Impact of climate anomalies on health determinants in states with co-endemicity of leprosy and other NTDs

Subhojit Goswami, Swagata Yadavar, Nikita Sarah

❑ Abstract

Title: Impact of climate anomalies on health determinants in states with co-endemicity of leprosy and other NTDs

Background: Seven states contribute more than 75% of the total leprosy cases in India every year. These states are co-endemic for Lymphatic Filariasis and Kala-azar. At least 70% of the districts across these states are vulnerable to extreme weather events, which puts at risk their nutrition security and sanitation safety—prerequisites for disease prevention and ending community transmission.

Objectives: Understanding the impact of climate anomalies on social determinants that influence health outcomes in people affected with leprosy, living in areas with co-endemicity of NTDs.

Methods: It is a mixed methods study that involved semi-structured interviews with persons affected by leprosy and their families across two states, and an analysis of the existing government data on disease prevalence, climate vulnerability and multidimensional poverty. The study also drew insights from peer-reviewed literature and media reports.

Results: Identified 30 districts with high number of at-risk populations having the triple burden of high leprosy prevalence, climate vulnerability and multidimensional poverty. Demonstrated that large concentration of tribal population, recurring droughts and floods, and poor adaptive capacity are the risk factors for leprosy and other NTDs.

Conclusion: The study points to a need for a multi-dimensional assessment of vulnerability in areas co-endemic for leprosy and other NTDs while prioritising efforts towards health systems strengthening and climate adaptation & mitigation. What emerges is the scope for implementing a holistic One Health approach towards elimination of NTDs that goes beyond only the clinical aspects of the diseases.

Key words: health determinants, disease prevention, Neglected Tropical Diseases, climate adaptation, One Health approach

Authors: Subhojit Goswami1, Swagata Yadavar2, Nikita Sarah1

Affiliations

1. The Leprosy Mission Trust India
2. Independent Consultant

India has the highest leprosy prevalence in the world, contributing about 55 per cent of the global cases reported each year. Historically, seven states—Bihar, Chhattisgarh, Jharkhand, Maharashtra, Odisha, Uttar Pradesh, and West Bengal—contribute 70-80 per cent of the cases1, as per data with the Directorate General of Health Services (DGHS) under the Union Ministry of Health and Family Welfare. (*Refer Table 1*)

A body of research suggests that nutritional deficiencies can facilitate a progression from Mycobacterium leprae infection to the clinical presentation of leprosy by impairing immune system.[2] The results of the studies conducted in South Asia and Africa bear a striking resemblance as almost all of them draw a connection between protein-energy malnutrition, inadequate intake of vitamins and/or minerals, reduced cell-mediated

immunity, and leprosy transmission.

There are other studies that attribute leprosy transmission to "lack of hygiene and proper sanitation, poor and inadequate supply of water".3 A study by The Leprosy Mission Trust India,4 published in the Indian Journal of Dermatology, Venereology, and Leprology in 2018, suggested that the contacts of active Leprosy cases "are getting constantly exposed directly to both patients and an environment (soil and water) wherein M. leprae has been shown to remain alive in all seasons for long duration." The study recommended improving the environment for health and hygiene, without which "shedding of bacilli from infected cases will prove to be a continuous source of exposure to infection". This is true for many other neglected tropical diseases (NTDs).

As an organisation focussed on leprosy and other NTDs, and being present in several climate-vulnerable states, we could hypothesize that a steady rise in both sudden and slow onset climate anomalies such as extremely heavy rain, intense cyclones, floods, and droughts has raised concerns over food security and access to clean water and sanitation—prerequisites for stopping transmission of leprosy and other NTDs.

❑ Methodology

We approached this problem statement in two different ways. We visited some of the most climate-vulnerable villages in West Bengal and Bihar. The villages were mapped based on the layered vulnerability we had experienced during our past community interventions. We met 60 members from 10 households in the Sundarbans and Muzaffarpur and had semi-structured discussions with them to understand the challenges they face in accessing livelihood and health care, and how resilient are they in the face of extreme climate events. Most of these households had one or two members either cured of leprosy or undergoing treatment for leprosy or have some form of disability.

We also delved into the observations made by government reports and multilateral organisations. Insights were drawn from research papers on the intersection of leprosy, poverty, and access to hygienic living conditions. Media reports were also referred to for understanding the widespread impact of extreme climate events on the targeted population in highly endemic districts. Available data on leprosy was also analysed to map hotspots and level of endemicity.

❑ Results

The Government of India report, *Climate Vulnerability Assessment for Adaptation Planning in India Using a Common Framework,*[5] which assessed Sensitivity ("degree to which a system or species is affected by climate variability") and Adaptive Capacity ("ability of systems, institutions, and humans to adjust to potential damage and respond to consequences"), identified states that are highly vulnerable to climate change. This study found that those are the same states with high endemicity of leprosy and other neglected tropical diseases (NTDs) such as lymphatic filariasis. Similar patterns emerged from the NITI Aayog's Multidimensional Poverty Index,[6] which measured "multiple and overlapping deprivations" in basic parameters of health, education, and living standards. The districts that perform poorly in nutrition intake and other socio-economic indicators are also co-endemic for leprosy and other NTDs. (*Refer Table 3*)

Bihar, for example, on an average, reports about 15% of new leprosy cases in India each year. It is a state whose more than half (51.9%) of its population is 'multidimensionally poor'. At district levels, this percentage shoots up further. Consider the three northern districts of Bihar: Sitamarhi, Supaul, and Kishanganj. Besides high leprosy prevalence rate—2.32 / 10,000 population as opposed to the national average of 0.57/ 10,000 population—some of these districts have a high share (up to 75%) of leprosy

multibacillary (MB) cases. Unlike paucibacillary (PB) cases, the MB patients have high bacterial load and are a major source of infection, leading to further transmission of mycobacterium leprae. The MB patients are also at greater risk of leprosy reactions and consequent nerve damage. The treatment is long-drawn and requires a more elaborate protocol for patients to follow.

It is to be noted that MB leprosy develops in patients with reduced or impaired cell-mediated immune reaction, which is caused due to protein-energy malnutrition. The three districts of the state, which have very high leprosy prevalence, also have a high percentage of people living in multidimensional poverty, ranging from 63% to 65%. This, of course, begs attention to the food security landscape in the state. About 80% (31 out of 38) of the districts in Bihar are among the top 25% most climate-vulnerable districts in the country. About 68.80 lakh hectares of the state's area (94.16 lakh hectare) is flood-prone, which covers 76% of north and 73% of south Bihar.7 Extended dry spells during summer, erratic monsoon rain, and abnormal rise and fall of temperature during planting season (Rabi crops) in winter cause high variability in yield of food grains, especially of diverse and nutritious crops, which can affect the intake of essential nutrients vital for health and immunity.

In neighbouring Uttar Pradesh, data on climate vulnerability, multidimensional poverty and leprosy prevalence demonstrate a similar cause-and-effect relationship. In 2020, Uttar Pradesh reported 15,484 new cases of leprosy, the third highest in the country. Districts with high prevalence of leprosy and other NTDs also have high multidimensional poverty. Over 74% of the population in Shravasti district and 71.8% of the population in Bahraich district are multidimensionally poor. The districts also report other neglected tropical diseases (NTDs) such as lymphatic filariasis and chikungunya.

The study analysed a report from the Council of Energy, Environment and Water (CEEW),8 which stated that 69% of districts in Uttar Pradesh are exposed to compounded climate events such as floods and droughts. Over the last two decades, the state has experienced an increase in incidence of extremely high temperatures, torrential rain, and, in certain areas, devastating floods and droughts. Hence, it is hardly any surprise that the state's agricultural productivity is predicted to decline by up to 25% in irrigated areas and up to 50% in rain-fed areas.9 Inconsistent and erratic monsoons have already affected crop yields, cropped areas, and livestock in Bundelkhand region in the last few years.

In Odisha, 26 out of 30 districts are exposed to extreme climate events such as cyclones, floods, and droughts. The state has witnessed a three-fold increase in cyclones between 1970 and 2019. Storm surges, too, have tripled during this period. In fact, climate change is causing stress even in hitherto less vulnerable parts of Odisha. Let's consider Kendrapara. It had been a fertile and prosperous region, "but climate extremes, in the form of rapid onset events, have proven that even stable ecosystems and prosperous economies can erode," said a collaborative study.10 It went on to add that social protection mechanisms are not able to absorb climate shocks or efficiently cover all eligible households.

❑ Discussion

The pattern that emerged in this study is true for other states such as Chhattisgarh, Maharashtra, and West Bengal. Be it Yavatmal district in the Vidarbha region of Maharashtra or Raigarh district of Chhattisgarh, the existence of multiple and simultaneous vulnerabilities is evident. The districts having high endemicity of leprosy and high proportion of tribal populations are shuttling between droughts and floods. This is having the greatest bearing on agriculture and allied sectors that provide income to the rural population, comprising marginal farmers and tribals who either rely on rain-fed monocrop agriculture or forest produce, making them most vulnerable to the impact of climate change.

Extreme climate events and food insecurity are major stressors for people in low-lying islands such as the Sundarbans in West Bengal that are facing a double whammy of climate hazards and chronic poverty. According to Future Health Systems—a research consortium—food insecurity level has a positive correlation with climatic vulnerability of households. "Recurrent climatic shocks and long-term climatic variability has downgraded all four dimensions of food security—availability, accessibility, utilisation and food system stability across the Indian Sundarbans," says their research.11 It also suggests that over 25% of households in the Sundarbans faced "extremely high losses to food resources during climatic emergencies in the last five years," and 30% of children (0–6 years) in climatically vulnerable households face chronic malnourishment.

❑ Conclusion

Given the impact of extreme climate events on the social determinants or the non-medical risk factors for leprosy and other NTDs, India has to adopt a two-fold approach to meet the 2027 target of interrupting leprosy transmission. The study recommends implementing a holistic One Health approach towards leprosy elimination that goes beyond only the clinical aspects of the disease and focuses on intersectoral co-ordination between departments of health, tribal affairs, agriculture, environment, etc. to plan interventions that will have co-benefits.

At the community level, the at-risk population needs awareness about disease transmission pathways and climatic factors (extreme rain, heat stress, and other extreme climate events) determining the persistence and spread of leprosy and ways to reduce the risk factors.

At the health systems level, there is a need for building institutional capacity in terms of analysing historical climate and epidemiological data, integrating climate information in health system planning, predicting disease outbreaks, and preparing the systems to serve people during climate emergencies. Similarly, the public health workforce at a sub-district level needs to be capacitated enough to interpret climate and health data and understand climate-sensitivity of diseases and changing seasonality of diseases.

At the policy level, local climate action plans, health action plans, ancillary policies, and schemes require a thorough review to ensure that they factor in emerging climate-related risks and changes in disease transmission patterns.

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States	*Total districts*	*Number (%age) of highly and very highly climate vulnerable districts*	*Percentage of population who are multidimensionally poor*	*Leprosy Cases Reported in 2019-20*
Bihar	38	38 (100%)	51.91	16595
Chhattisgarh	18	3 (16.67%)	29.91	8905
Jharkhand	24	23 (96%)	42.16	6160
Odisha	30	19 (63%)	29.35	10077
Uttar Pradesh	70	48 (69%)	37.79	15484
West Bengal	19	14 (74%)	21.43	6208
Maharashtra	35	19 (54%)	14.85	16572
Total	234	164 (70%)		80001

Table 1. Source: Central Leprosy Division, NITI Aayog MPI, and Climate Vulnerability Assessment for Adaptation Planning in India Using a Common Framework

S. NO.	State	Districts	Leprosy Prevalence Rate	%age of population multidimensionally poor	Climate Vulnerability Rank
1	Bihar	Kishanganj	2.32	64.75	8
2		Supaul	1.11	64.1	53
3		Sitamarhi	0.95	63.46	36
4	Chhattisgarh	Surguja	0.99	47.37	419
5		Bastar	1.71	46.95	NA
6		Jashpur	1.10	45.85	NA
7		Bijapur	1.54	41.2	427
8		Kabirdham	1.94	39.6	474
9		Korba	1.52	31.86	413
10		Raigarh	4.40	30.82	263
11		Mahasamund	3.34	29.85	328
12		Bilaspur	1.99	25.66	273
13	Maharashtra	Nandurbar	2.46	52.12	50
14		Dhule	1.79	33.23	101
15		Yavatmal	1.4	23.54	167
16	Odisha	Nabarangapur	1.72	59.32	74
17		Malkangiri	0.45	58.71	100
18		Koraput	0.89	51.14	55
19		Kalahandi	1.22	47.28	NA
20		Mayurbhanj	1.05	44.90	NA
21		Nuapada	3.21	38	14
22	Uttar Pradesh	Shravasti	1.24	74.38	58
23		Bahraich	0.72	71.88	30
24		Kaushambi	0.61	56.06	358
25		Lakhimpur Kheri	0.98	59.95	109
26		Sitapur	0.98	56.83	188
27	West Bengal	Purulia	1.33	49.69	31
28		Birbhum	0.9	27.6	161
29		Bankura	0.8	27.4	146
30		Jhargram	1.45	23.82	57

Table 2. Source: Central Leprosy Division, NITI Aayog MPI, and Climate Vulnerability Assessment for Adaptation Planning in India Using a Common Framework

References

1. Director General of Health Services, State-wise Report 2019-20, https://dghs.gov.in/WriteReadData/userfiles/file/Leprosy/State%20wise%20report-2019-20.pdf

2. W. Inge, M. Lisanne, et al., Diet-Related Risk Factors for Leprosy: A Case-Control Study, National Library of Medicine, May 12, 2015, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4428634/#:~:text=Nutritional%20deficiencies%20impair%20the%20immune,the%20clinical%20presentation%20of%20Leprosy.

3. L. Yu-Ye, S. Sunaula, et al., Factors Influencing Leprosy Incidence: A Comprehensive Analysis of Observations in Wenshan of China, Nepal, and Other Global Epidemic Areas, Frontiers, May 31, 2021, https://www.frontiersin.org/articles/10.3389/fpubh.2021.666307/full

4. S. Utpal, Elimination of Leprosy in India: An analysis, Indian Journal of Dermatology and Venereology and Leprology, Feb 7, 2018, https://ijdvl.com/elimination-of-Leprosy-in-india-an-analysis/#ref52

5. IIT- Mandi and IIT-Guwahati, Climate Vulnerability Assessment for Adaptation Planning in India Using a Common Framework, 2019-20, https://dst.gov.in/sites/default/files/Full%20Report%20%281%29.pdf

6. NITI Aayog, National Multidimensional Poverty Index, November, 2021, https://www.niti.gov.in/sites/default/files/2021-11/National_MPI_India-11242021.pdf

7. K. Mohammad, Early, repeated floods wreaked havoc on north Bihar farms, Down To Earth, Aug 6, 2021, https://www.downtoearth.org.in/news/natural-disasters/early-repeated-floods-wreaked-havoc-on-north-bihar-farms-78326

8. M. Abinash and W. Shreya, Mapping India's Climate Vulnerability: A district-level assessment, CEEW & India Climate Collaborative, Oct 2021, https://www.ceew.in/sites/default/files/ceew-study-on-climate-change-vulnerability-index-and-district-level-risk-assessment.pdf

9. State Action Plan on Climate Change: Uttar Pradesh, Department of Environment, Government of Uttar Pradesh, 2014 https://moef.gov.in/wp-content/uploads/2017/09/SAPCC_UP_final_version_0.pdf

10. B. Ritu, C. Devanshu, et al., Climate change, migration, and vulnerability to trafficking, International Institute for Environment and Development, May 2022, https://www.iied.org/sites/default/files/pdfs/2022-05/20936IIED.pdf

11. Climate change: a threat to child food security in the Indian Sundarbans, Future Health Systems, Issue 1, June 2018, https://opendocs.ids.ac.uk/opendocs/bitstream/handle/20.500.12413/13823/FHS_IssueBrief1_Sundarbans.pdf?sequence=15&isAllowed=y

12. Report, The Indian Express, Jan 29, 2022, https://indianexpress.com/article/cities/pune/over-65000-Leprosy-cases-recorded-in-india-in-2020-21-report-7746973/

13. Ministry of Health & Family Welfare, National Health Profile 2021, Pg 151, https://www.cbhidghs.nic.in/showfile.php?lid=1160

14. Ministry of Health & Family Welfare, National Family Health Survey – 5 2019-20 http://rchiips.org/nfhs/NFHS-5_FCTS/Maharashtra.pdf