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Sub-Theme 7: Water for People and Planet
TF20 Water and Human Health

Climate Change Impacts on Urban Water Systems: Implications on Human Health from a Global South Perspective

Authors

Apoorva Animesh Prabhugaonkar
Doctoral Research Scholar, Department of Urban and Regional Planning
School of Planning and Architecture, Bhopal

Dr. Gaurav Vaidya
Assistant Professor, Department of Urban and Regional Planning
School of Planning and Architecture, Bhopal

Why It Matters: Water Stress Meets Health Risk

Urbanisation and Climate Change are pushing water systems past their design limits

2.4 billion

Urban people facing water scarcity by 2050, up from 933 million in 2016

2.1 billion

People lack safely managed drinking water; 3.4 billion lack safely managed sanitation

1.6-1.9 million

Deaths every year linked to inadequate water, sanitation and hygiene

600 million

Indians face high to extreme water stress; demand may double supply by 2030

200,000

Indians die each year from inadequate access to safe water

> 80%

of Indian districts are highly climate-vulnerable

Source: *Assessing Risks to India's Drinking Water, Sanitation, and Hygiene Systems from Extreme Climate Events, 2024*

Research Gap and Objectives

Five disconnected research streams leave few integrated evidence base

Hydrology and engineering

Public health and epidemiology

Political ecology and governance

Vulnerability and risk indices

Climate-water-health nexus studies

Lack of studies that have synthesised hazards, infrastructure failure, vulnerability and health outcomes through one structured, replicable framework.

The problem is sharpest in the Global South, where rapid urbanisation and institutional fragmentation amplify climate risk.

1 UWS impacts

How floods, droughts, heat and extreme rain impair supply, sanitation and drainage

2 Health nexus

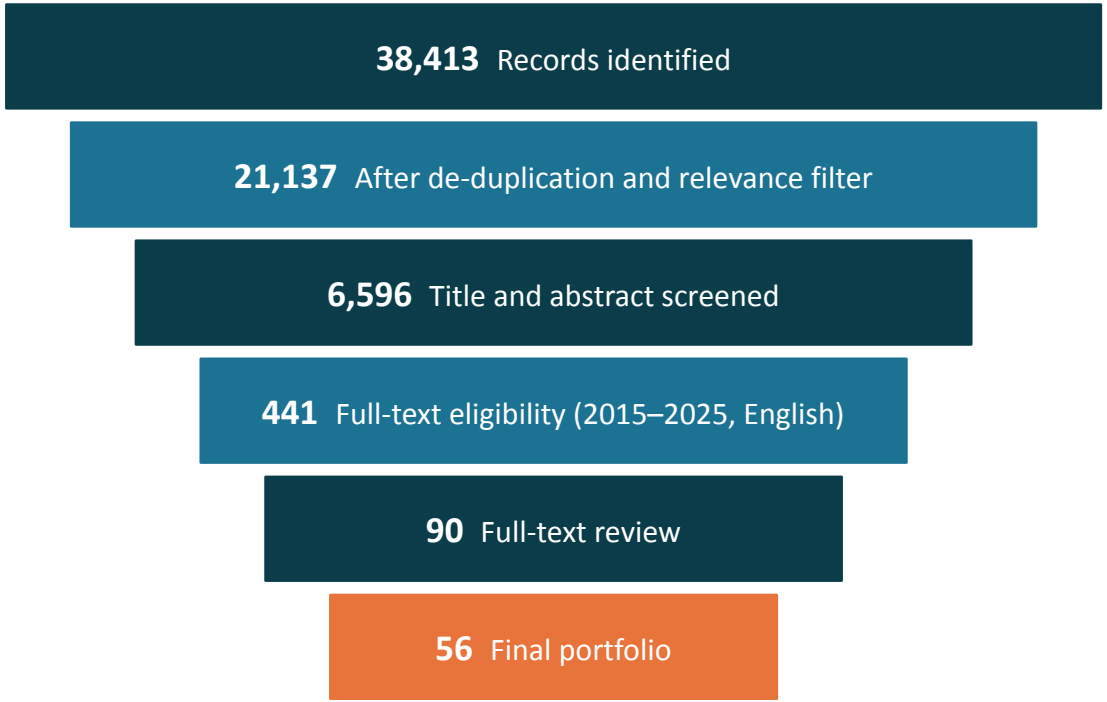
How UWS failures become physical, mental and social health outcomes

3 Vulnerability

How socio-economic, institutional and hydro-social dynamics shape health risk

Methodology: PROKNOW-C Systematic Review

From 38,413 records to a core portfolio of 56 studies



Portfolio profiled bibliometrically, then content-analysed across hazards, nexus pathways and vulnerability.

Search design

Boolean AND across three keyword blocks

Block A: climate terms

Block B: urban water system components

Block C: impact and effect terms

Block D: health, as a cross-cutting lens

Databases: Science Direct, Google Scholar, Jan-Feb 2026

Scope: peer-reviewed, 2015-2025

Analytical Framework: Three Stages

From hazard to health to who is most harmed

1 Stage 1: Hazard impacts

- Five scenarios: temperature, precipitation, extreme events, sea-level rise, wind pattern
- Three subsystems: supply, sanitation, stormwater
- Country-specific spatial and temporal variation

2 Stage 2: Health nexus

- Synthesis matrix of UWS failures and outcomes
- Four pathways: quantity, quality, sanitation, drainage
- Physical, mental and social health

3 Stage 3: Vulnerability

- Biophysical: Age, Gender, Income, Geography
- Structural: governance, institutions, hydro-social relations
- Why identical stressors cause unequal harm

Output: An evidence-based conceptual framework linking climate hazards, UWS failures and health outcomes, with explicit attention to equity (SDG 6 and SDG 13).

Stage 1: How Climate Hazards Break Each Subsystem: Water Supply

Climate change scenarios and hazards: country-specific Global South evidence

South Asia C1, C2	Hydropower and irrigation cut river flows; in heat waves demand rises as flows hit lows. Each dry season starts from a lower baseline.	**Pakistan** C1–C3	Glacier melt shifts runoff timing so reservoirs fill out of sync; floods damage intakes. Long-term melt decline, short-term flood risk.
Bangladesh C2–C4	Flood-season saline intrusion raises coastal groundwater salinity, making shallow aquifers unfit to drink; salinity spreads inland.	**Western Cape** C1, C2	Higher evapotranspiration cuts soil moisture, so reservoirs can fall even in wetter years; deficits persist for years.
Malawi C1–C3	Falling lake levels concentrate nutrients and cut oxygen; dry-season algal blooms, wet-season flood damage to boreholes.	**Sub-Saharan Africa** C1, C2	Multi-year droughts deplete groundwater beyond design; underfunded utilities cannot recover, so adaptive capacity declines.
Kenya & Uganda C2–C4	Extraction exceeds recharge in secondary cities; coastal Kenya faces salinity and higher treatment costs, inland Uganda recharge deficits.	**India** C2, C3	Pathogen contamination peaks in the dry-to-monsoon transition as first rains flush pollutants into water bodies; both seasons worsen.

Scenarios: C1 Temperature C2 Precipitation C3 Extreme events C4 Sea-level rise C5 Wind pattern

Hazards on Urban Water Systems: Sanitation and Wastewater

Climate change scenarios and hazards: On-site sanitation and treatment failure

Uganda **C1-C3**	Floods make on-site systems fail as containment barriers in low-lying informal settlements, releasing waste into shallow groundwater; heat then speeds pathogen growth. Topography and pit-to-water-table distance govern risk.
Zambia **C3**	Floodwater overtops pit latrines and slabs collapse; rising groundwater keeps hand-dug wells contaminated long after floods recede. Rebuilt pits are re-flooded, leaving less time for desludging.
Kenya **C3**	Floodwater carries faecal waste from latrines and open defecation sites into the city's main lake, turning local failures into widespread sources of cholera and diarrhoea. Biannual rain peaks recur.
Ethiopia **C1-C3**	Floods damage latrine access and infrastructure; drought then limits water for handwashing, creating a cycle of declining service. Lowlands face contamination, uplands hygiene gaps; heat sustains pathogens.
Indonesia & Fiji **C3, C4**	Sea-level rise lifts groundwater, shrinking the soil layer under pit latrines; surges and tides can inundate treatment plants. Each rise permanently cuts the buffer, with episodic plant shutdowns.

Scenarios: C1 Temperature C2 Precipitation C3 Extreme events C4 Sea-level rise C5 Wind pattern

Hazards on Urban Water Systems: Stormwater and Drainage

Climate change scenarios and hazards: drainage designed for a historical climate

New Cairo, Egypt **C3**	Drainage designed for under 25 mm annual rain has no answer to convective storms of an order of magnitude higher intensity; peri-urban growth lacks drainage and floods are more frequent.
Bogotá, Colombia **C2, C3**	Rainfall-to-flood volume is highly non-linear, so small rises in peak rainfall sharply raise flood risk in dense catchments; peripheral informal settlements are most exposed.
Lagos, Nigeria **C2-C4**	Flat terrain and shallow groundwater limit drainage; sea-level rise cuts the hydraulic gradient so floods that drained in hours last days, while urbanisation raises runoff yearly.
Singapore **C2, C3**	Threshold response: runoff is conveyed below design capacity, but any excess becomes surface flooding at low-lying convergence points. Rising intensity needs redesign, not maintenance.
South & SE Asia **C2-C5**	Heavier monsoons, storm surges and cyclones exceed single-hazard design; informal settlements without drainage see flash floods carrying faecal sludge, while engineered cities partly absorb stress.

Scenarios: C1 Temperature C2 Precipitation C3 Extreme events C4 Sea-level rise C5 Wind pattern

Stage 2: Climate-Water-Health Nexus

Four UWS failure pathways carry climate stressors to health outcomes

Climate stressors

- C1 Temperature change
- C2 Precipitation change
- C3 Extreme climate events
- C4 Sea-level rise
- C5 Wind pattern change

UWS failure pathways

- **Water quantity failure**
- **Water quality deterioration**
- **Sanitation breakdown**
- **Stormwater / drainage failure**

Health outcomes

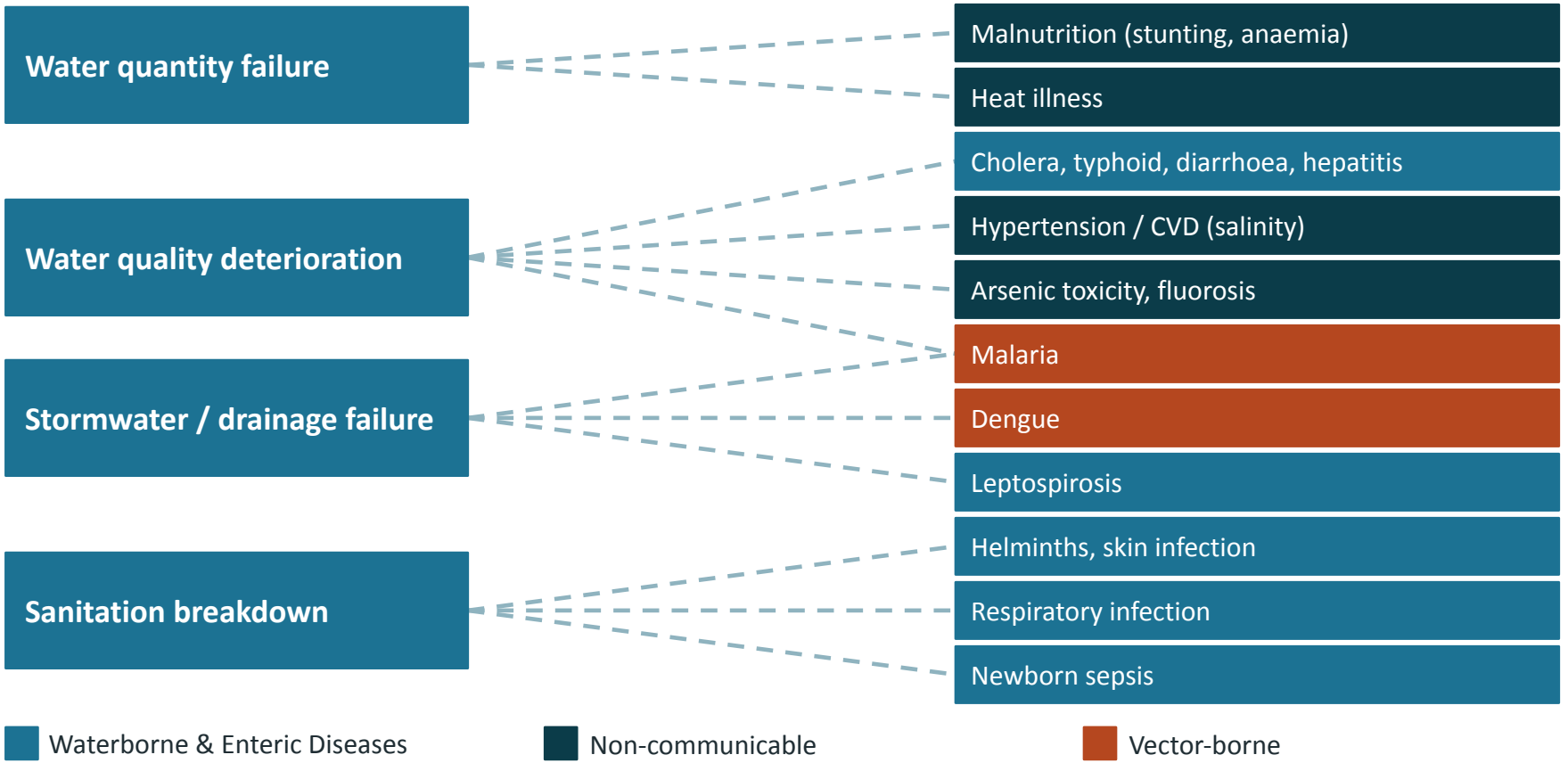
Physical: Most extensively documented: waterborne, non-communicable and vector-borne disease.

Mental: Least documented yet most significant: acute, sub-acute and chronic registers.

Social: Primary vulnerability determinants: access inequality, livelihoods, gender, community.

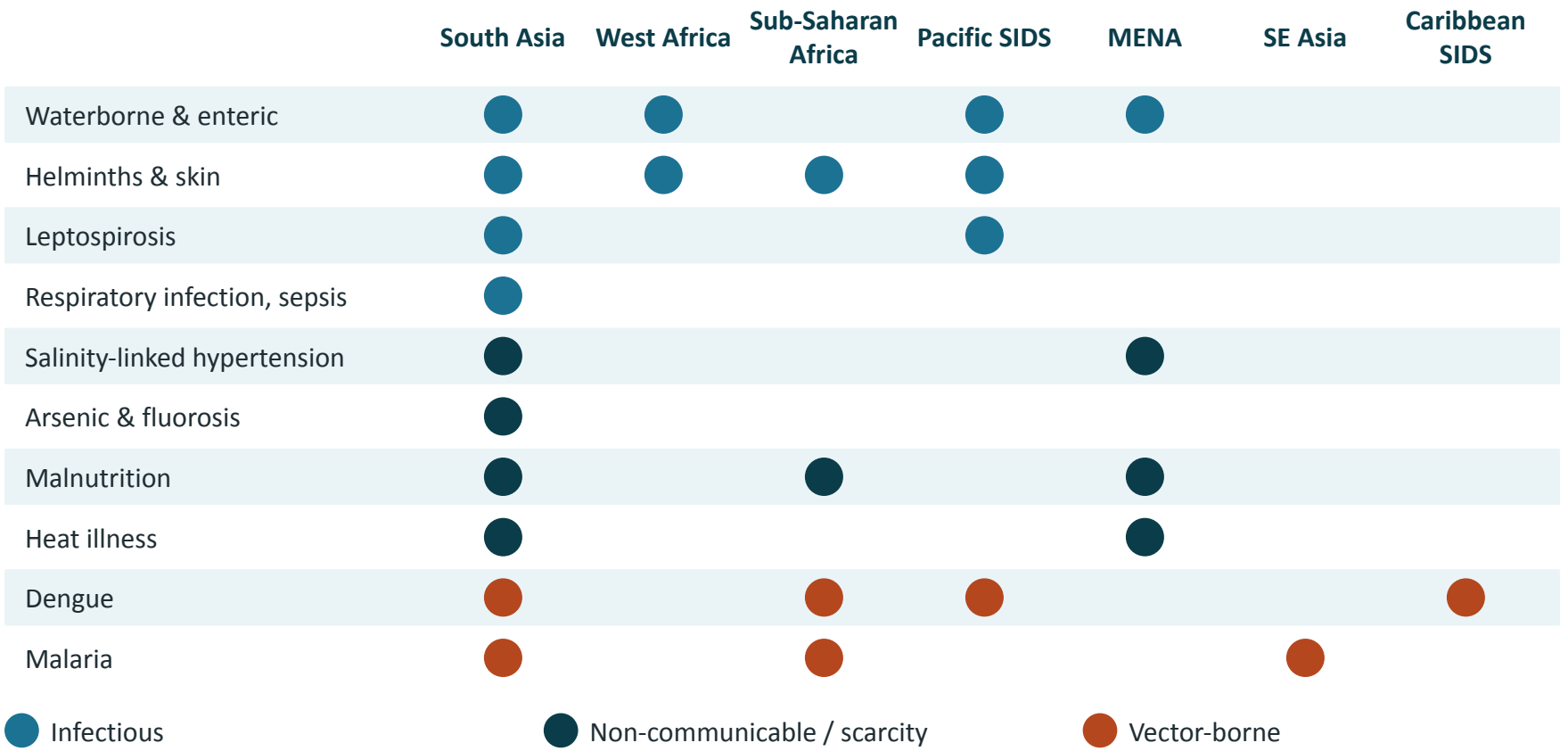
Stage 2: Physical Health, From Failure Pathway to Disease

Which UWS failure activates which disease



Stage 2: Physical Health, Where Each Disease Is Documented

Disease groups by Global South region



Stage 2: Mental Health, From Acute Shock to Chronic Strain

The least-documented yet most significant dimension of the nexus

Acute shock → **Chronic strain**

A. Acute: storms & cyclones

Myanmar: PTSD, acute anxiety, displacement trauma

Fiji, Solomon Is.: PTSD, long-term psychiatric effects

Kiribati: existential distress over homeland loss

B. Sub-acute: flooding

Bangladesh: maternal stress, livelihood-loss distress

Myanmar: conflict, displacement, camp-living trauma

Uganda, West Africa: sanitation anxiety, hits women most

C. Chronic: drought & scarcity

India: mood disorders, chronic anxiety

Burkina Faso, Mali, Senegal: farmer suicides, depression

Ethiopia, Yemen: anxiety, depression, conflict stress

Pakistan: anxiety from contaminated water

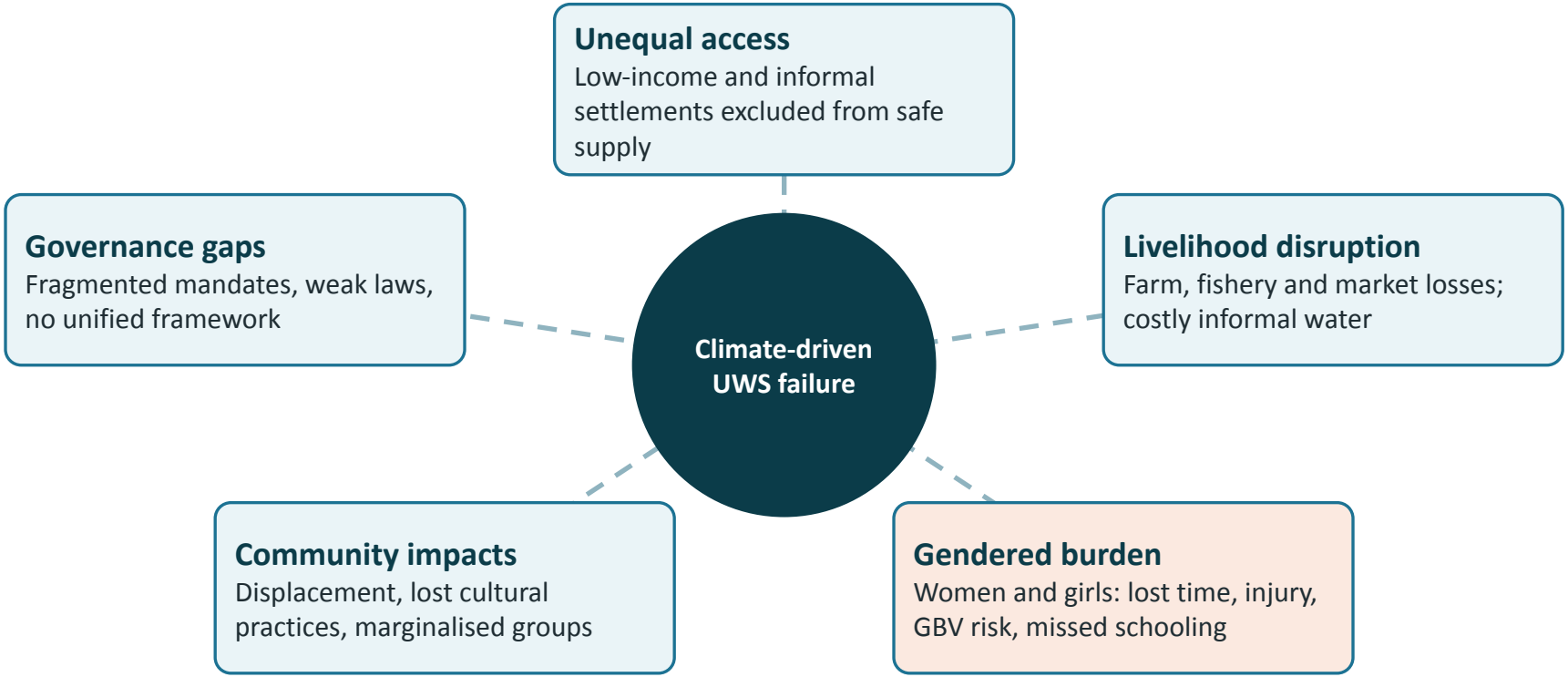
Farmer suicide and cyclone PTSD are among the most under-recognised burdens.

D. Extreme heat, compounded by water scarcity

India: mood and anxiety disorders, dementia. **Yemen:** heat, scarcity and conflict raise neurodegenerative risk.

Stage 2: Social Health, Five Dimensions of Impact

Primary determinants of vulnerability, not secondary consequences



Regions: South Asia, sub-Saharan Africa, MENA, Pacific and Caribbean SIDS, Southeast Asia

Stage 3: Biophysical Vulnerability, Who and Where

Differential exposure rooted in physiology, water labour and spatial proximity to hazard

A Age: Children under five

- Immature immunity: highest exposure to waterborne pathogens

B Age: Older adults

- Reduced heat tolerance turns stress into crisis

C Gender: Women

- Pregnancy risk from salinity; water-collection burden

D Socio-Economic Status

- Informal settlements bear the highest contamination burden
- Hand-dipped storage adds recontamination risk
- Education gap widens the awareness-to-action divide
- HDI is the strongest predictor of burden

E Spatial & Geographical

- Small islands: one flood contaminates water, sanitation and healthcare at once
- Too close to water breeds vectors; too far brings scarcity
- Per-capita gains mask rising absolute unsafe water use

Stage 3: Structural Vulnerability, Governance and the System

Whether biophysical exposure becomes health harm, or is absorbed by protective institutions

1 Governance Arrangements

- Decides whether institutions absorb or amplify stress

Policy coherence • Legal frameworks • Inter-agency coordination • Conflict and fragility

2 Institutional Capacity

- Surveillance gaps leave people invisible to early warning

Surveillance systems • Enforcement capacity • Laboratory capacity • Early warning systems

3 Hydro-Social Relations

- Who controls, prices and reaches water, and who is left out

Water control and access • Water pricing and affordability • Gender norms • Social inequalities

Equity is a governance challenge as much as a hydrological one: identical stressors yield radically different health burdens across institutional contexts.

Key Findings

Three messages from 56 core studies

1 Hazards and UWS

Extreme events are the most cross-cutting climate scenario, hitting water supply, sanitation and stormwater at once. Impacts are spatially uneven and compound over time, with each dry season starting from a lower baseline than the last.

2 Health nexus

Four pathways carry climate stressors to health: water quantity failure, water quality deterioration, sanitation breakdown, and stormwater/drainage failure. Physical health is the most documented burden; mental health, such as drought-linked depression, farmer suicide and cyclone-induced PTSD, is the most under-recognised.

3 Health inequity

Exposure concentrates among children under five, women, the elderly and informal settlement residents. Governance gaps, missing regulation and weak surveillance amplify this, so identical climate stressors produce very different health burdens depending on institutional context.

Conclusions and Implications

Four contributions of the review

1 Integrated framework

Three stages linking hazard characterisation, health pathway mapping and vulnerability, absent from siloed reviews

2 Synthesis matrix

Links UWS failure types to physical, mental and social health, disaggregated by region and climate zone

3 Neglected dimensions

Mental and social health surfaced as underrepresented in water governance and public health practice

4 Vulnerability reframed

Institutionally produced: governance and hydro-social architecture matter more than hazard intensity

For policymakers and water managers: health-sensitive, equity-centred resilience strategies advancing SDG 6 and SDG 13 through unified institutional response.

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Full reference list of 34 sources is in the accompanying paper

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Thank you

Climate-resilient urban water systems must be designed for health and equity, not only for hydrology

Apoorva A. Prabhugaonkar | Dr. Gaurav Vaidya
School of Planning and Architecture, Bhopal