoon the slope of decline is slight and close to the average/ mean The average maximum temperature during the summer season (March to June) often exceeds 35°C, with heatwaves. During the winter months (December to February), temperatures in Virudhunagar district remains milder, with average minimum temperatures ranging between 20°C to 25°C.	**Lack of Nutrition: Stunted growth in children** Health parameters of children and women in the district are low compared to state averages. The percentage of anemic women (15-49 years age group) is almost 57 per cent. Further the percentage of stunted children under 5 is almost 29 per cent (state - 25) and underweight children in this age group is 23.7 percent (state- 22). In such situations impact of climate change in form of farm production, food diversity, vector and water borne diseases, adverse impact on live stocks etc. can make the women and_children further vulnerable	**Reducing food diversity and nutritive elements** The farm produce has lesser diversity and less nutritive compared to earlier times which was based on organic farming and biodiversity	Due to erratic rain fall farmers are shifting towards short duration crops dependent on chemical fertilizers and pesticides. Such crops are practiced as mono-crops. Hence farm production is losing diversity and moving towards less nutritious food
		Lack of iron content in food consumed by women and children.	Changing food habits shifting towards fast and junk food from millets and diverse local production The rainfall vulnerabilities and increasing pest infestations vegetable production is now mainly dependent on chemicals. Also, consumption of vegetables have gone down Processed food is consumed more. The earlier foods like sprouts, pulses, greens have gone down due to reducing farm diversity

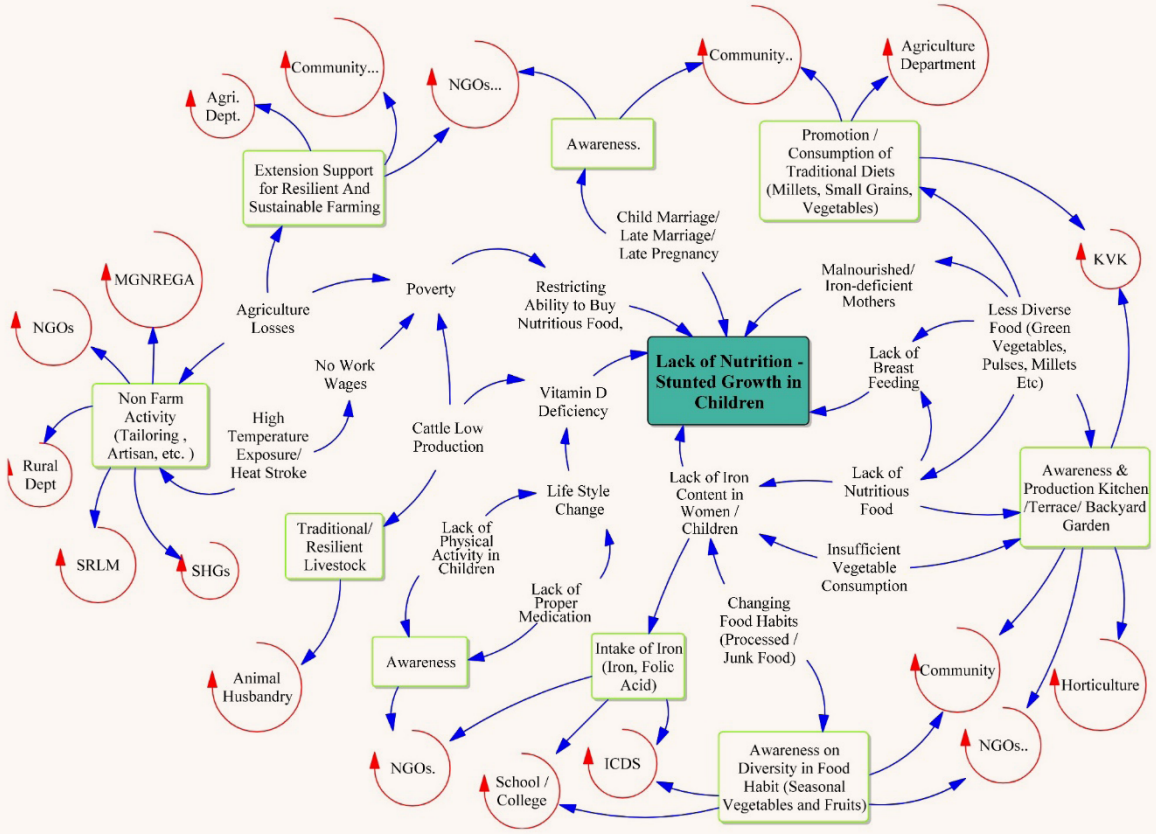
Climate change impacts	Sectoral Vulnerability	Causes	Sub-Causes
		Malnourished mothers and lesser breast feeding impacting balanced nutrition in children from early stage.	Less diverse food (green vegetables, pulses, millets etc) due to change in food practice linked to farm production based on rainfed agriculture Reduced number of livestock (cows, goats, poultry) at household level causing lesser household level livestock produce and easy availability. This is also linked to water stress and changing temperature trends
		Poverty - restricting ability to buy nutritious food, vegetables and fruits in absence of availability of home grown nutritious food due to changing farming practices and water stress	Loss of agriculture production and quality of produce due to climate variability causing lesser income to small-marginal farmers and hence ability to overcome poverty levels Loss of daily wages because to laborers due to high temperature exposure and heat stroke while working in open
		Vitamin D deficiency becoming quite common. Sunlight is available in plenty but the malnutrition and lack of food diversity cause increasing Vit D deficiency	Lesser diversity in food, lesser availability of fruits, lesser availability of livestock produce adversely impacts appropriate nutrition
		Genetic/Hereditary Stunting is also caused due to genetic reasons without any climate change links	
		Child Marriage/late marriage/late pregnancy Child marriage is still prevalent in villages. Further, due to social ambitions the marriages are delayed causing late pregnancy. In such situation, the nutrition at the fetus and child birth stage is low.	Besides social issues and changing trends, poverty is also linked to early/delayed marriages. Climate variability is directly connected to income and poverty. The gap between two child also get reduced in such cases.
	Increase in sudden illness during summers and post-monsoon months (esp. in Children and Elderly) The extreme heat and increasing number of hot days as well as variability of weather during post monsoon months sudden illness is being reported in children and elderly population	**Conjunctivitis (Madras Eye) spreads amongst children** and large number of children get affected during specific seasons	The disease is contagious and needs special care communities ignore because of lack of awareness Poor hygienic situation at households and community levels Lack of awareness on preventive measures during high temperature and humidity (like touching the eyes with unclean hands, lack of washing with clean water etc)

Climate change impacts	Sectoral Vulnerability	Causes	Sub-Causes
		Chest disease/respiratory disease /pneumonia due to sudden change (cold) in temperature	Lack of awareness of preventive measures in specific seasons Lack of awareness on air born spread of the causal organisms
		Higher temperature cause skin diseases (carbuncle, blisters, HFMD)	Lack of personal hygiene Lack of awareness on preventive measures and no awareness drive in this regard in specific season
		Increasing number of jaundice cases in summer season	Water borne - viral spread Lack of potable water supply
		Chickenpox/measles in extreme summers	Lack of required immunization and related awareness/ motivation Lack of ventilation in homes due to small spaces in house/ housing designs
		Water borne diseases like worm infestations/acute diarrhea during summers and sudden seasonal changes	Contaminated drinking water/non-availability of safe drinking water Buying of safe water is expensive and hence people go for unsafe locally available drinking water in specific villages Lack of awareness on preventive measures
	Anaemia in women and adolescent girls (owing to lack of nutrition attributed to low levels of farm production): In Virudhunagar, a significant number of women and adolescent girls suffer from anaemia due to nutritional deficiencies largely stemming from low levels of local farm production due to climate stress. The limited cultivation of nutrient-rich crops means that diets in the region often lack essential iron and vitamins, adversely affecting health, growth, and overall productivity.	**Low farm production:** Climate stress—characterized by rising temperatures and erratic rainfall—results in low farm production, significantly reducing the availability of nutrient-rich, locally grown foods. This impacts the nutritional intake of the community, particularly women, who are more susceptible to iron deficiency. As a result, many women and young girls face an increased risk of anaemia	**Social norms**: In order to ensure ample food for everyone in the family, women tend to eat at last, which contributes to anemia by limiting access and quantity of nutritious food.

Climate change impacts	Sectoral Vulnerability	Causes	Sub-Causes
		High intake of Carbohydrates: Women in the communities mainly consume rice (3 times in a day)	**Free ration:** Government provides free ration in the form of rice (carbohydrates) for consumption. Communities are reluctant to spend money on buying vegetables and other sources of proteins and vitamins
		Lack of kitchen garden practices: Communities are not much aware of kitchen garden practices in which they can grow green vegetables for home consumption	**High dependency on free ration:** Communities are highly dependent on free ration that the government provides which mainly comprises of rice (Carbohydrates). Sources of protein and other vitamins are missing from dietary habits of communities
		Excessive use of chemical inputs in vegetable crops: In vegetable crops, excessive use of chemical fertilizers and pesticides is being practiced	**Increases pests and diseases:** Due to climate stress and increased incidences of pests and diseases in vegetable crops, the use of chemical pesticides has also increased
		Lack of awareness: Women are not aware of causes and impacts of anaemia.	**Blood check-ups:** Lack of regular blood tests and check-ups
		No regular intake of IFA Tablets: Under the NHM and Anaemia Mukt Bharat Campaigns, IFA tablets are provided on a weekly basis to women and girls. But they do not consume it.	**Behavioural issue:** Myths prevailing around ill-effects of IFA tablets restrict women to consume it
	Increase in vector-borne diseases: Climate change is contributing to an increase in vector-borne diseases in Virudhunagar. Rising temperatures and altered rainfall patterns create favorable conditions for the proliferation of disease-carrying vectors such as mosquitoes. This environmental shift has led to a noticeable rise in cases of illnesses like dengue, malaria, and chikungunya in the region. The expansion of vector habitats, coupled with stagnant water accumulation and solid waste dumping, is exacerbating public health challenges.	**Stagnant water:** Stagnated water in small potholes, tyres, plastics, etc during rainy season	**Lack of maintenance** and cleanliness of surrounding areas

Climate change impacts	Sectoral Vulnerability	Causes	Sub-Causes
		Unclean cattle breeding practices: Cattles living in unclean environment attracts mosquitoes and other vectors	**Water scarcity –** for daily cleaning of animals and its surrounding areas/cattle sheds, etc.
		Open defecation: Open defecation practice leads to the contamination of soil and water sources, creating ideal breeding grounds for mosquitoes and other disease-carrying insects. Stagnant water and unhygienic conditions resulting from open defecation not only facilitate the proliferation of these vectors but also heighten the risk of diseases such as dengue, malaria, etc.	**Lack of toilets:** Some households do not have toilets and hence defecate outside **Lack of toilet usage:** Some households, even though they have toilets, prefer to go out for defecation, due to lack of water availability.
		Open drains: Uncovered drains also help in spread of vectors	**Inadequate infrastructure development:** Underdeveloped sanitation infrastructure result in insufficient drainage systems.
		Clogged drains: Clogged drains become breeding grounds for mosquitoes with all kinds of dirt and stagnated water in it	**Lack of regular cleaning of drains –** drains are not de-silted, esp. during pre-monsoon season.
		Unwanted weeds: The surrounding areas in village has lots of unwanted wild weeds/vegetation which also supports in mosquito breeding	**Lack of maintenance** and cleanliness of surrounding areas, esp. in pre-monsoon season.

In view of the climate variability and its impact on Health sector in Virudhunagar, a comprehensive discussion and brainstorming session was held with the communities and relevant stakeholders. The goal was to understand the problems that have emerged, their underlying causes/sub-causes, and possible interventions. This exercise was carried out through Causal Loop Diagramming tool. As an example, a CLD illustrating one of the identified problems is provided here.




Mission Samriddhi
காரியாமேடு ஒன்றியத்தில் பருவகால நிலை மாற்றத்தினால்
ஏற்படும் பிரச்சனைகள் மற்றும் அதற்கான தீர்வுகள்
சுகாதாரம்

Sectoral Resilience Action Plan – Health

Climate Change Variability	Impact of Climate Change on Health Sector	Actions				Level of Implementation (District/ Block/Gram Panchayat)	Responsible Stakeholders	Time frame Short term (0-6 months) Medium term (1-2 years) Long term (3-5 years)
		Training and Capacity Building	Community level Awareness Programs	On-ground Implementation	Convergence and Linkages			
• In the last 30 years, significant decline in average annual rainfall is witnessed. • Rate of rainfall decline during pre and monsoon periods is high while in post monsoon the slope of decline is slight and close to the average/mean • The average maximum temperature during the summer season (March to June) often exceeds 35°C, with heatwaves. • During the winter months (December to February), temperatures in Virdhunagar district remains milder, with average minimum temperatures ranging between 20°C to 25°C.	**Lack of Nutrition:** Stunted growth in children Health parameters of children and women in the district are low compared to state averages. The percentage of anemic women (15-49 years age group) is almost 57 per cent. Further the percentage of stunted children under 5 is almost 29 per cent (state - 25) and underweight children in this age group is 23.7 percent (state-22). In such situations impact of climate change in form of farm production, food diversity, vector and water borne diseases, adverse impact on live stocks etc. can make the women and children further vulnerable	• Scientific methods of kitchen gardening, terrace gardening on small land and use of waste water • Resilient and sustainable farming and needed extension support at village level	• Awareness on Need for diversity in food habit (vegetables, livestock and poultry produce), according to local availability • Production and consumption of seasonal vegetables and fruits to be promoted • Harmful effects of consumption of junk and processed food • Promoting traditional diets (small grains, natural vegetables, minimally processed foods)	• Resilient and bio-intensive farming helping in reduction of use of chemical fertilizers and pesticides • Resilient farming (resilient varieties, integrated and diverse farming) able to sustain water scarcity and heat • Production and consumption of small millets • Kitchen garden, Terrace and backyard farming to be adopted using domestic waste water and local compost	• Intake of Iron (Iron, folic acid) to be ensured at school/college level. Weekly intake to be ensured by health/ education department • MNREGA to be used for environmental friendly activities in the villages thereby also providing wages to marginalized communities. Timings of MGNREGA related work to be planned which can save exposure of severe heat • Increase in Livestock activities introducing resilient varieties (Cows, goats, poultry) Enforcing food safety standards for pesticides, packaged milk and processed food. • Non-farm income generation avenues to be promoted and needed skills to be provided so for additional income (to meet the challenges due to agriculture production losses)	Block and Gram Panchayat levels	• Health Dept • Agriculture Dept • Horticulture Dept • Animal Husbandry Dept • KVK • Education Dept • NGOs • PRI • SRLM, SHGs • Rural Development Dept	Medium to Long term

Climate Change Variability	Impact of Climate Change on Health Sector	Actions				Level of Implementation (District/ Block/Gram Panchayat)	Responsible Stakeholders	Time frame Short term (0-6 months) Medium term (1-2 years) Long term (3-5 years)
		Training and Capacity Building	Community level Awareness Programs	On-ground Implementation	Convergence and Linkages			
	Increase in sudden illness during summers and post-monsoon months (esp. in Children and Elderly) The extreme heat and increasing number of hot days as well as variability of weather during post monsoon months sudden illness is being reported in children and elderly population	• Training of Health Dept on CCA-DRR and needed measures • Training of PRI (esp health and WASH committees) on CCA-DRR in the local context	• Awareness/ Campaigns/ health camps in specific seasons on • preventive and care measures of conjunctivitis • air born viral spread • required personal and community hygiene for specific health problems • needed immunization of chickenpox/measles • need to have safe drinking water (esp during sensitive times of occurrence of specific health problems) • Community awareness on precaution and isolation as per the need • SBC campaign on safe drinking water	• Regular testing of drinking water (locally available and supplied) and informing the result to community if any adverse situation is noticed • Health committee of GP to be made active and be informed on the health sensitivities and needed actions	VHND to cover climate induced health problems		• Village Health Committee • ANM, ASHA • TWAD • NGO • PM AWAS • DDMA • Health Dept • GPDP/PRI	

Climate Change Variability	Impact of Climate Change on Health Sector	Actions				Level of Implementation (District/ Block/Gram Panchayat)	Responsible Stakeholders	Time frame Short term (0-6 months) Medium term (1-2 years) Long term (3-5 years)
		Training and Capacity Building	Community level Awareness Programs	On-ground Implementation	Convergence and Linkages			
	Anaemia in women and adolescent girls (owing to lack of nutrition attributed to low levels of farm production): In Virudhunagar, a significant number of women and adolescent girls suffer from anaemia due to nutritional deficiencies largely stemming from low levels of local farm production due to climate stress. The limited cultivation of nutrient-rich crops means that diets in the region often lack essential iron and vitamins, adversely affecting health, growth, and overall productivity.	• Awareness campaign in community especially focusing women and adolescent girls on Anaemia prevention and nutrition for good health. • Sensitization of women and children to break the myths around consumption of IFA Tablets • Behaviour Change Communication for women to prioritize their own health also along with the health of their family members • Sensitization of women on maintaining time gap between deliveries	• Training on kitchen garden – need, importance, design, vegetable annual calendar, etc. • Training on chemical-free farming – using more of bio-inputs • Training on maintaining diversity in food intake and a balanced diet	• Promotion of kitchen garden/ back yard garden to grow vegetables • Promotion of organic/chemical-free farming	Convergence between Health and Education department is crucial to roll out Anaemia Mukt Bharat programme including supplementation of IFA tablets trhough schools and Anganwadi Centres to women and adolescent girls	Block and Gram Panchayat levels	• Agriculture Dept • KVK • Health Dept • National Health Mission • Anaemia Mukt Bharat programme • ICDS • NGOs	Short to Medium term

Climate Change Variability	Impact of Climate Change on Health Sector	Actions				Level of Implementation (District/ Block/Gram Panchayat)	Responsible Stakeholders	Time frame Short term (0-6 months) Medium term (1-2 years) Long term (3-5 years)
		Training and Capacity Building	Community level Awareness Programs	On-ground Implementation	Convergence and Linkages			
	Increase in vector-borne diseases: Climate change is contributing to an increase in vector-borne diseases in Virudhunagar. Rising temperatures and altered rainfall patterns create favorable conditions for the proliferation of disease-carrying vectors such as mosquitoes. This environmental shift has led to a noticeable rise in cases of illnesses like dengue, malaria, and chikungunya in the region. The expansion of vector habitats, coupled with stagnant water accumulation and solid waste dumping, is exacerbating public health challenges.	• Awareness programmes on ill-effects of open defecation and promoting toilet usage • Awareness programmes on cleanliness and hygiene of surrounding areas and avoid water stagnation in the vicinity • Awareness on personal hygiene	Training on solid and liquid waste management for communities, Gram Panchayats and other related stakeholders	• Promote construction of toilets in unserved areas • Pre and post monsoon – cleaning of drains need to be taken up • Soakpit construction to be promoted to avoid spillage of wastewater in the surroundings • Trimming of wild grasses, esp in pre-monsoon and post monsoon season • Drains need to be covered to avoid spread of diseases	Gram Panchayat, Swachch Bharat Mission and Communities should work in tandem to ensure clean surroundings to avoid spread of vector borne diseases	Gram Panchayat level	• Swachch Bharat Mission • Gram Panchayat • NGOs	Short to Medium term

WATER, SANITATION AND HYGIENE (WASH)

The climate change impacts in Virudhunagar have direct and far-reaching consequences on Water, Sanitation, and Hygiene (WASH) sector. Erratic rainfall and prolonged droughts have led to acute water scarcity, forcing communities to rely on distant, unreliable and un-safe sources. This not only increases the physical burden on women and girls, who often collect water for household needs, but also raises the risk of water contamination when supplies are stored for extended periods under inadequate conditions.

With limited water availability, sanitation infrastructure suffers as well. Many households, especially in rural areas, resort to open defecation, further degrading local water sources and heightening the risk of diseases. The absence of adequate drainage and sewage systems compounds the problem, particularly during sporadic heavy rains, which can result in stagnant water, promoting the spread of waterborne and vector-borne diseases such as dengue and malaria.

Climate-induced pressures also affect hygiene practices, as erratic water supply reduces the frequency of handwashing, clothes washing and other essential hygiene behaviors. Schools and healthcare centers face similar constraints, with insufficient water and sanitation facilities impacting overall community well-being. These conditions disproportionately affect vulnerable groups—women, children, the elderly, and those with limited economic resources—who bear the brunt of poor hygiene and disease outbreaks.

The impact of climate variabilities as observed in climate risk assessment in Virudhunagar on WASH sector was identified around which the causes and sub-causes were understood in a participatory manner during the sectoral workshop. The action points as evolved to address these causes and sub-causes were also shared by the community members on the basis of which this sectoral action plans are developed.

WASH Vulnerability and its Causes and Sub-Causes

Climate change impacts	Sectoral Vulnerability	Causes	Sub-Causes
• In the last 30 years, significant decline in average annual rainfall is witnessed. • Rate of rainfall decline during pre and monsoon periods is high while in post monsoon the slope of decline is slight and close to the average/mean • The average maximum temperature during the summer season (March to June) often exceeds 35°C, with heatwaves. • During the winter months (December to February), temperatures in Virudhunagar district remains milder, with average minimum temperatures ranging between 20°C to 25°C.	Ground water depletion and lack of adequate water re-charging mechanisms: The district is water deficient and the overall rainfall is on decreasing trend. It is reported that 30 years back water for agriculture was abundant due to consistent rain fall and accessible ground water tables. Communities relied on natural water sources like wells, ponds and rivers for drinking and irrigation maintaining these sources to ensure sustainability. Ground water table is now often beyond 200 ft making it inaccessible and expensive to extract. The lack of proper infrastructure to store rainwater such as rain water harvesting systems and reservoirs cause the limited rainwater to be wasted	• **Low priority of water harvesting at household and village level:** The efforts of rain water harvesting have reduced in comparison of earlier times	• **Lacking sensitivity** Due to lacking sensitivity and growing dependency on supplied water (although on limited days/timings).

Climate change impacts	Sectoral Vulnerability	Causes	Sub-Causes
		• **Rainwater harvesting/re-charging mechanisms require investment:** Investments are needed for household level water harvesting which is now a low priority compared to other emerging needs	• **Low cost water-recharging techniques not known/available** • **Limited space in house premises** Land within house area is limited which restricts and water harvesting structure • **Increasing demand of money for better health care, living standards, education etc**
		• **Over exploitation of water in agriculture:** The changes in cropping pattern from traditional crops like millets to high yielding crops and mixed cropping to mono-cropping, the irrigation water demand has increased causing more and more water extraction from below the ground	• **Support and encouragement by Government lacking**
		• **Farm Ponds are not practiced by majority of farmers:** Farm ponds can help water recharge but it is not adopted by majority of small-marginal farmers	• **Arrangements of subsidies for farm ponds not availed**
		• **Village Ponds:** The area under waterbodies in the district is less as compared to state average. Ponds in the villages generally get dried soon after monsoon period	• **Village Ponds are not maintained properly and is negatively affected due to** » solid waste dumping » plastic dumping » waste water inflow » encroachments • **Soil structure** The soil has negligible organic content and hence porosity which can retain water. Further, the water swiftly percolates down leaving the ponds dry

Climate change impacts	Sectoral Vulnerability	Causes	Sub-Causes
		• **Natural Ecosystems: declining services:** Natural ecosystems like wetlands, open green area, water streams, afforested areas etc play a vital role in water re-charge. However, shrinking areas under such ecosystems cause declining ecosystem services and ground water re-charge.	• Prosopis julifera • An invasive species which absorbs high amount of ground water causing further water stress in the water deficient district. • **Removal of plants** is not easy as these are deep rooted and require JCB machines for complete removal • Community Forests and green areas declined • Afforested areas in the villages have declined because of land pressure which is due to increasing requirement for agriculture
		• **There is no mass movement on water recharging:** School children not aware of need for water recharging. The current school books do not cover/cover to a limited extent the content regarding water-recharging and simple methods of water harvesting/recharging	• **Lack of education and awareness:** Children and communities are not educated on these issues
	• **Frequent drought spells impact sanitation services** In Virudhunagar there have been 17 years in the last 30 years receiving lesser annual rainfall and overall the annual rainfall is on decreasing trend. With this decrease, particularly in monsoon and pre-monsoon months, drought like situations are frequently observed. This deficiency in rain fall, added by declining availability of surface water and lowering of ground water table, directly impact sanitation services	• **Water scarcity impacting personal hygiene** Limited availability of water discourages practices like periodic and proper hand washing. Also, washing of clothes is also postponed till it is very important thus repeated wearing even during hot and humid situations	• **Water not available in several bore wells** (because of deepening of water table) which were water sources earlier • **Water in waterbodies** is polluted and contaminated • **Tanker Water supply** is limited on fixed number of days and hours

Climate change impacts	Sectoral Vulnerability	Causes	Sub-Causes
		• **People (men, women and children) are going for open defecation**	• **Water availability** in toilets is a problem.
		• **Use of Contaminated raw food materials leading to health problems**	• **Limited water** use in kitchens and incomplete washing of raw food materials like vegetables etc
		• **Menstrual hygiene is affected and school children are impacted**	• **Non availability of water** make the school toilets unclean and non-operational impacting esp the girl children • Large number of children use the same toilets • Sanitary Pads are used by girls for longer duration • Washable sanitary pads are avoided
		• **Livestock impacted** Bathing of cattle becoming a problem. Health of livestock is linked to such challenges. Drinking water for cattle also becomes a problem during extreme water scarce situation	• There being no water/limited water in village ponds/waterbodies cattle cannot be washed.
	Over Exploitation of Ground Water in Water stressed Virudhunagar: Causing various vulnerabilities related to drinking water, irrigation, sanitation, hygiene, health etc. Over 55 per cent of available ground water in the district is used for irrigation purposes	• **Extensive digging for deep bore wells** With increasing water demands in agriculture and other activities, lesser rain fall and ground water recharge and lowering of ground water table cause excessive boring, often beyond 200 ft, in search of ground water	• **High yielding varieties** in agriculture demand more irrigation. The reduced soil moisture holding capacity due to excessive use of fertilizers and deep ploughing also create requirement for frequent irrigation. • **Violation of rules** restricting deep boring , there being no effective enforcement due to need of communities

Climate change impacts	Sectoral Vulnerability	Causes	Sub-Causes
		• **Vested Interests:** There is growing practice by bigger farmers to purchase land of small-marginal farmers and extraction and selling underground water	• **Selling Water gives good income:** Selling water to nearby markets, hotels etc is a profit earning business • **Farming not a profitable venture**: There being reduction in net gains in farming (higher input costs and lower returns) small land holding farmers opt for non-farm livelihoods and move to towns for wages
		• **Growing infrastructure and construction of houses:** There are large scale infrastructure based developmental activities in the district (flyovers, roads, buildings etc) under various government programmes. Further, new house construction is increasing in villages as well as towns. All such activities require heavy amount of water mainly extracted from ground water	• Required developmental activities and requirement of houses
		• **Lack of ground water management (availability-assessment), at village level:** Assessment of availability of ground water for a sustainable use plan is not practiced thereby over extraction of water without bothering on future availability	• **Skills of participatory Water budgeting is missing at gram panchayat level:** Water budgeting at village level is not practiced • Ground water management is not part of GPDP • Lack of community ownership of ground water

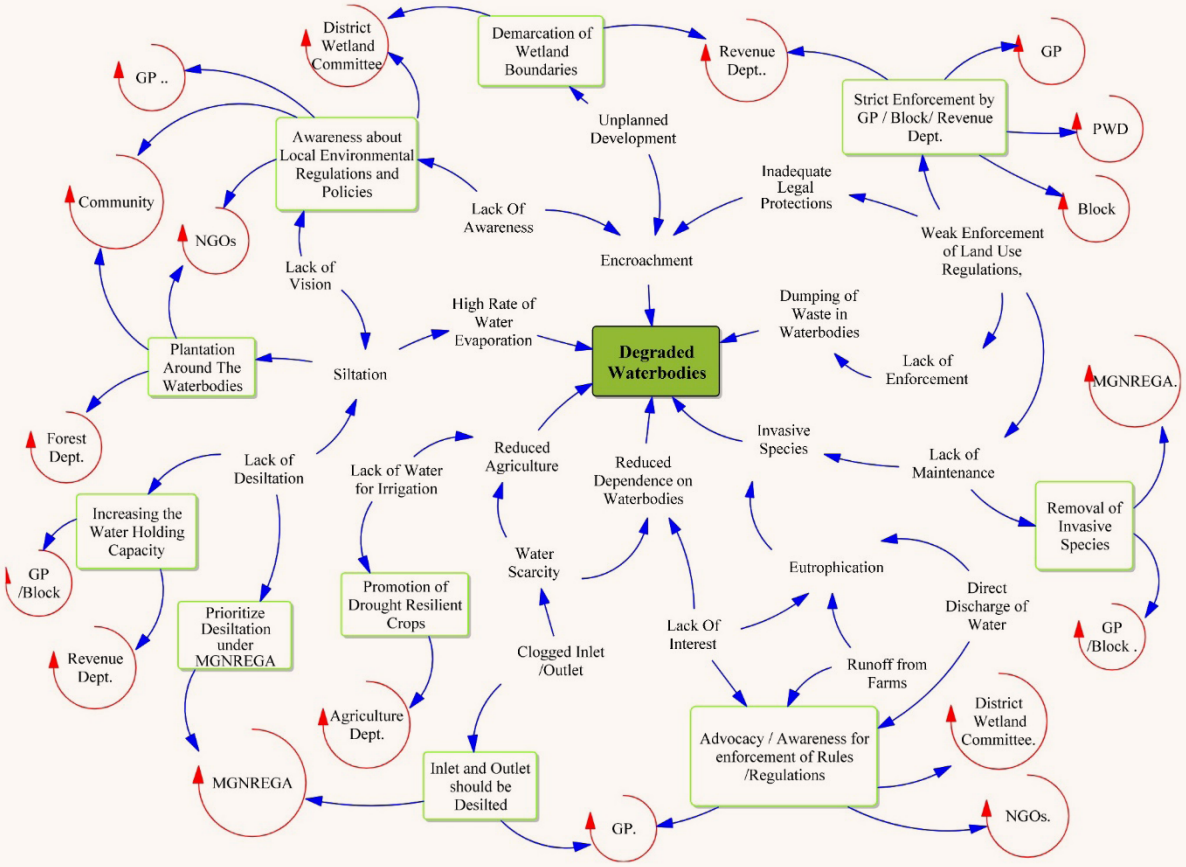
Climate change impacts	Sectoral Vulnerability	Causes	Sub-Causes
		• **Lesser avenues of ground water re-charging:** The decreasing open green spaces providing the spaces for ground water recharge and number and area of wetlands with ability to retain water for longer period and ground water recharge. • **Water streams/canals being encroached and silted.** The feeding water channels in the catchment of smaller rivers and wetlands are encroached and silted. They are no more/less functional and hence not performing functions of water collection	• Encroachment on wetlands and water channels • Waste dumping in wetlands: Pollution • Siltation in wetlands • Lack of community management of wetlands
		• **Invasive species Prosopis julifera:** which consumes heavy amount of water	• Charcoal making business using Prosopis trees • The wood is used as fuel wood
	Degraded waterbodies: Degraded waterbodies in Virudhunagar have become a pressing environmental concern. Rapid urbanization, industrial discharge, and unchecked encroachment have led to significant pollution and siltation of local ponds, lakes, and reservoirs. This degradation not only threatens the delicate ecosystems and biodiversity dependent on these water sources but also undermines the water supply crucial for agriculture and domestic use.	• **Encroachment:** Unauthorized construction and expansion into traditional water bodies obstruct natural water flow, leading to sedimentation and increased pollution. This unchecked development reduces the size and recharge capacity of these water sources impacting water availability	• **Inadequate legal protections:** Weak enforcement of land use regulations, policies on protection of wetlands and unclear property rights encourages unauthorized construction. • **Lack of awareness:** Limited understanding of the ecological value and environmental benefits of wetlands leads communities to undervalue their conservation. • **Unplanned development:** Poor planning and unregulated expansion result in encroachment, as settlements and infrastructural projects spill over into wetland areas.

Climate change impacts	Sectoral Vulnerability	Causes	Sub-Causes
		• Invasive species: • Invasive species, such as water hyacinth, significantly contribute to the degradation of waterbodies. These species clog water channels, limiting water flow and reducing oxygen levels, which harms aquatic life. They also compete with native plants and animals, disrupting the ecosystem balance. Such growth impacts water quality and biodiversity, making waterbodies less suitable for both wildlife and local communities that depend on these resources.	• **Eutrophication:** Runoff from farms and domestic areas increases nutrient levels in the wetlands, which favors fast-growing invasive plants, etc. • **Lack of maintenance:** Lack of regular cleaning and removal of invasive species
		• **Dumping of waste in waterbodies:** Waterbodies usually have become dumping grounds in which the village waste is dumped, clogging the inlet and outlet channels, leading to its degradation.	• **Lack of awareness:** Limited understanding of the natural ecosystems and its services along with its environmental benefits leads communities to undervalue their conservation. • **Lack of enforcement:** Weak enforcement of rules and absence of any punishment/fines for waste dumping in waterbodies
		• **High rate of water evaporation:** Intense sunlight and high temperatures accelerate the loss of water from waterbodies, reducing the overall water availability. This rapid evaporation not only diminishes water levels but also hampers the natural recharge of groundwater, thereby intensifying water scarcity	• **Siltation:** Siltation and waste accumulated in the waterbodies has reduced its water holding capacity. In events of extreme heat, the less amount of water present in the waterbodies get evaporated

Climate change impacts	Sectoral Vulnerability	Causes	Sub-Causes
		• Reduced dependence on waterbodies: • The dependence of communities on waterbodies has reduced which does not give them a sense of ownership to protect these waterbodies	• **Lack of interest:** Communities, especially youth, do not see any benefit from the waterbodies and so its left un-maintained. • **Water scarcity:** Due to scarce water in the waterbodies, it is not used for irrigation or other purposes due to which community does not see any value of these waterbodies
	Water shortage for drinking and hygiene (due to less rainfall and dry spells): Water shortage is affecting drinking water and hygiene related aspects of rural communities. Over-extraction of groundwater and erratic rainfall exacerbate the scarcity of safe water, disrupting daily life. This shortage makes it challenging for communities to maintain basic hygiene, which increases the likelihood of public health problems. Lack of proper sanitation further heightens the risk of waterborne diseases, impacting the community's well-being	• **Hygiene and cleanliness:** Water scarcity/limited water supply leads to constrained use of water for cleaning and hygiene, e.g. bathing, washing, toilet, etc.	• **Low groundwater table:** The GW table in Virudhunagar is already in black zone (very low) • **Excessive deep boring:** Lack of regulation on digging deep bores, leading to over extraction of groundwater
		• Bore wells go dry: • The borewells do not provide water in all seasons, rather go dry during summers.	• **Excessive deep boring:** Lack of regulation on digging deep bores, leading to over extraction of groundwater • **Lack of water recharge:** Mechanisms to recharge water or conserve water is lacking

Climate change impacts	Sectoral Vulnerability	Causes	Sub-Causes
		• **Low water recharge causing depletion of groundwater table:** • Lack of efficient water recharge mechanisms leads to depletion of groundwater table	• **Lack of water harvesting structures:** Limited awareness and willingness to implement • **Low permeability of soil:** Lack of organic content in the soil results in low permeability
		• Unsafe water: Iron and Fluoride contamination: • Presence of high iron and fluoride content in water makes it unsafe for drinking	• Geo-physical reasons for iron and fluoride contamination • Lack of information on water testing
		• Degraded waterbodies and less recharge: • Degraded waterbodies do not result in recharging groundwater	• **Encroachment:** Waterbody area encroached resulting in reducing water holding capacity • Dumping of solid waste and plastic • Feeding channels choked/not de-silted regularly • Lack of maintenance of waterbodies – it's a low priority

In view of the climate variability and its impact on WASH sector in Virudhunagar, a comprehensive discussion and brainstorming session was held with the communities and relevant stakeholders. The goal was to understand the problems that have emerged, their underlying causes/sub-causes, and possible interventions. This exercise was carried out through Causal Loop Diagramming tool. As an example, a CLD illustrating one of the identified problems is provided here.



Sectoral Resilience Action Plan – WASH

Climate Change Variability	Impact of Climate Change on WASH Sector	Actions				Level of Implementation (District/ Block/Gram Panchayat)	Responsible Stakeholders	Time frame Short term (0-6 months) Medium term (1-2 years) Long term (3-5 years)
		Training and Capacity Building	Community level Awareness Programs	On-ground Implementation	Convergence and Linkages			
• In the last 30 years, significant decline in average annual rainfall is witnessed. • Rate of rainfall decline during pre and monsoon periods is high while in post monsoon the slope of decline is slight and close to the average/mean • The average maximum temperature during the summer season (March to June) often exceeds 35°C, with heatwaves. • During the winter months (December to February), temperatures in Virdhunagar district remains milder, with average minimum temperatures ranging between 20°C to 25°C.	**Ground water depletion and lack of adequate water re-charging mechanisms:** The district is water deficient and the overall rainfall is on decreasing trend. It is reported that 30 years back water for agriculture was abundant due to consistent rain fall and accessible ground water tables. Communities relied on natural water sources like wells, ponds and rivers for drinking and irrigation maintaining these sources to ensure sustainability. Ground water table is now often beyond 200 ft making it inaccessible and expensive to extract. The lack of proper infrastructure to store rainwater such as rain water harvesting systems and reservoirs cause the limited rainwater to be wasted	• Demo models of low cost water harvesting/ recharging to be developed in villages. • Demo models to be developed in schools • IEC materials for low cost techniques of water recharging devices, in local language, to be developed • Water budgeting training to be imparted for Gram Panchayat office bearers and community leaders to assess the water availability and explaining the needs of water recharge	• Household level awareness campaigns on water harvesting/ water re-charging mechanisms towards a public movement on the issue • Awareness drive on saving village waterbodies and not dumping wastes in/near waterbodies • Public campaign for reducing/ stopping plastics	• Farm Ponds to be revived and efforts to be made for adopting farm ponds by all farmers • Subsidies for farm ponds for proven farm ponds • Annual Water budgeting to be adopted by Gram Panchayats for community monitoring for progress on available water in the village • Encroachment on village waterbodies, afforested/ green areas to be removed for revival of natural ecosystem • Restricting waste and plastic dumping in village ponds • Waste water from houses to be re-used in home gardens for growing fruits and vegetables • Discouraging plantation and use of Prosopis julifera. Strict enforcement restricting farmers to grow the species in their farms.	• Low costs techniques appropriate for small house premises to be developed by R&D institutions and popularized • Needed policies to be developed for discouraging Prosopis and identifying alternate livelihoods for those dependent on charcoal making	• District • Block • Gram Panchayat	• Agriculture Dept • Rural Development-MGNREGA • Horticulture Dept • Gram Panchayats • Block officials • KVK/TNAU • Education Dept	Medium to Long term

Climate Change Variability	Impact of Climate Change on WASH Sector	Actions				Level of Implementation (District/ Block/Gram Panchayat)	Responsible Stakeholders	Time frame Short term (0-6 months) Medium term (1-2 years) Long term (3-5 years)
		Training and Capacity Building	Community level Awareness Programs	On-ground Implementation	Convergence and Linkages			
	Frequent drought spells impact sanitation services In Virudhunagar there have been 17 years in the last 30 years receiving lesser annual rainfall and overall the annual rainfall is on decreasing trend. With this decrease, particularly in monsoon and pre-monsoon months, drought like situations are frequently observed. This deficiency in rain fall, added by declining availability of surface water and lowering of ground water table, directly impact sanitation services	Water budgeting and assessment at village level to be part of GPDP	• Awareness for efficient water storage at household level for use during stress period • Awareness on water borne diseases due to lack of sanitation practices	• Water harvesting at household level to be adopted by maximum number of households • Water storage for use of water during water stressed situation. Mechanisms to check water percolation and water loss • Rejuvenation of water bodies which have become less functional	• Technology support for water efficient systems like spray based hand washing • Water efficient toilets/eco toilets	Gram Panchayat	• Swachch Bharat Mission • PRI/Gram Panchayat • PWD • Rural Development • Health Dept	Short to Medium term

Climate Change Variability	Impact of Climate Change on WASH Sector	Actions				Level of Implementation (District/ Block/Gram Panchayat)	Responsible Stakeholders	Time frame Short term (0-6 months) Medium term (1-2 years) Long term (3-5 years)
		Training and Capacity Building	Community level Awareness Programs	On-ground Implementation	Convergence and Linkages			
	Over Exploitation of Ground Water in Water stressed Virudhunagar: Causing various vulnerabilities related to drinking water, irrigation, sanitation, hygiene, health etc. Over 55 per cent of available ground water in the district is used for irrigation purposes	Training of Gram Panchayat and WASH committees on water budgeting	• Awareness on rules/ regulations related to ground water use • Discouraging invasive species like Prosopis	• Developing water conservation committees in at GP level (GP functionaries, WASH committee, teachers etc) who can be trained on conservation skills, water recharging and water budgeting to be taken-up annually • More tree Plantation which can help in recharging • Promoting organic/ bio-intensive ecological farming helping in enhanced organic matter and soil moisture retention • Mulching to be practiced extensively • Rejuvenation of wetlands and needed supportive measures (dumping, siltation etc)	• Checking un-controlled water extraction for commercial purposes. Strict enforcement of regulations • Enforcing regulations related to over extraction of ground water, excessive deep boring • Demarcation of wetland boundaries and removal of encroachments. • Sustainable use plan of wetlands	Block, Gram Panchayat	• Ground Water Board • Revenue Dept/District Collector • Agriculture Dept • KVK • Forest Dept • SRLM	Medium to Long term

Climate Change Variability	Impact of Climate Change on WASH Sector	Actions				Level of Implementation (District/ Block/Gram Panchayat)	Responsible Stakeholders	Time frame Short term (0-6 months) Medium term (1-2 years) Long term (3-5 years)
		Training and Capacity Building	Community level Awareness Programs	On-ground Implementation	Convergence and Linkages			
	Degraded waterbodies: Degraded waterbodies in Virudhunagar have become a pressing environmental concern. Rapid urbanization, industrial discharge, and unchecked encroachment have led to significant pollution and siltation of local ponds, lakes, and reservoirs. This degradation not only threatens the delicate ecosystems and biodiversity dependent on these water sources but also undermines the water supply crucial for agriculture and domestic use	• Organize regular workshops for community leaders, local government officials, and water management committees to educate them on sustainable water resource management, conservation practices, and the importance of maintaining healthy waterbodies. • Organize trainings on design and maintenance of rainwater harvesting systems and other groundwater recharge methods.	• Organise awareness programmes to raise awareness about local environmental regulations and policies. Equip community members and local officials with knowledge on how to enforce these regulations to prevent encroachment and other harmful practices affecting waterbodies.	• Waterbodies need to be rejuvenated and their water holding capacity needs to be increased • Extensive plantation around the waterbodies need to be done • Strict enforcement of rules and policies around wetland conservation need to be urgently done • Regular de-siltation of waterbodies, especially the inlet and outlet channels need to be done	• Enforcing regulations related to protection of waterbodies • Demarcation of wetland boundaries and removal of encroach-ments	• Revenue Dept • Gram Panchayat • MGNREGA • PWD • Forest Dept • District Wetland Committee • Rural Dept • NGOs	• District Level • Block Level • Gram Panchayat Level	Short, Medium and Long Term

Climate Change Variability	Impact of Climate Change on WASH Sector	Actions				Level of Implementation (District/ Block/Gram Panchayat)	Responsible Stakeholders	Time frame Short term (0-6 months) Medium term (1-2 years) Long term (3-5 years)
		Training and Capacity Building	Community level Awareness Programs	On-ground Implementation	Convergence and Linkages			
		• Integrate water conservation topics into school curricula and community outreach programs. Training teachers and local educators on importance of natural ecosystems and its ecosystem services is crucial						
	Water shortage for drinking and hygiene (due to less rainfall and dry spells): Water shortage is affecting drinking water and hygiene related aspects of rural communities. Over-extraction of groundwater and erratic rainfall exacerbate the scarcity of safe water, disrupting daily life.	• Community awareness programmes on solid waste management at the local level to avoid waste dumping in waterbodies • Strengthening community engagement towards wise-use of	Organize sensitization workshops for local stakeholders to on water policies and regulation	• Rejuvenation of waterbodies is very important and need to be done. Regular cleaning of waterbodies also need to be ensured • All natural ecosystems to be managed and maintained well • Water filtration methods to be put in place to check iron and fluoride contamination. Local filters that are effective	• Enforcing rules and policies for wise use of waterbodies and natural ecosystems • Convergence between PRI and Jal Jeevan Mission for ensuring safe and quality drinking water to communities	• Groundwater Board • PRI • Rural Development • Water Resources Dept • Jal Jeevan Mission • Agriculture Dept • Forest Dept	Block and Gram Panchayat Levels	Medium to Long Term

Climate Change Variability	Impact of Climate Change on WASH Sector	Actions				Level of Implementation (District/ Block/Gram Panchayat)	Responsible Stakeholders	Time frame Short term (0-6 months) Medium term (1-2 years) Long term (3-5 years)
		Training and Capacity Building	Community level Awareness Programs	On-ground Implementation	Convergence and Linkages			
	This shortage makes it challenging for communities to maintain basic hygiene, which increases the likelihood of public health problems. Lack of proper sanitation further heightens the risk of waterborne diseases, impacting the community's well-being	• waterbodies and understanding its ecological value • Training and orientation on quality issues related to drinking water – including local testing methods using Field Testing Kits, etc. • Training on Water Budgeting to be imparted to local stakeholders – GP, Communities and other related stakeholders		• may also be promoted • Water quality analysis to be done regularly • Water budgeting to be adopted by Gram Panchayats for community monitoring for progress on available water in the village • Policy regulations to be ensured for quality drinking water, avoid degradation of waterbodies, etc.		• Health Dept • TWAD • Revenue Dept • NREGA • NGOs		

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