Local to Global WASH Climate nexus

Global South Academic Conclave
CEPT University, 2 Feb 2024

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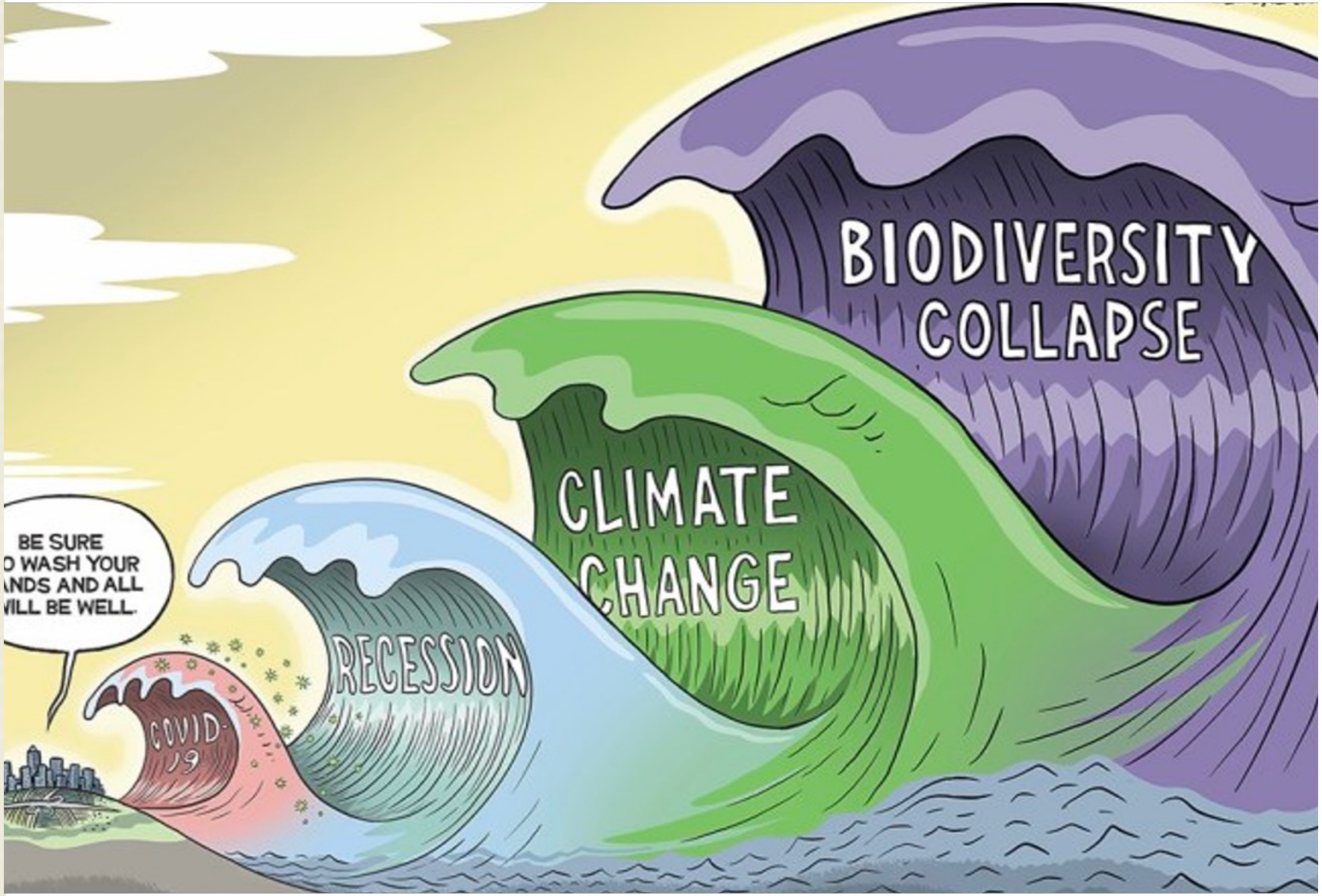
Context & Sources of Evidence

The Global Polycrisis of the early Anthropocene



We live in an era of interconnected global polycrises:

- Poverty
- Inequality
- Climate & Water
- Biodiversity
- Debt
- Intergovernmental fragmentation

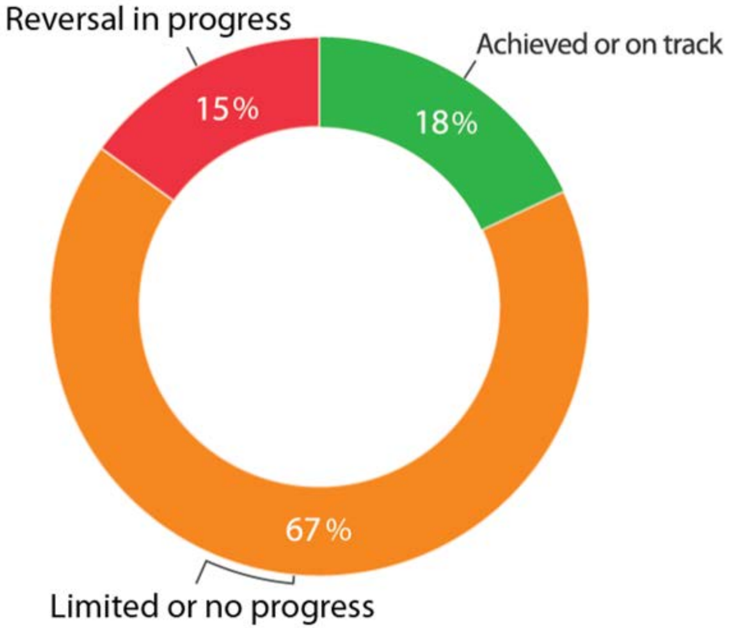
GDP/cap (PPP): $12,703

World SDG Dashboard (2023)

HDI: 0.73

World SDG Dashboard at the midpoint of the 2030 Agenda

Status of individual SDG targets at the midpoint of the 2030 agenda



Gross World Output: ~$ 100 trillion Growth: ~2.5% per year Losses: ~ 1% per year

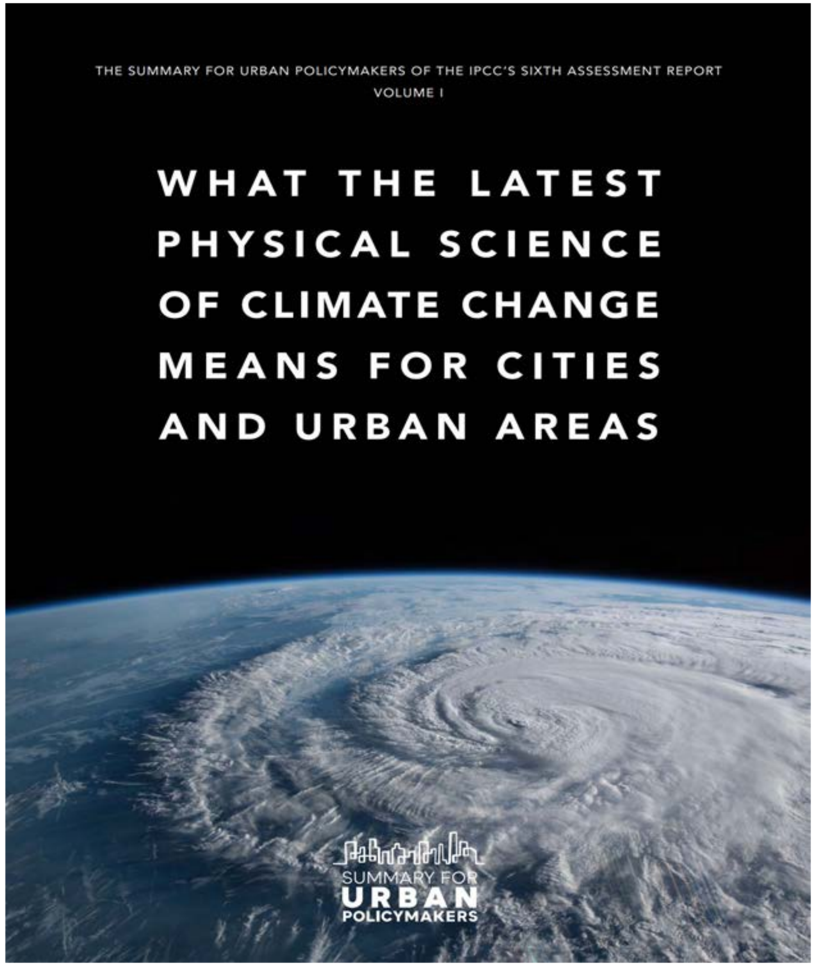
Capital Assets : ~$ 550 trillion Growth: ~2 % per year

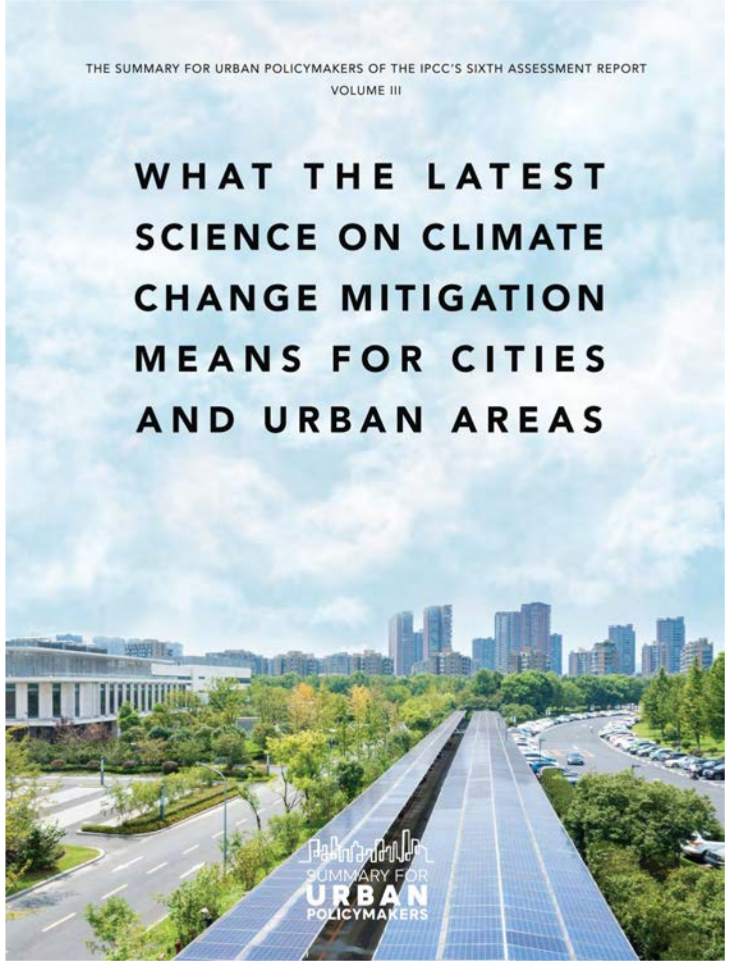
Biocapacity: - 1 gHa/cap

Sources: SDR,2023; World Bank, 2022; UN, 2021; GFN, 2022

Population: 8 billion

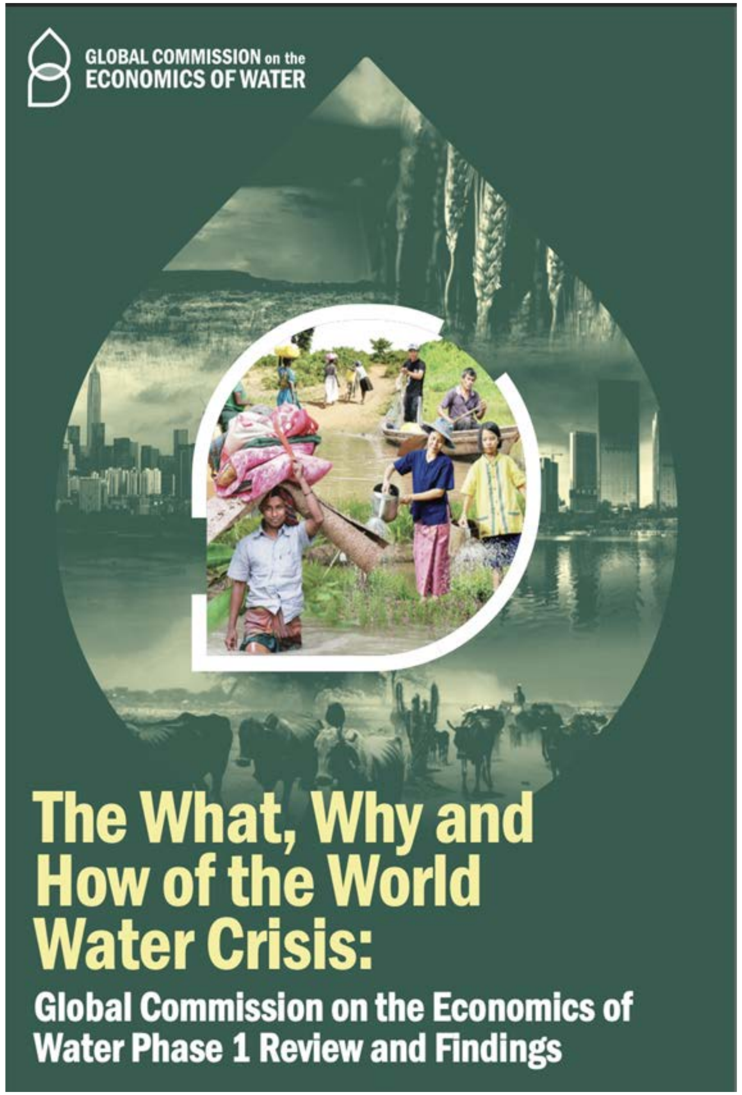
IPCC AR6 Summary for Urban Policymakers (2022)

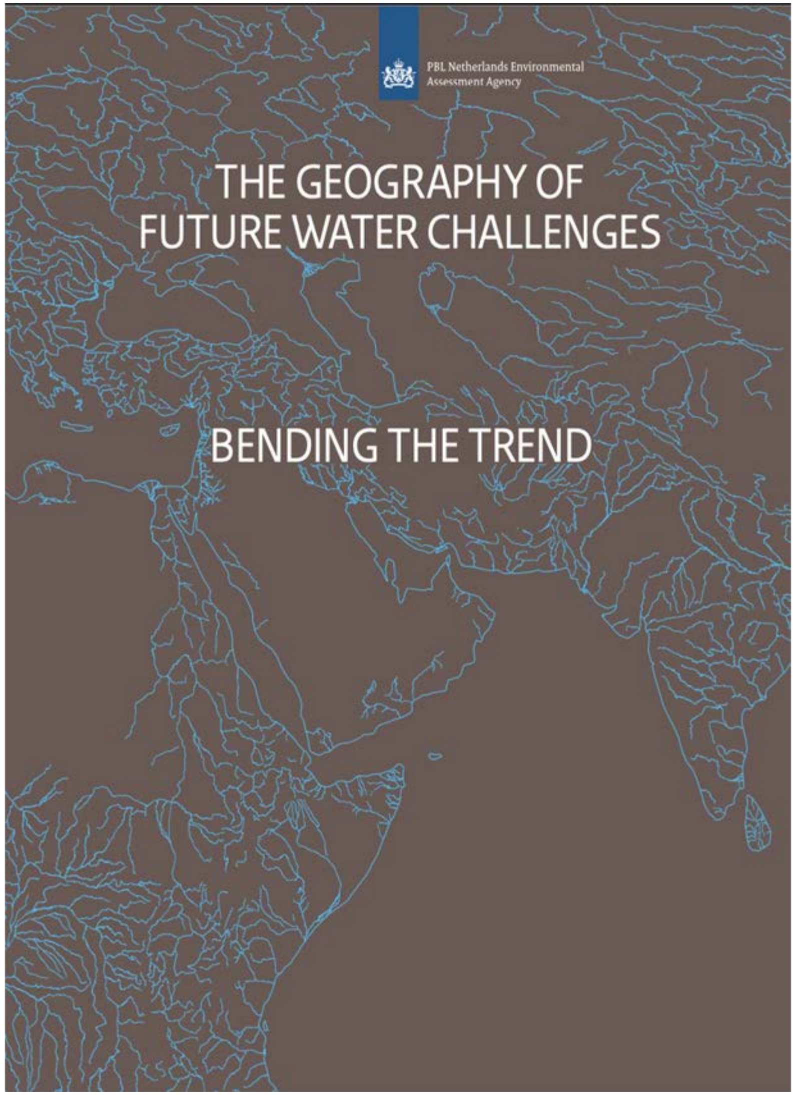


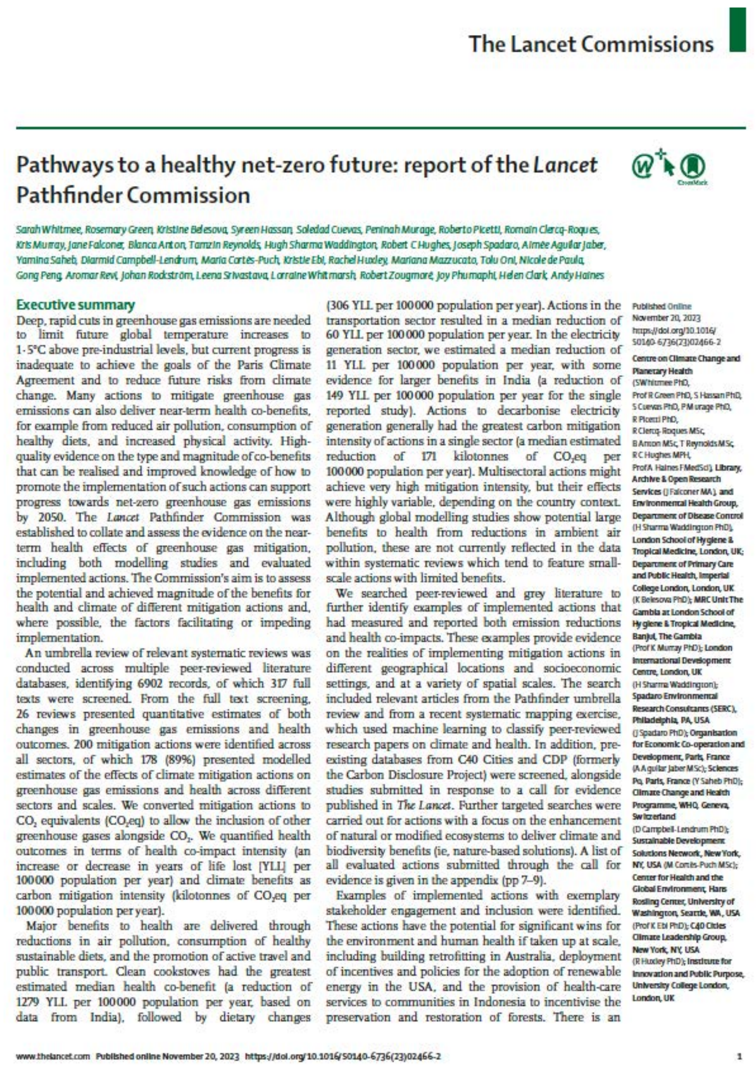


AR6 Summary for Urban Policymakers at CoP27

GCEW World Water Crisis, PBL Bending the Trend, Lancet Pathfinder Commission (2023)







The Lancet Commissions

Pathways to a healthy net-zero future: report of the *Lancet* Pathfinder Commission

Sarah Whitmee, Rosemary Green, Kristine Belesova, Syreen Hassan, Soledad Cuevas, Peninah Murage, Roberto Picetti, Romain Clercq-Roques, Kris Murray, Jane Falconer, Blanca Anton, Tamzin Reynolds, Hugh Sharma Waddington, Robert C Hughes, Joseph Spadaro, Aimée Aguilar Jaber, Yamina Saheb, Diarmid Campbell-Lendrum, Maria Cortés-Puch, Kristie Ebi, Rachel Huxley, Mariana Mazzucato, Tolu Oni, Nicole de Paula, Gong Peng, Aromar Revi, Johan Rockström, Leena Srivastava, Lorraine Whitmarsh, Robert Zougmoré, Joy Phumaphi, Helen Clark, Andy Haines

Executive summary

Deep, rapid cuts in greenhouse gas emissions are needed to limit future global temperature increases to 1·5°C above pre-industrial levels, but current progress is inadequate to achieve the goals of the Paris Climate Agreement and to reduce future risks from climate change. Many actions to mitigate greenhouse gas emissions can also deliver near-term health co-benefits, for example from reduced air pollution, consumption of healthy diets, and increased physical activity. High-quality evidence on the type and magnitude of co-benefits that can be realised and improved knowledge of how to promote the implementation of such actions can support progress towards net-zero greenhouse gas emissions by 2050. The *Lancet* Pathfinder Commission was established to collate and assess the evidence on the near-term health effects of greenhouse gas mitigation, including both modelling studies and evaluated implemented actions. The Commission's aim is to assess the potential and achieved magnitude of the benefits for health and climate of different mitigation actions and, where possible, the factors facilitating or impeding implementation.

An umbrella review of relevant systematic reviews was conducted across multiple peer-reviewed literature databases, identifying 6902 records, of which 317 full texts were screened. From the full text screening, 26 reviews presented quantitative estimates of both changes in greenhouse gas emissions and health outcomes. 200 mitigation actions were identified across all sectors, of which 178 (89%) presented modelled estimates of the effects of climate mitigation actions on greenhouse gas emissions and health across different sectors and scales. We converted mitigation actions to CO_2 equivalents (CO_2eq) to allow the inclusion of other greenhouse gases alongside CO_2. We quantified health outcomes in terms of health co-impact intensity (an increase or decrease in years of life lost [YLL] per 100 000 population per year) and climate benefits as carbon mitigation intensity (kilotonnes of CO_2eq per 100 000 population per year).

Major benefits to health are delivered through reductions in air pollution, consumption of healthy sustainable diets, and the promotion of active travel and public transport. Clean cookstoves had the greatest estimated median health co-benefit (a reduction of 1279 YLL per 100 000 population per year, based on data from India), followed by dietary changes (306 YLL per 100 000 population per year). Actions in the transportation sector resulted in a median reduction of 60 YLL per 100 000 population per year. In the electricity generation sector, we estimated a median reduction of 11 YLL per 100 000 population per year, with some evidence for larger benefits in India (a reduction of 149 YLL per 100 000 population per year for the single reported study). Actions to decarbonise electricity generation generally had the greatest carbon mitigation intensity of actions in a single sector (a median estimated reduction of 171 kilotonnes of CO_2eq per 100 000 population per year). Multisectoral actions might achieve very high mitigation intensity, but their effects were highly variable, depending on the country context. Although global modelling studies show potential large benefits to health from reductions in ambient air pollution, these are not currently reflected in the data within systematic reviews which tend to feature small-scale actions with limited benefits.

We searched peer-reviewed and grey literature to further identify examples of implemented actions that had measured and reported both emission reductions and health co-impacts. These examples provide evidence on the realities of implementing mitigation actions in different geographical locations and socioeconomic settings, and at a variety of spatial scales. The search included relevant articles from the Pathfinder umbrella review and from a recent systematic mapping exercise, which used machine learning to classify peer-reviewed research papers on climate and health. In addition, pre-existing databases from C40 Cities and CDP (formerly the Carbon Disclosure Project) were screened, alongside studies submitted in response to a call for evidence published in *The Lancet*. Further targeted searches were carried out for actions with a focus on the enhancement of natural or modified ecosystems to deliver climate and biodiversity benefits (ie, nature-based solutions). A list of all evaluated actions submitted through the call for evidence is given in the appendix (pp 7–9).

Examples of implemented actions with exemplary stakeholder engagement and inclusion were identified. These actions have the potential for significant wins for the environment and human health if taken up at scale, including building retrofitting in Australia, deployment of incentives and policies for the adoption of renewable energy in the USA, and the provision of health-care services to communities in Indonesia to incentivise the preservation and restoration of forests. There is an

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Centre on Climate Change and Planetary Health (S Whitmee PhD, Prof R Green PhD, S Hassan PhD, S Cuevas PhD, P Murage PhD, R Picetti PhD, R Clercq-Roques MSc, B Anton MSc, T Reynolds MSc, R C Hughes MPH, Prof A Haines FMedSci), Library, Archive & Open Research Services (J Falconer MA), and Environmental Health Group, Department of Disease Control (H Sharma Waddington PhD), London School of Hygiene & Tropical Medicine, London, UK; Department of Primary Care and Public Health, Imperial College London, London, UK (K Belesova PhD); MRC Unit The Gambia at London School of Hygiene & Tropical Medicine, Banjul, The Gambia (Prof K Murray PhD); London International Development Centre, London, UK (H Sharma Waddington); Spadaro Environmental Research Consultants (SERC), Philadelphia, PA, USA (J Spadaro PhD); Organisation for Economic Co-operation and Development, Paris, France (A Aguilar Jaber MSc); Sciences Po, Paris, France (Y Saheb PhD); Climate Change and Health Programme, WHO, Geneva, Switzerland (D Campbell-Lendrum PhD); Sustainable Development Solutions Network, New York, NY, USA (M Cortés-Puch MSc); Center for Health and the Global Environment, Hans Rosling Center, University of Washington, Seattle, WA, USA (Prof K Ebi PhD); C40 Cities Climate Leadership Group, New York, NY, USA (R Huxley PhD); Institute for Innovation and Public Purpose, University College London, London, UK

The WSS-Climate nexus

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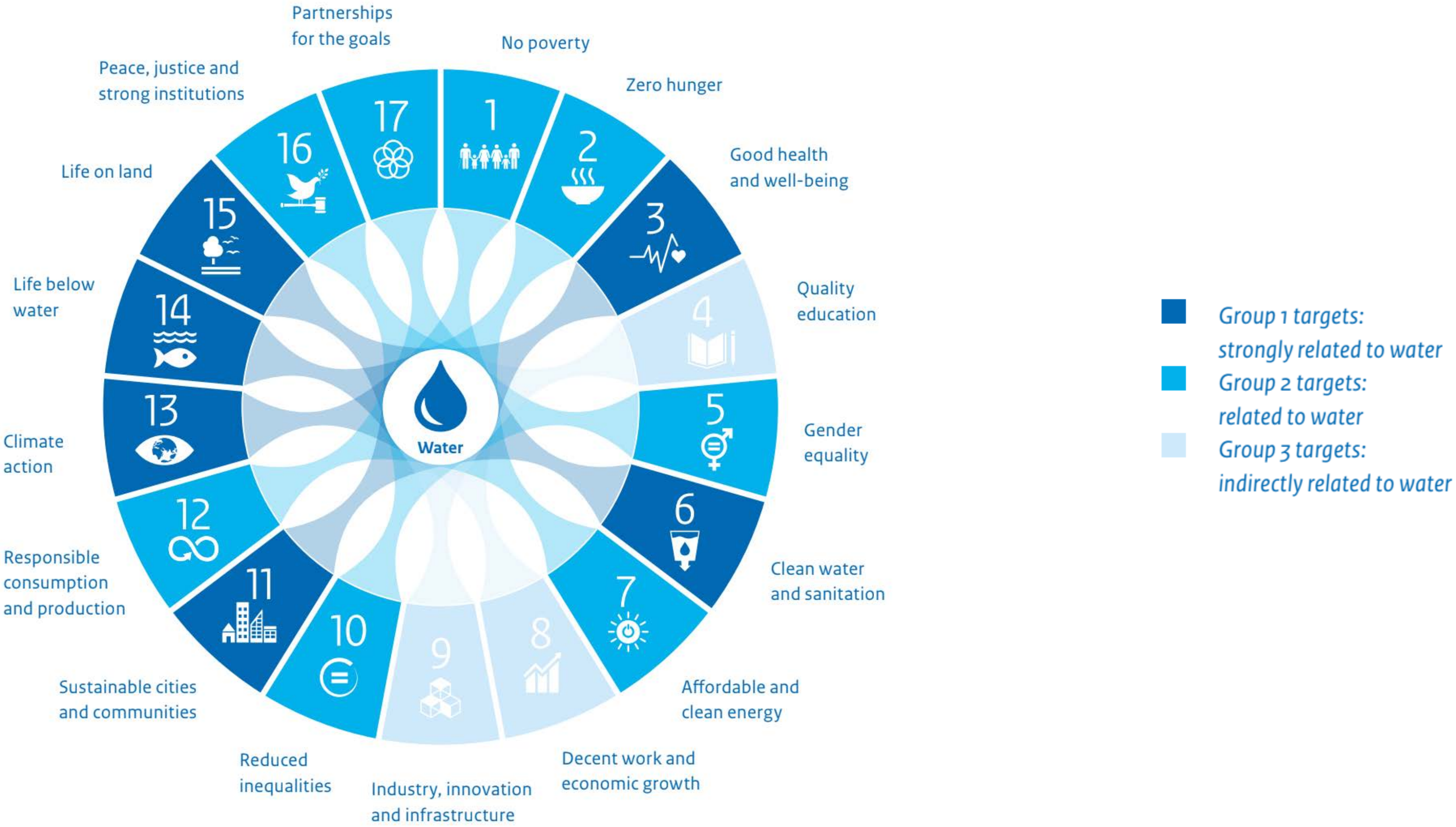
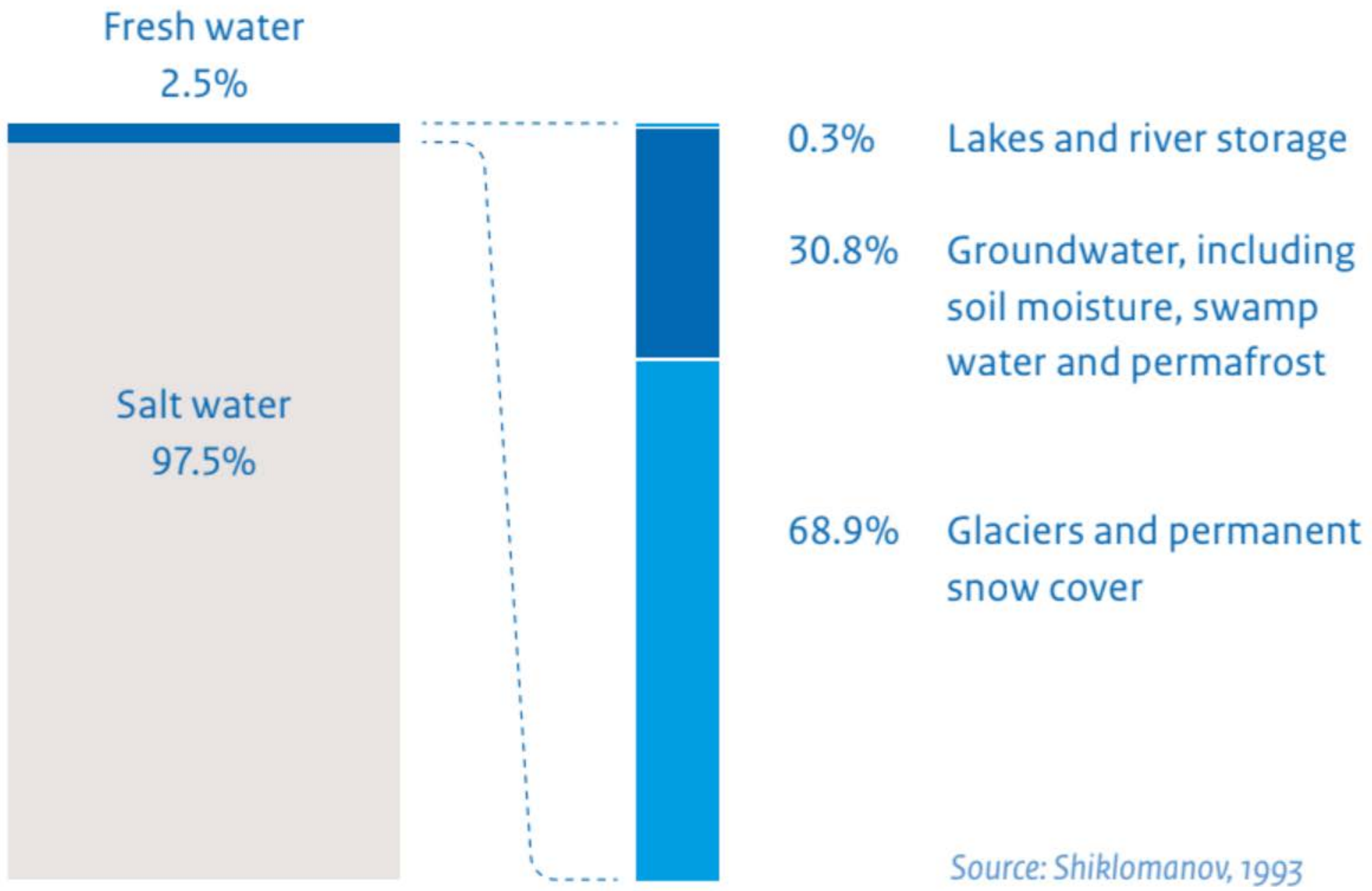
Scoping the Solution space: Water is the common thread linking all the SDGs



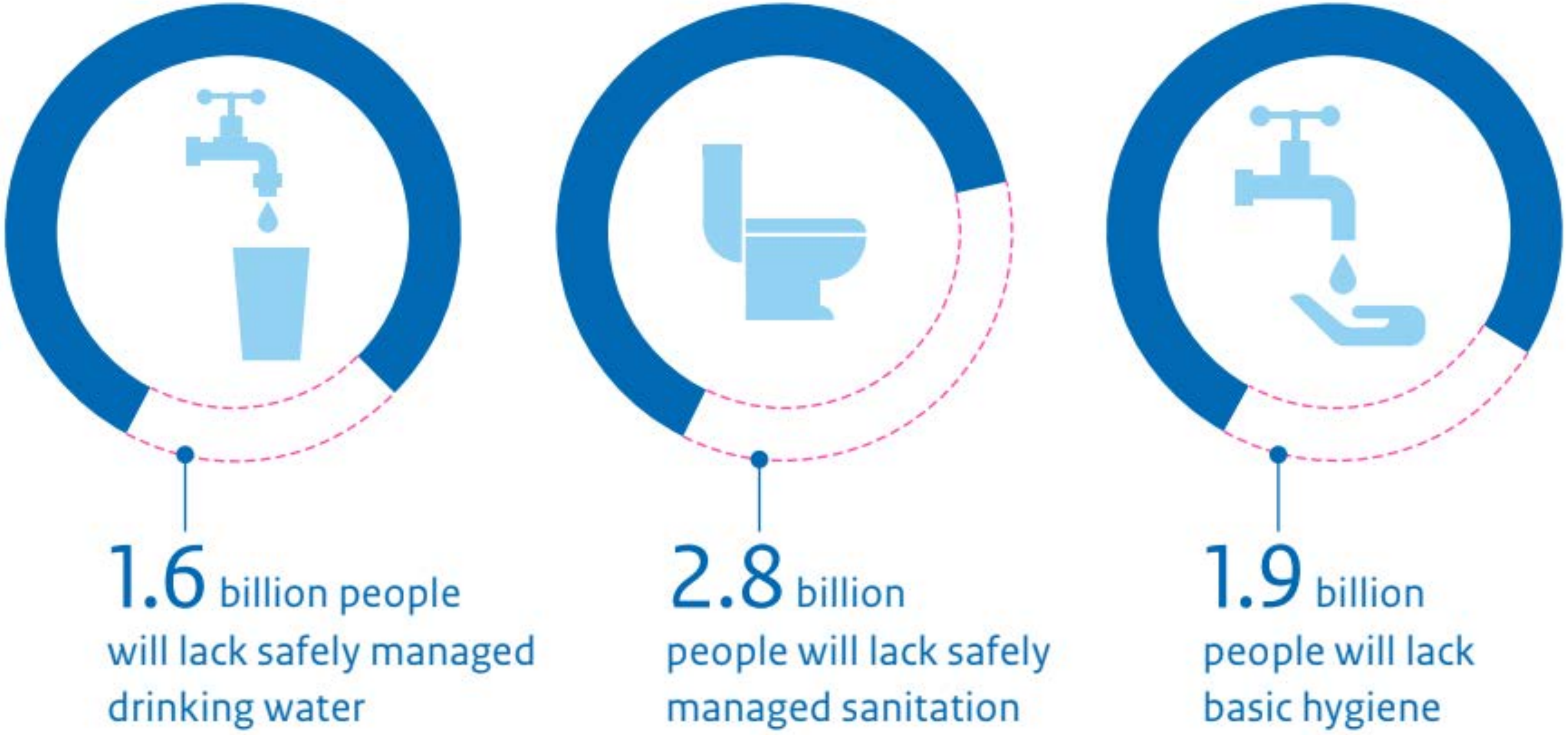
Source: PBL, 2023

Fresh water is a very precious resource



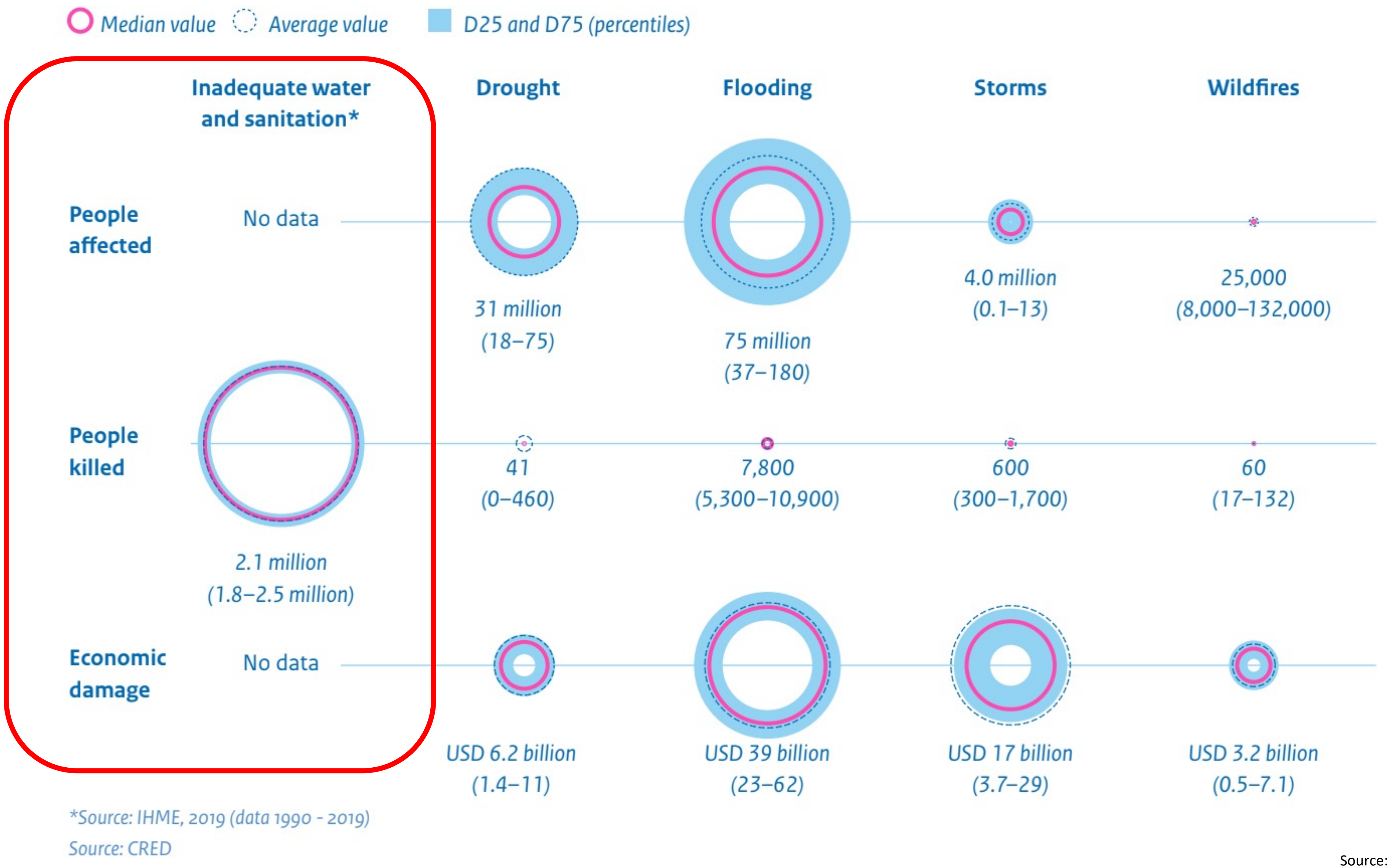
Source: Shiklomanov, 1993

Projected progress on SDG6: Access to clean water or sanitation (2030)



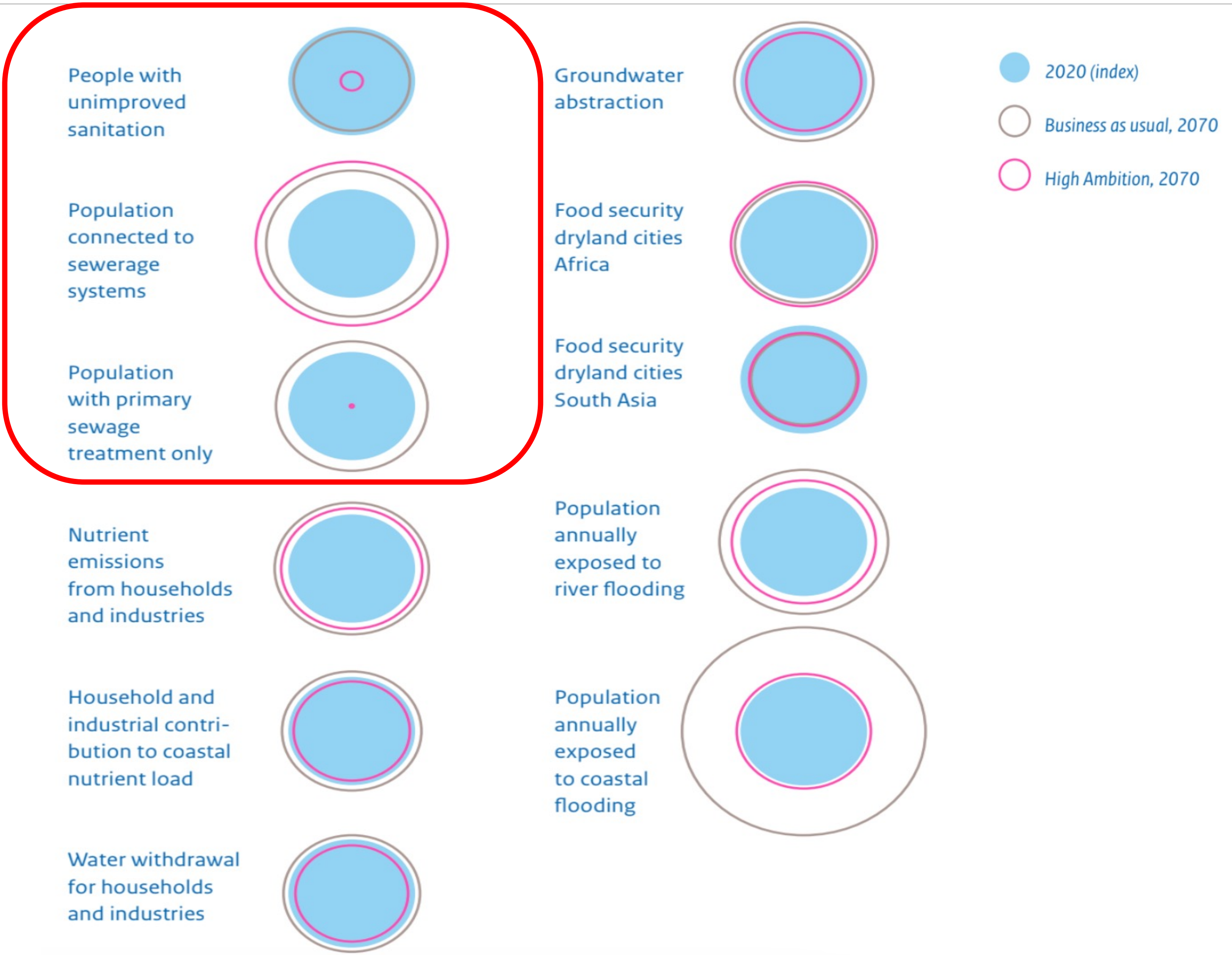
Source: United Nations, 2022

Annual Global impact of water-related disasters and diseases (1980-2021)



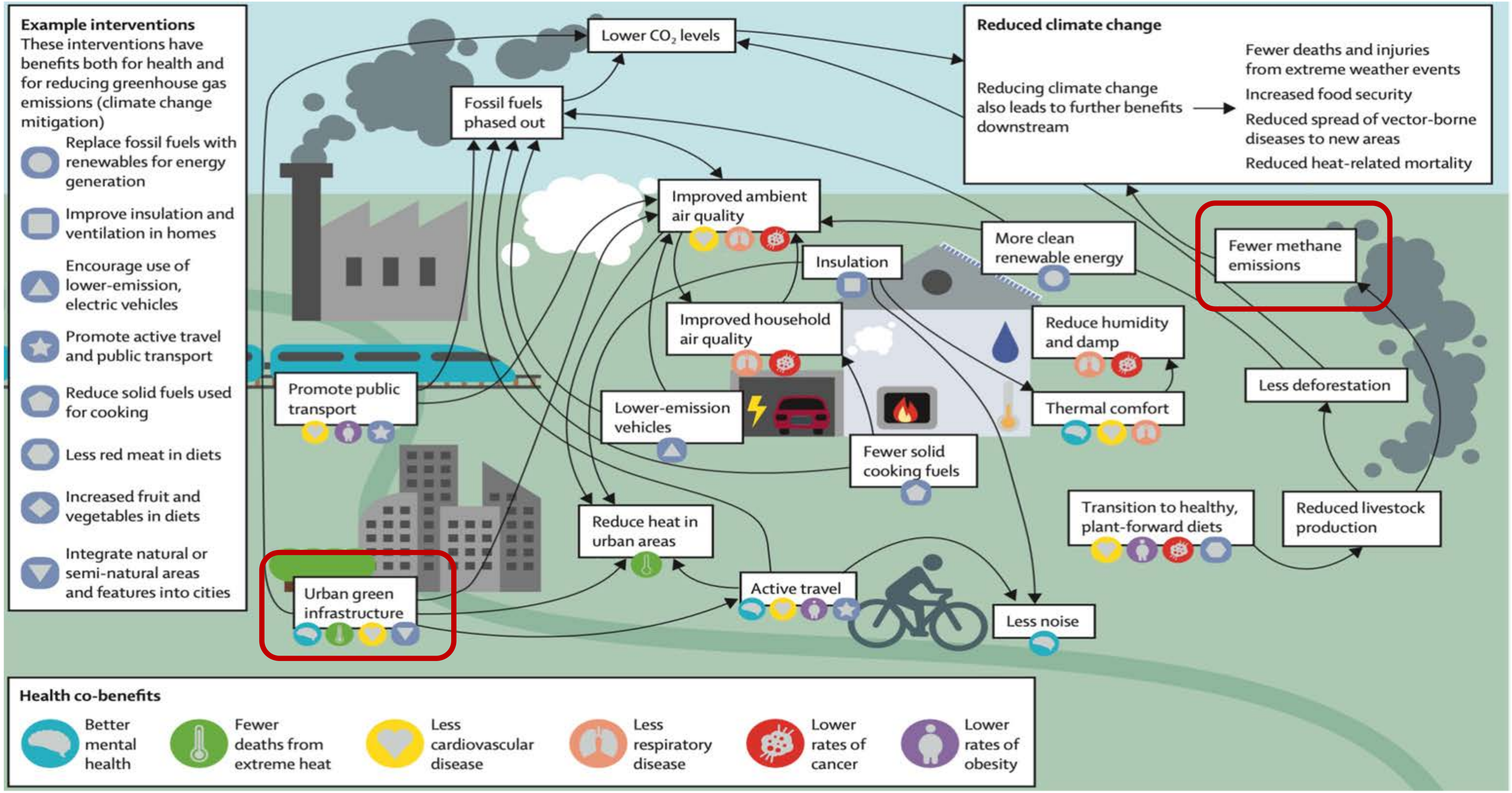
Source: IHME, 2019 (data 1990 - 2019)
Source: CRED

Water- and climate-related risks in Cities and regions (2020-70)



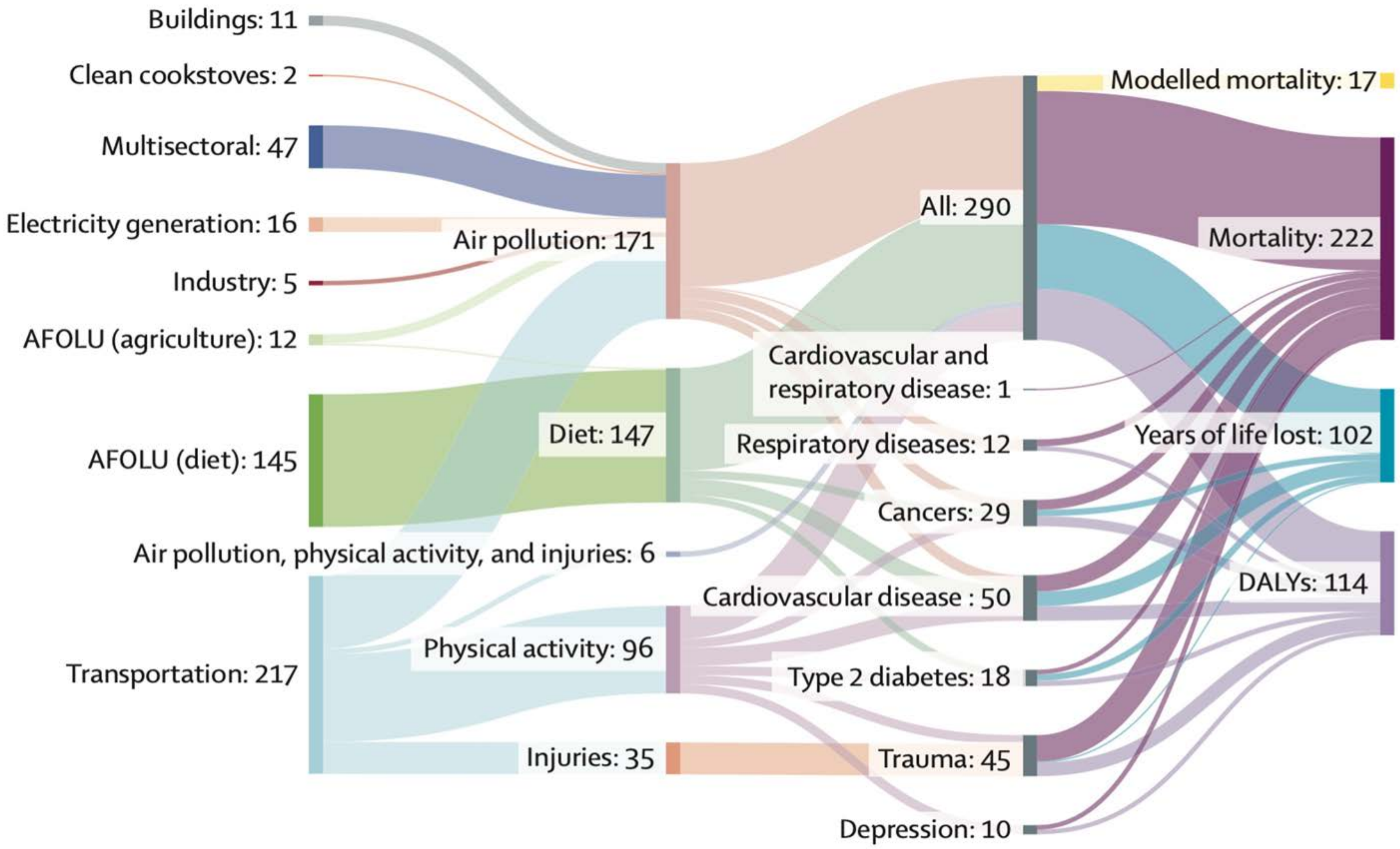
Source: PBL, 2023

Key Pathways & connections between climate mitigation and health



Credits: Lancet Pathfinder Commission Report, 2023

Mitigation across sectors and pathways to Health outcomes



Credits: Lancet Pathfinder Commission Report, 2023

Climate Action: as if only temperature extremes matter

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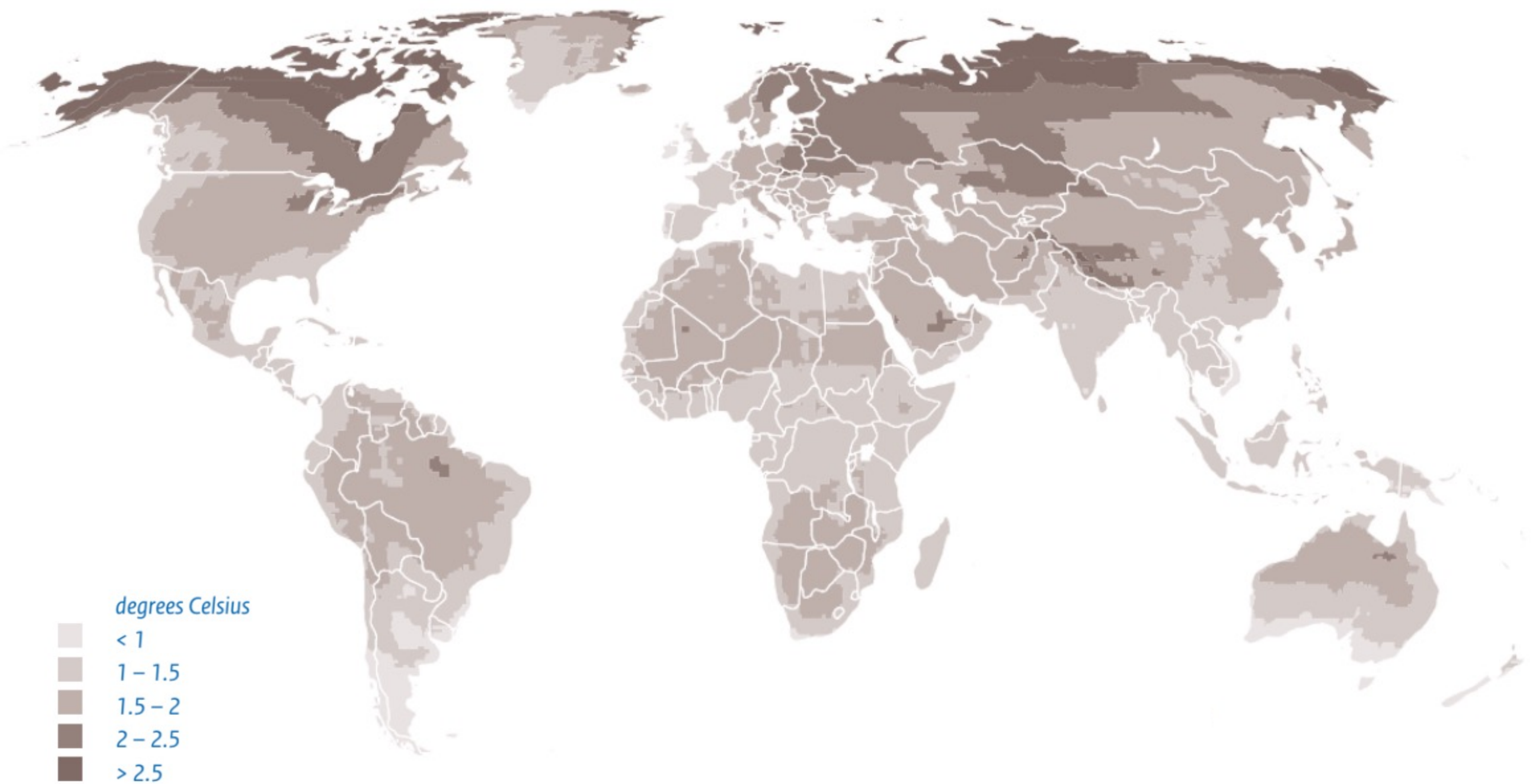
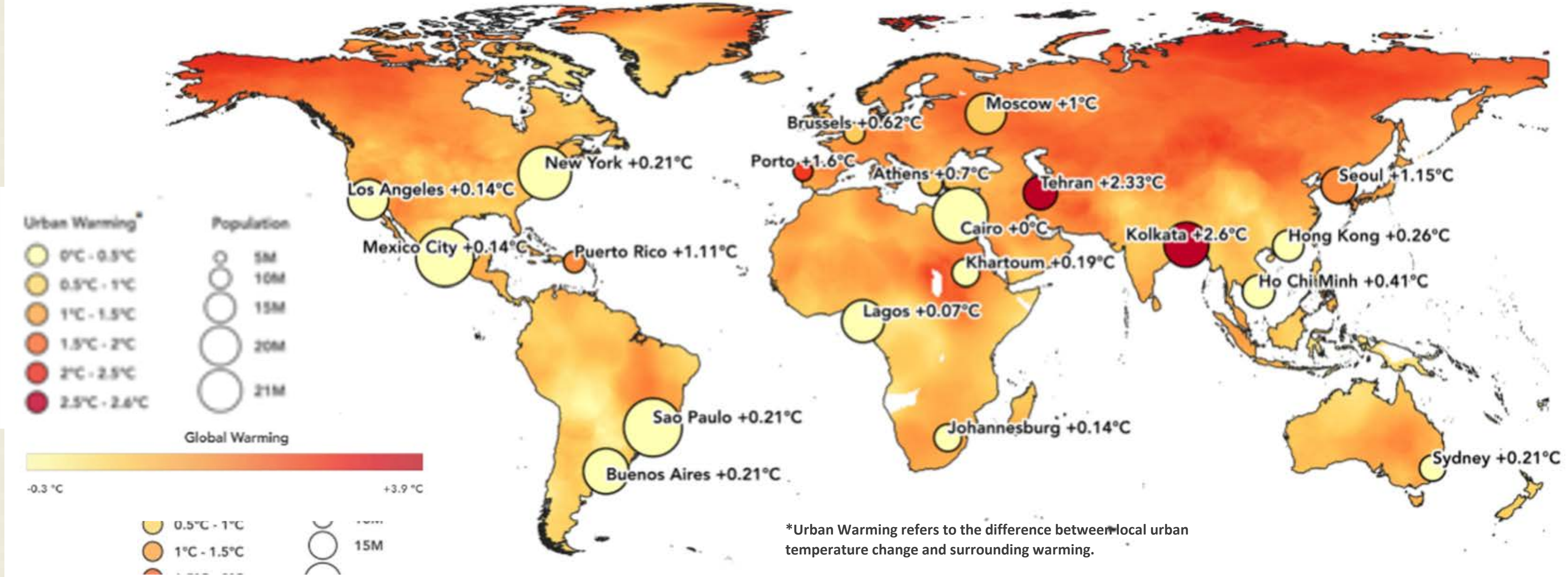
We are headed for a 1.5^{o}C Overshoot: Temperature change (2020-2070)



Source: Lange and Büchner, 2017; PBL: the results are based on the projections of 4 climate models

Changes in Global & Urban Surface Air Temperature (1958-2018)

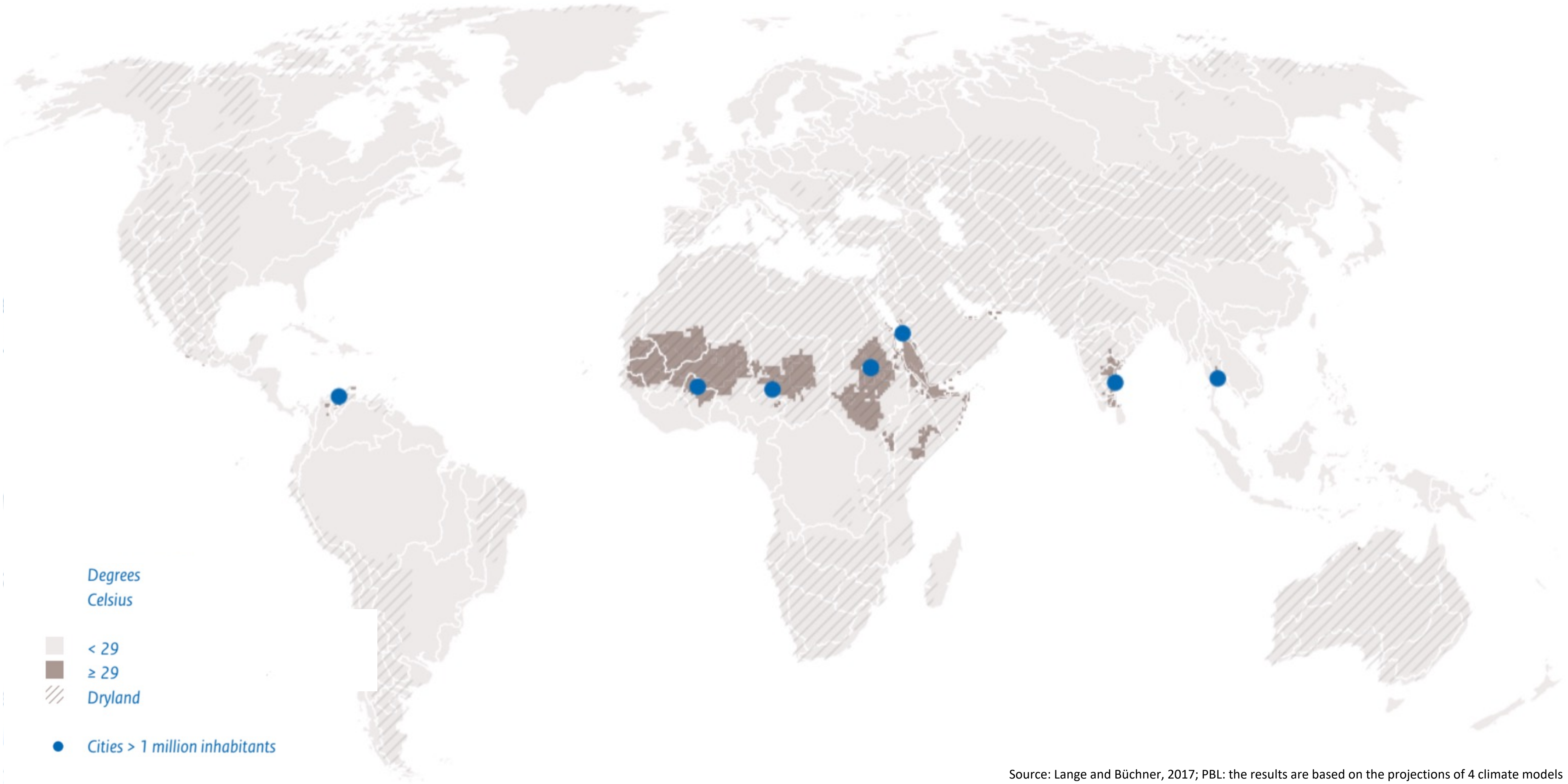


Source: Change in the annual mean surface air temperature over the period 1958-2018 based on the local linear trend retrieved from CRU TS (°C per 68 years). This map has been amended from IPCC 2021, Climate Change 2021: The Physical Science Basis, Chapter 10: Linking Global to Regional Climate Change; United Nations, Department of Economic and Social Affairs, Population Division (2018); World Urbanization Prospects: The 2018 Revision, Online Edition.

Cities and regions as Climate hotspots (2010-2050)

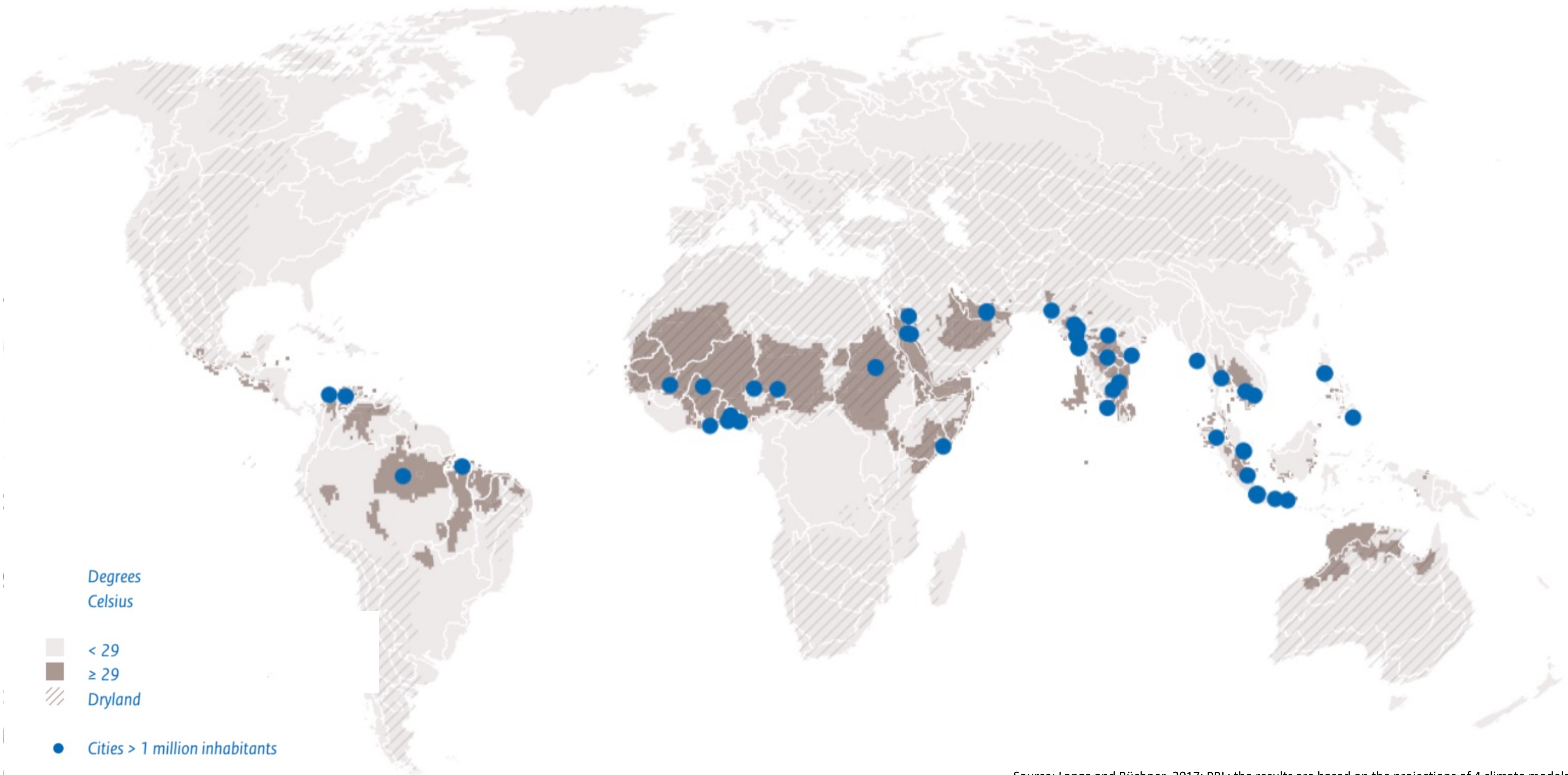
Source: PBL, 2023

Concentrated in regions & large cities in the global South: Projected mean annual temperatures of over 29 °C (2020)



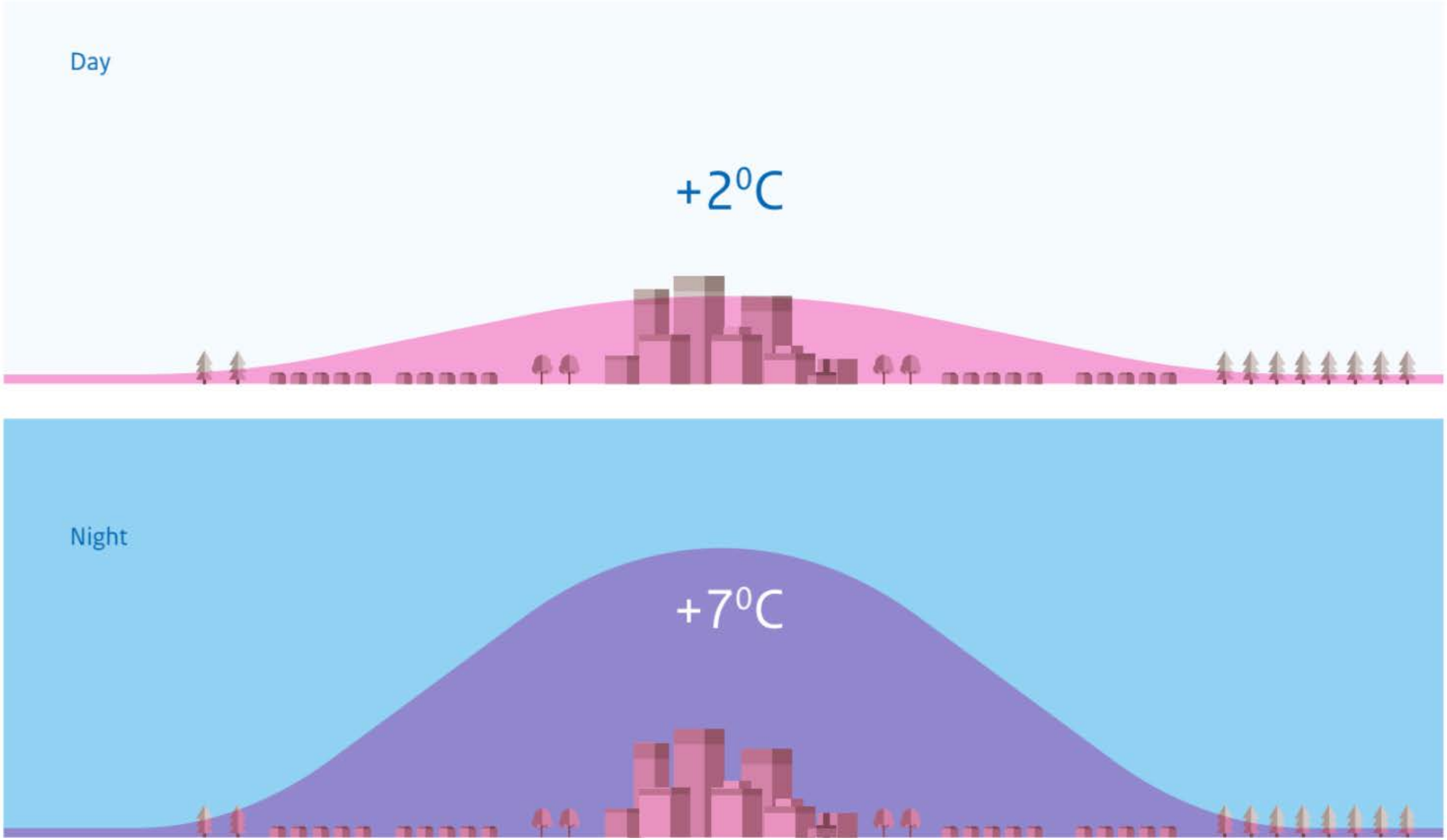
Source: Lange and Büchner, 2017; PBL: the results are based on the projections of 4 climate models

Concentrated in regions & large cities in the global South: Projected mean annual temperatures of over 29 °C (2070)



Source: Lange and Büchner, 2017; PBL: the results are based on the projections of 4 climate models

Urban Heat Island (UHI) will make things worse



Source: Zhou et al., 2013; Schlünzen and Bohnenstengel, 2016; Huang et al., 2019

Climate Resilient Development: mapping the Solution space

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Image credits: Patricia Jekki / Unsplash

Every system & place are connected in an urban world with over 4 billion urban residents. The global economy & human societies are strongly coupled with the climate system and ecosystems. A change in one system impacts the others.

The Climate system, Ecosystems and Human Systems are tightly coupled

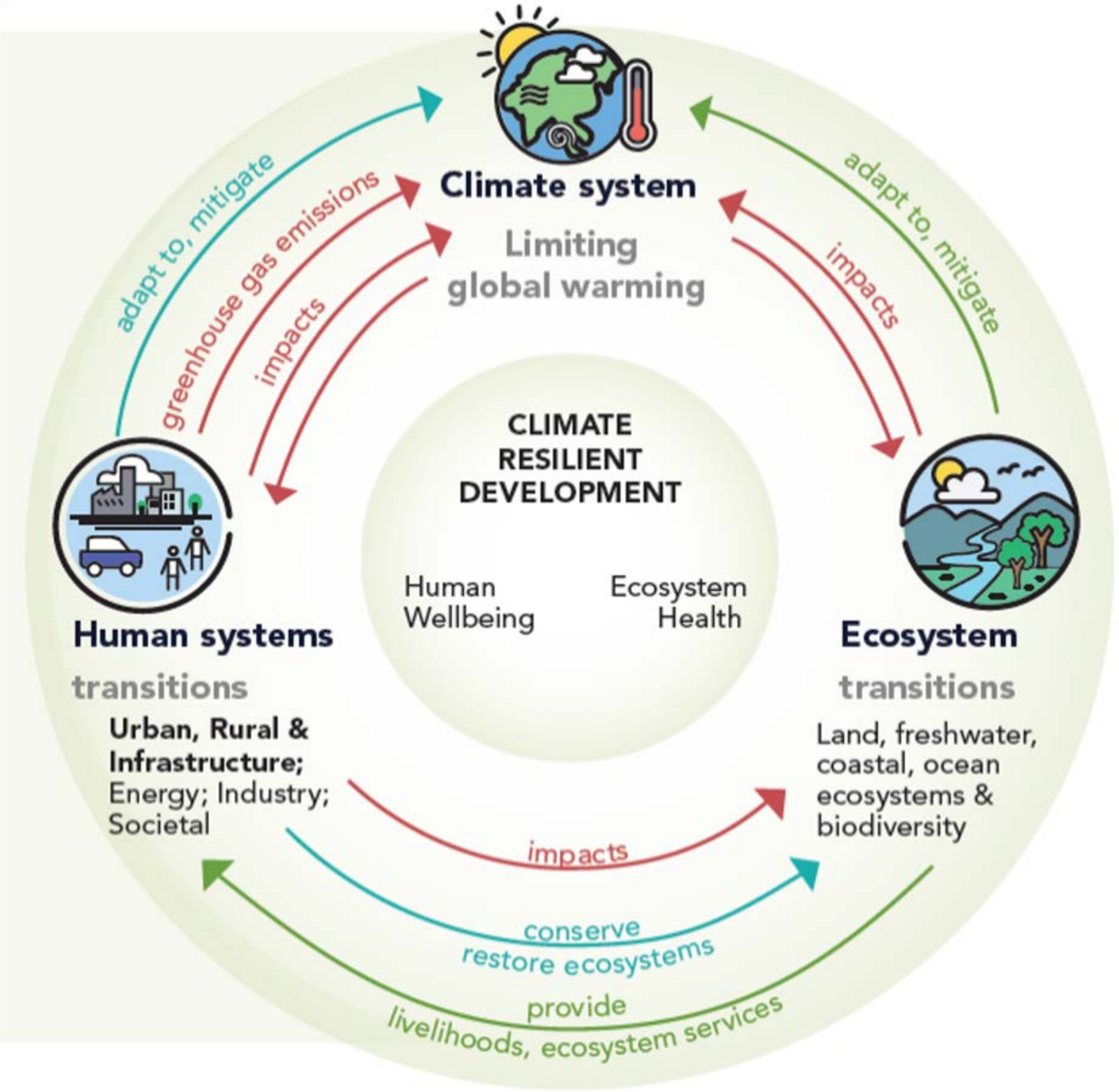


Figure Source: A re-interpretation of data underlying the Figure SPM.1, Summary for Policymakers, IPCC AR6 WGII

Heat & cold

Rain & drought

Snow & ice

Wind

Coastal & oceanic

Other

Open ocean

Every region will experience concurrent and multiple changes in climatic impact-drivers in a warming world. In many places, these cause compound and cascading events.

Image credits: Logan Abassi / UN Photo

Cape Town, South Africa

Climate Resilient Development (CRD) brings together Sustainable Development for All, with Climate adaptation, Mitigation and Biodiversity conservation.

Image credits: Tobias Reich / Unsplash

System Transitions are key to address systemic risks to coupled human, natural and climate systems.

These include five simultaneous transitions in:

- **Energy systems**
- **Industrial systems**
- **Land, coastal, ocean and freshwater ecosystems**
- **Urban and Infrastructure systems**
- **Societal choices and transitions**

Together, these transitions advance CRD i.e. sustainable development along with adaptation and mitigation and biodiversity conservation.

Image credits: JP Holecka / Unsplash

Climate Mitigation

Multiple feasible Mitigation Options across the System Transitions that are clearly mapped to the SDGs and hence to Climate Resilient Development.

We need to make choices on the deployment of mitigation and adaptation options that can accelerate System Transitions for CRD

Figure Source: Derived from IPCC AR6 WGIII, Summary for Policymakers, SPM.8

Climate Adaptation

Multiple feasible adaptation options across the System Transitions to respond to a range of Representative Key Risks (RKRs).

The question is which of these ‘solutions’ should be deployed, where and when in aid of which goals?

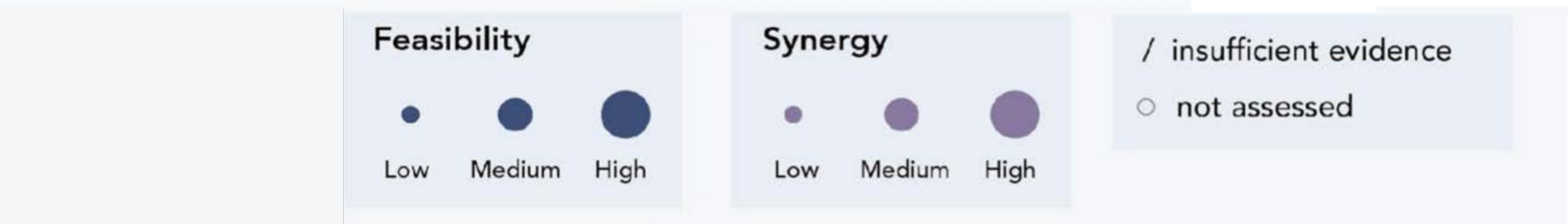


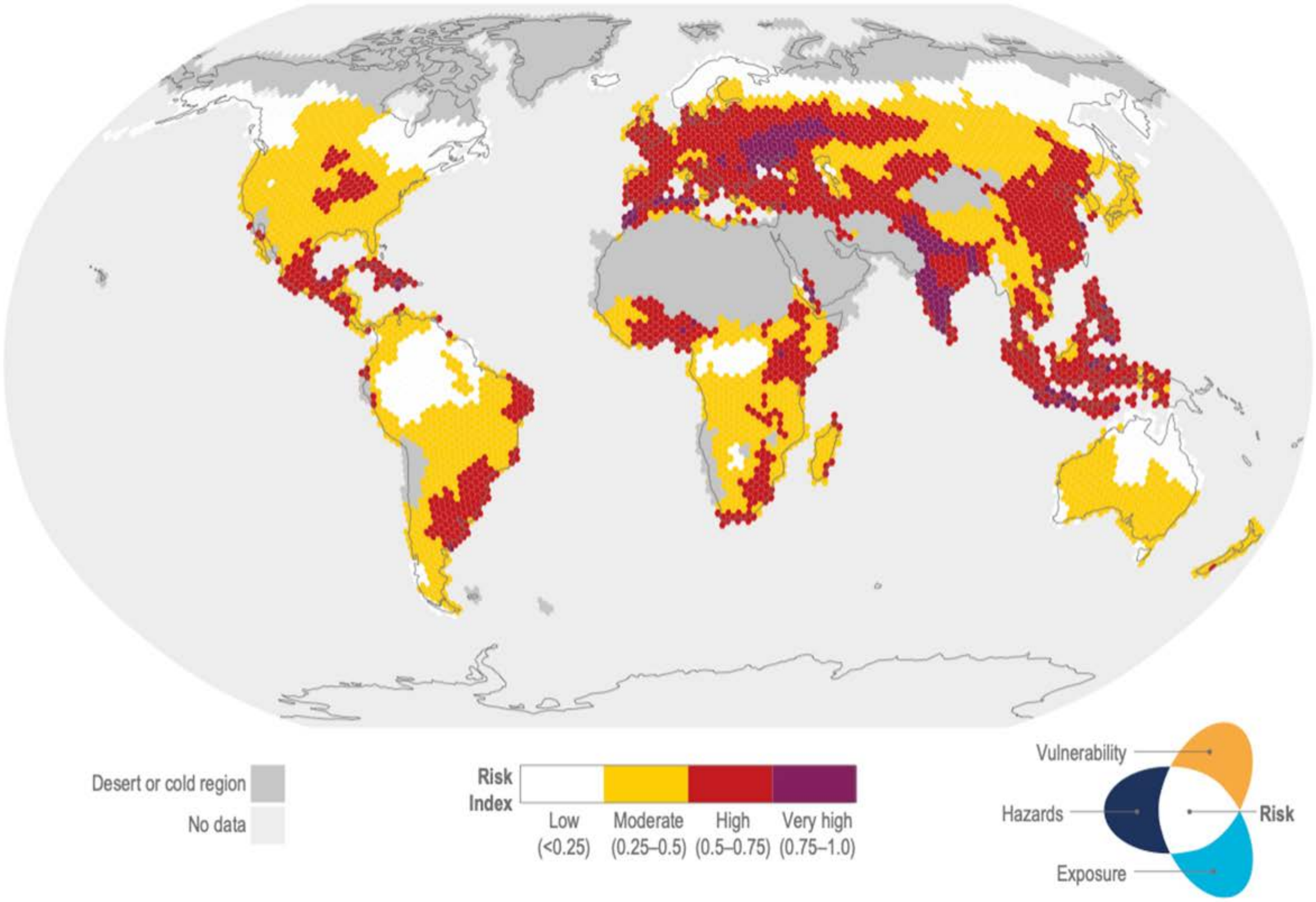
Figure Source: Derived from IPCC AR6 WGII, Summary for Policymakers, Figure SPM.4(a)

Cities hold the key to Climate Resilient Development. Cities and urban areas have a central role to play in the Systems Transitions and future transformations needed to adapt and mitigate to the climate crisis.

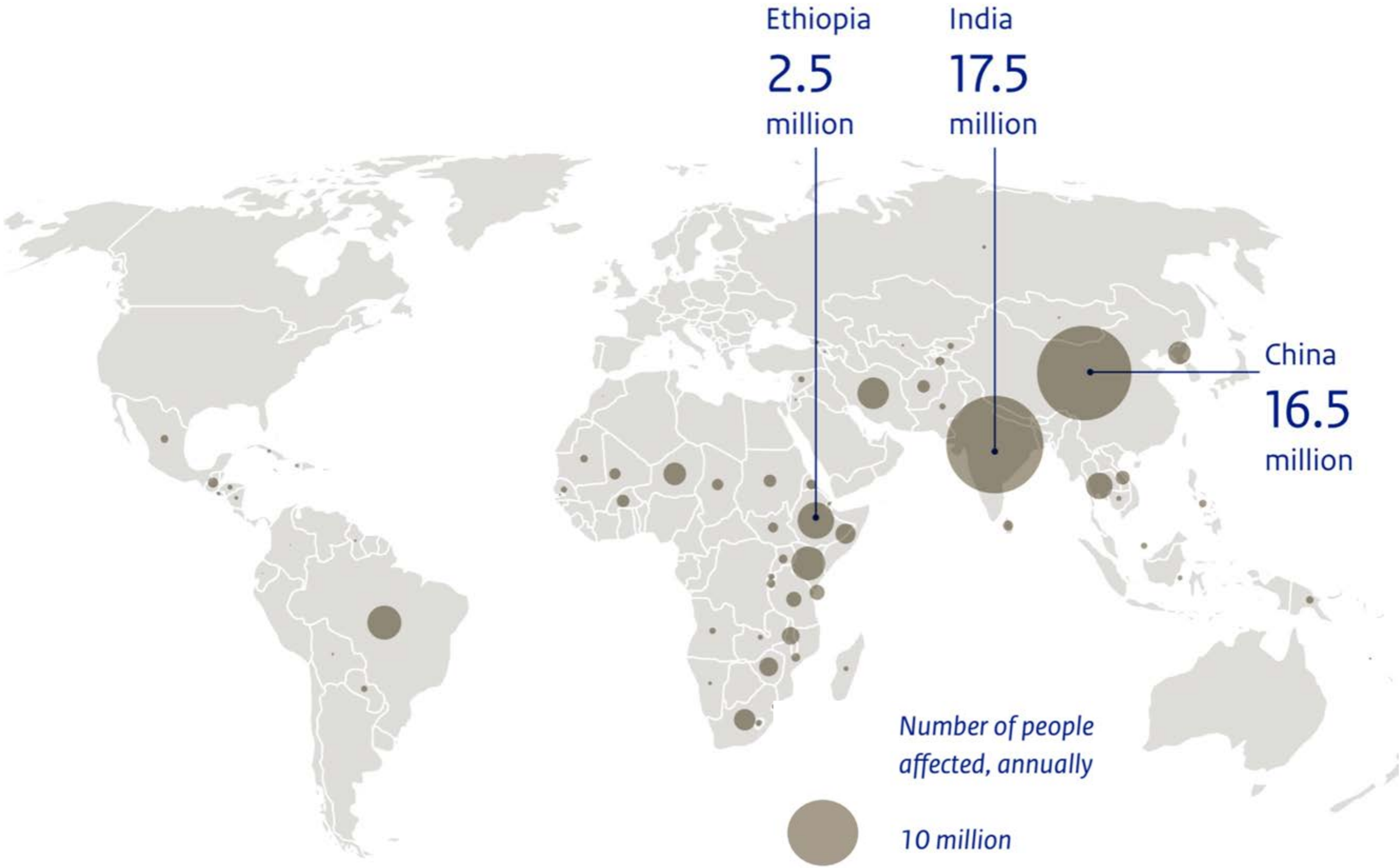
Image credits: JP Holecka / Unsplash

The Global Water crisis of the Anthropocene

Too little Water: Global Drought Risk (1900-2010)

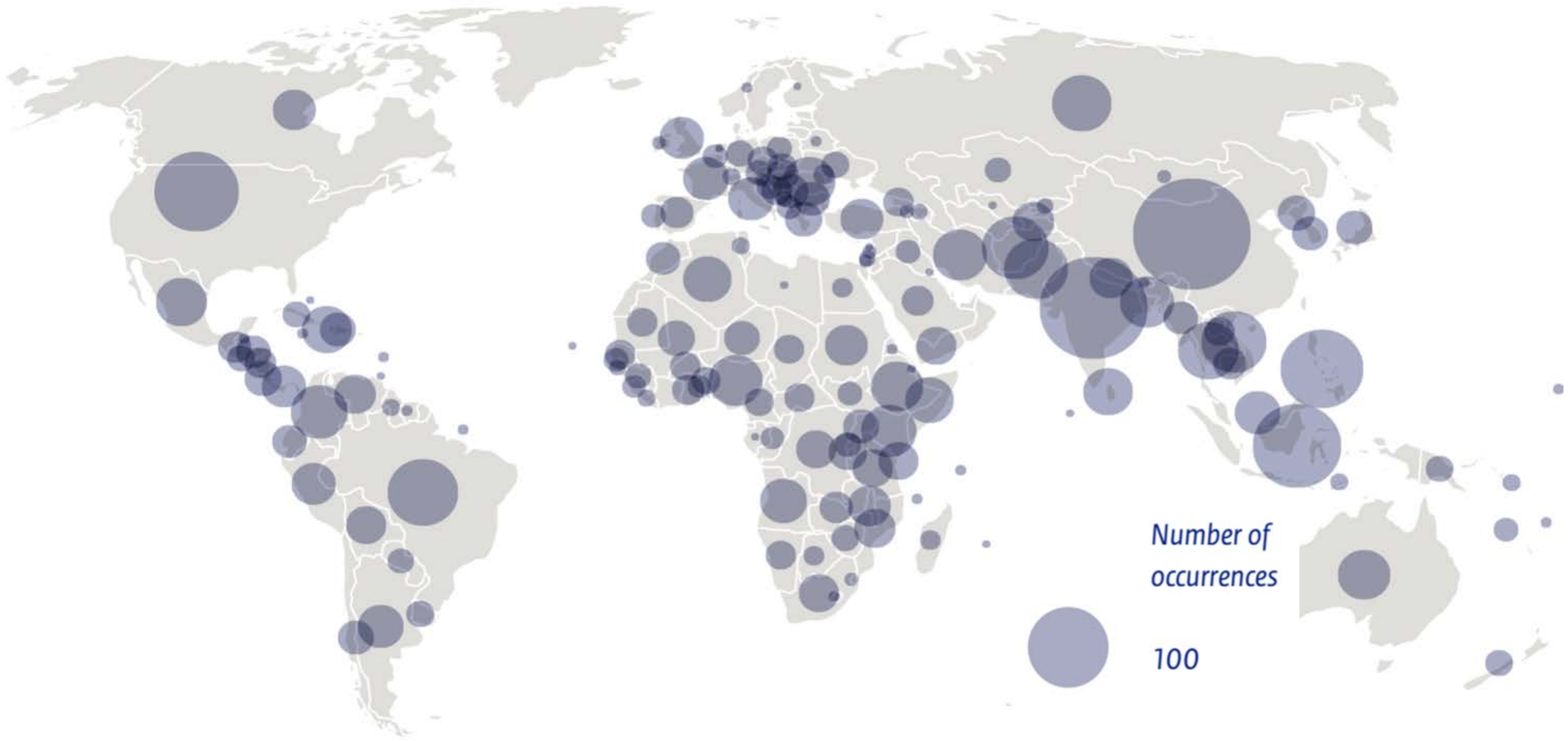


Too little Water: Annual Drought Affected People (1996-2015)



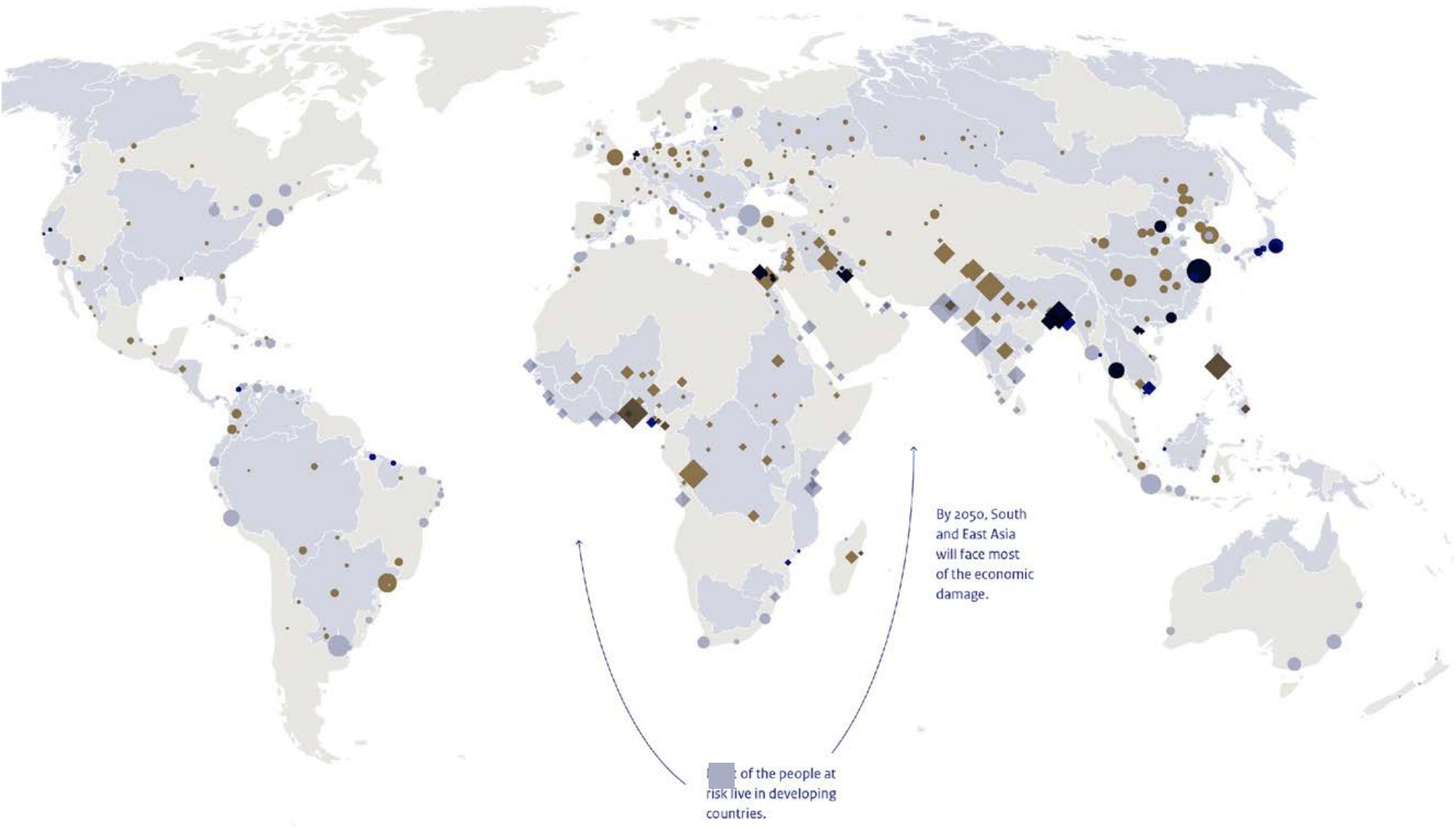
Source: PBL, 2018

Too much Water: Flood events (1996-2015)



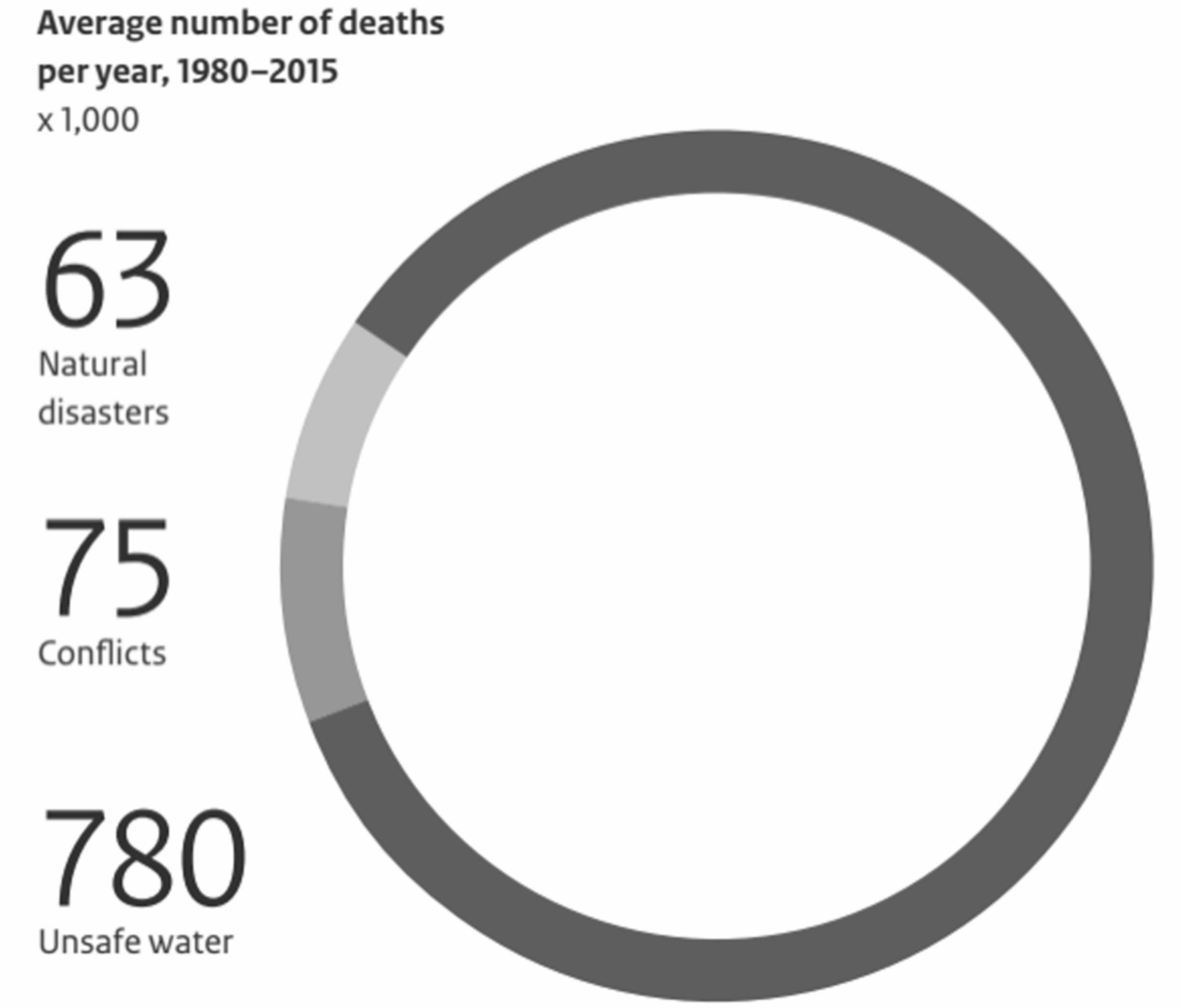
Source: PBL, 2018

Too much Water: Cities as flood-risk hotspots



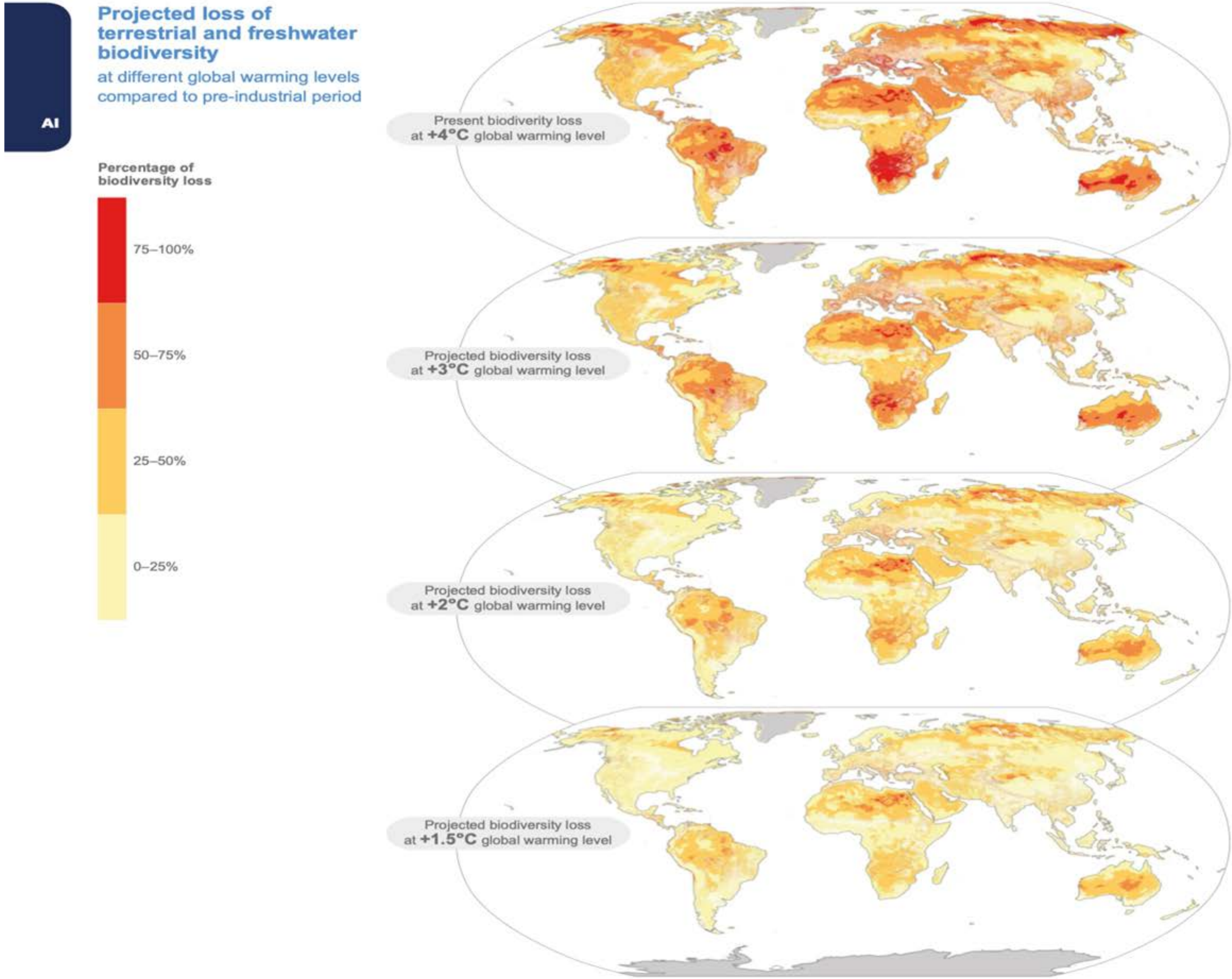
Source: PBL, 2018

Too Dirty & Polluted water: Annual deaths (1980-2015)



Source: PBL, 2018

Loss of Terrestrial & Freshwater biodiversity in a warming world (1.5^{o}C to 4^{o}C)



Source: IPCC 2022,

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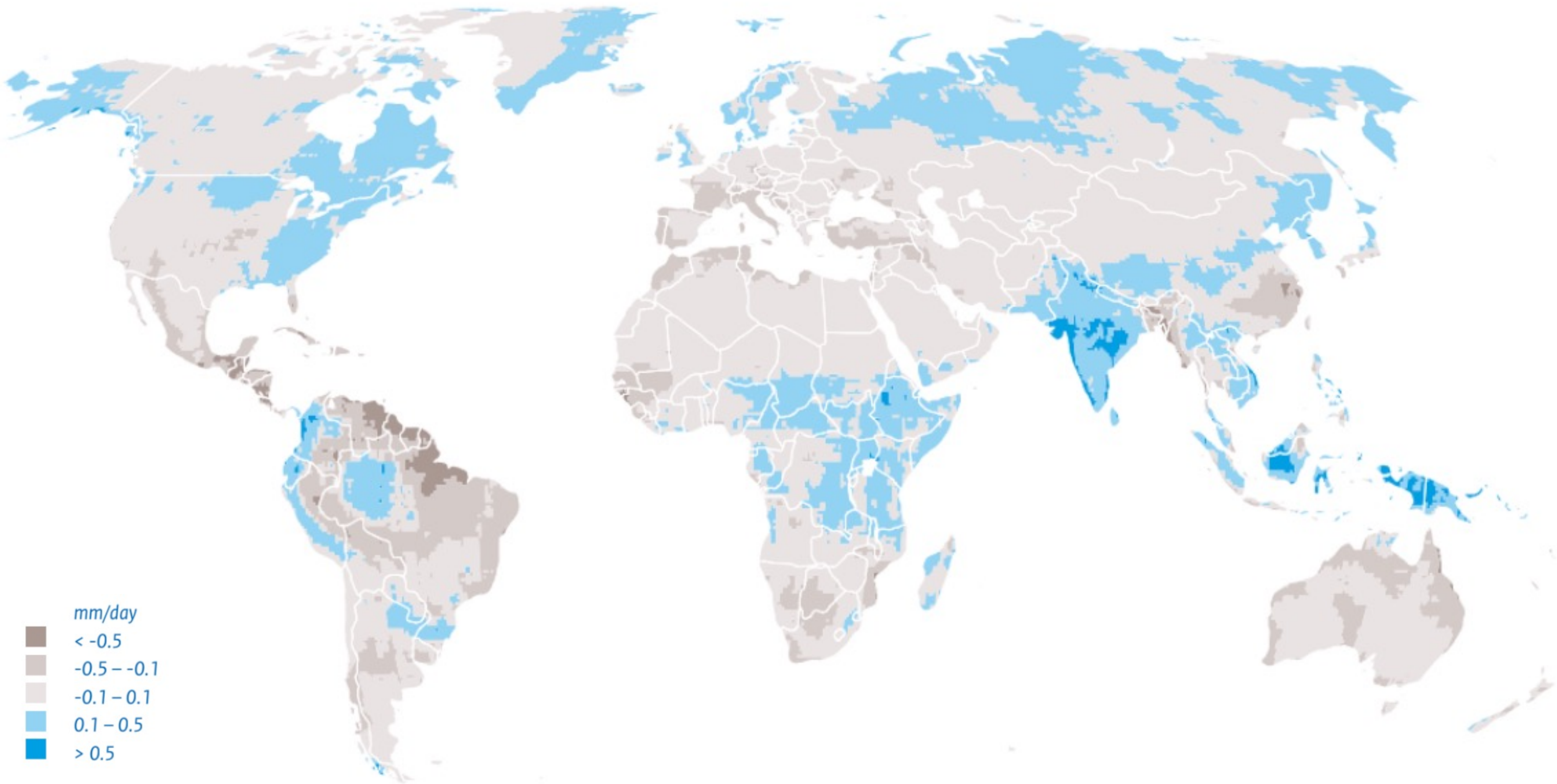
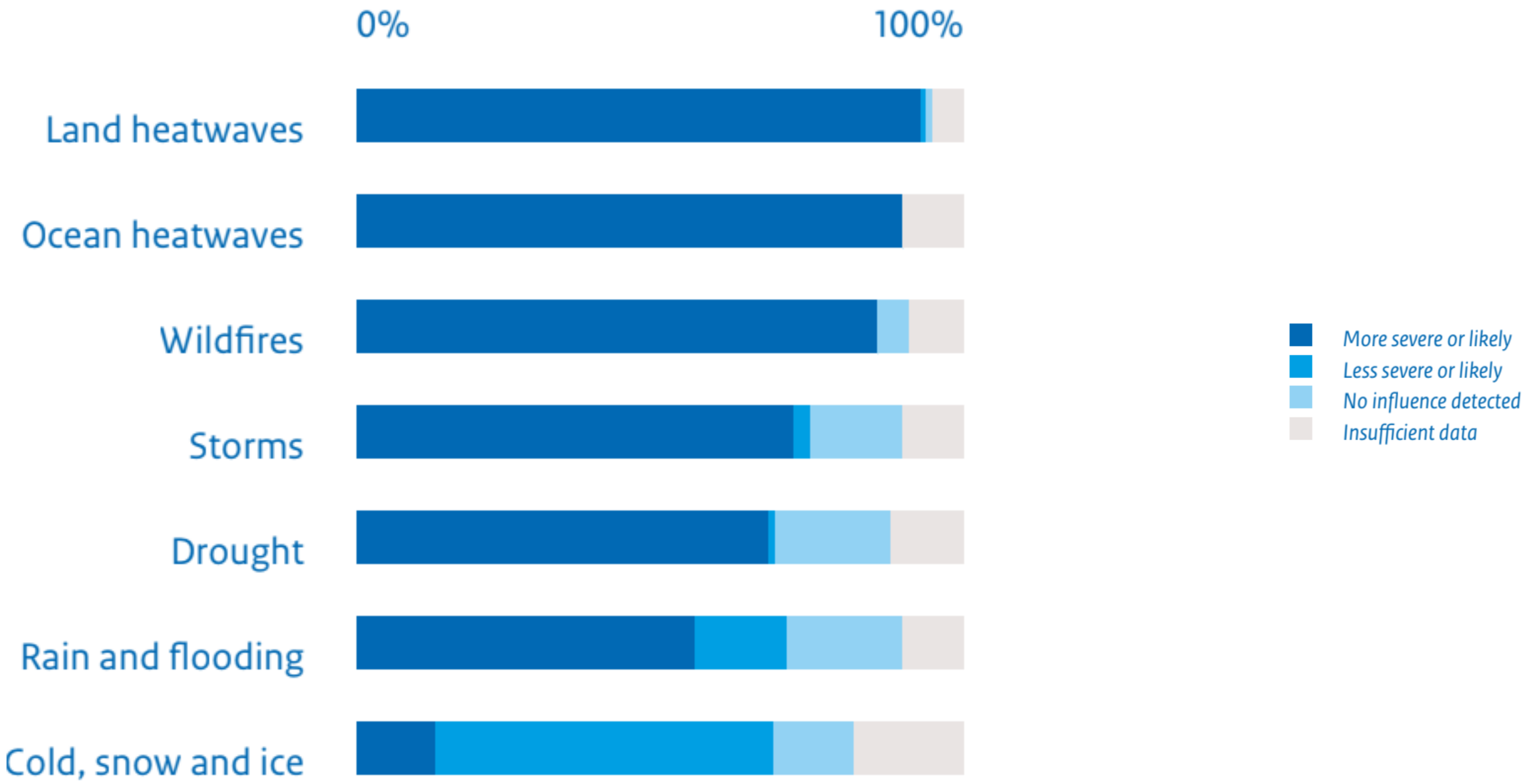
The coming together of the Global Water & Climate crises

We are headed for a 1.5oC Overshoot: Precipitation change (2020-2070)



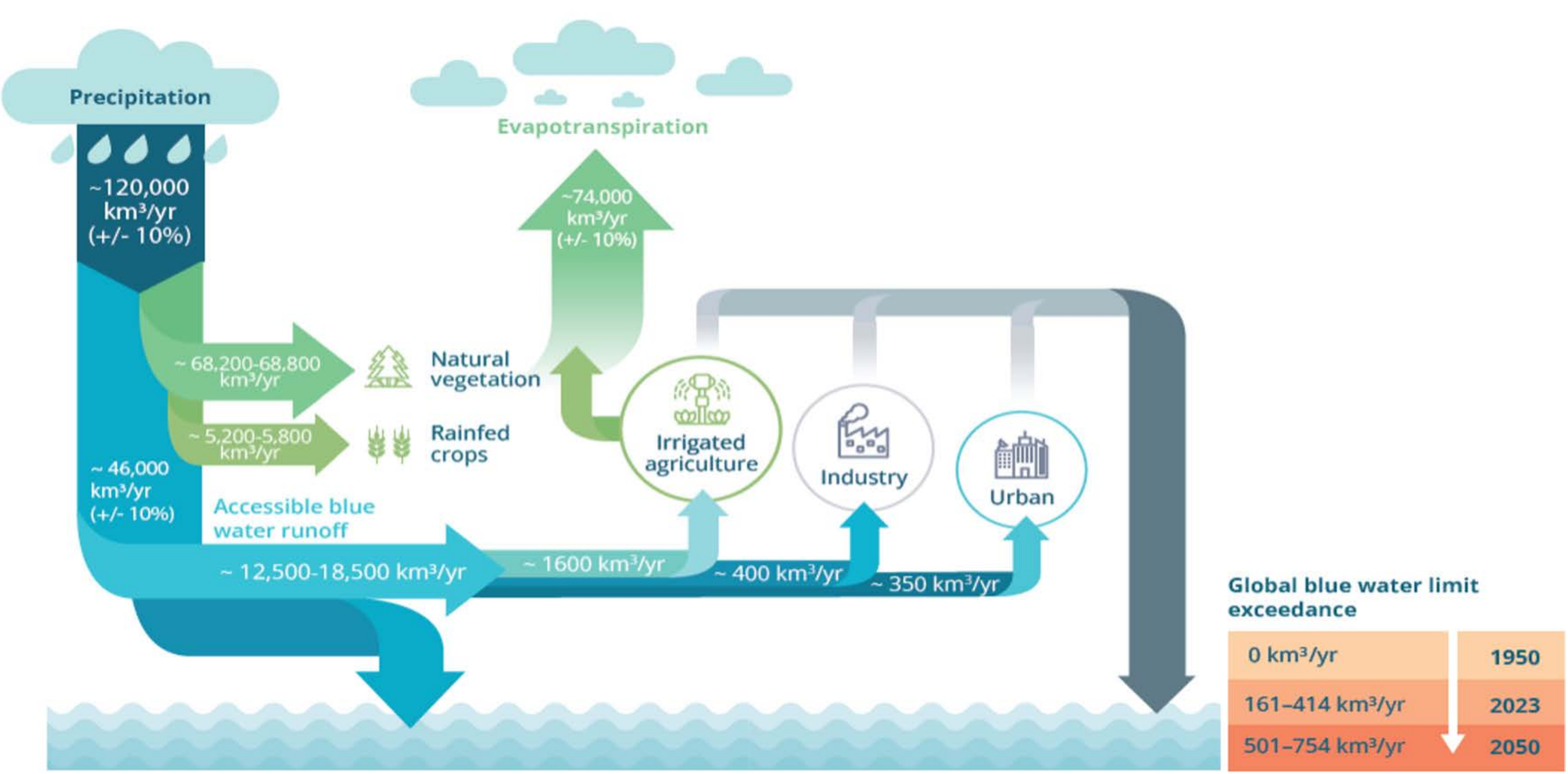
Source: Lange and Büchner, 2017; PBL: the results are based on the projections of 4 climate models

Climate change will only make extreme weather events worse



Source: Carbon Brief, 2022

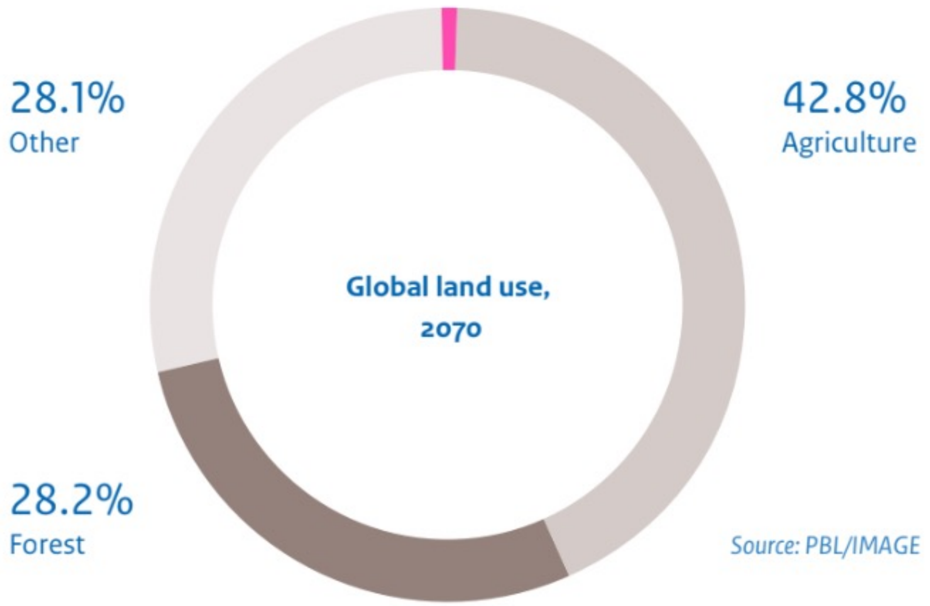
The Global Water cycle is out of balance
The Blue-Green water planetary boundary has been breached



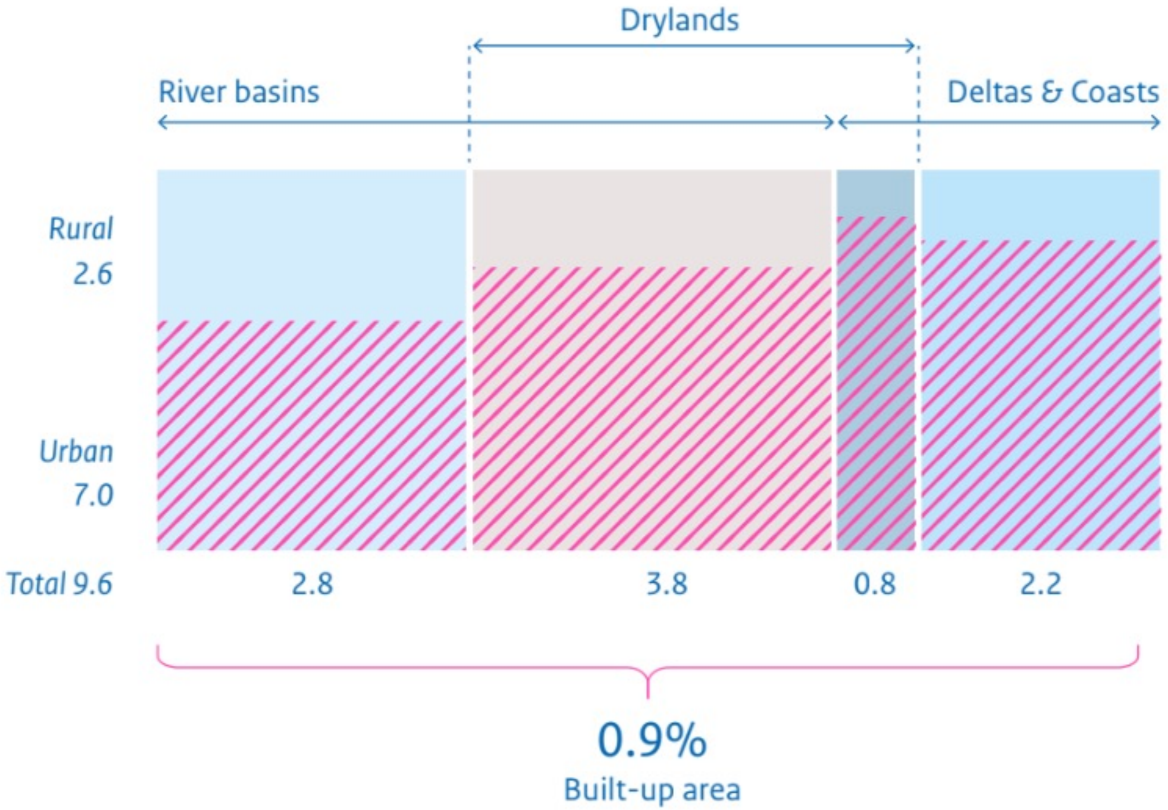
Source: Grafton, Krishnaswamy and Revi, 2023

Image credit: The What, Why and How of the World Water Crisis, GCEW, 2023

Projected Global Land use & Population distribution (2070)



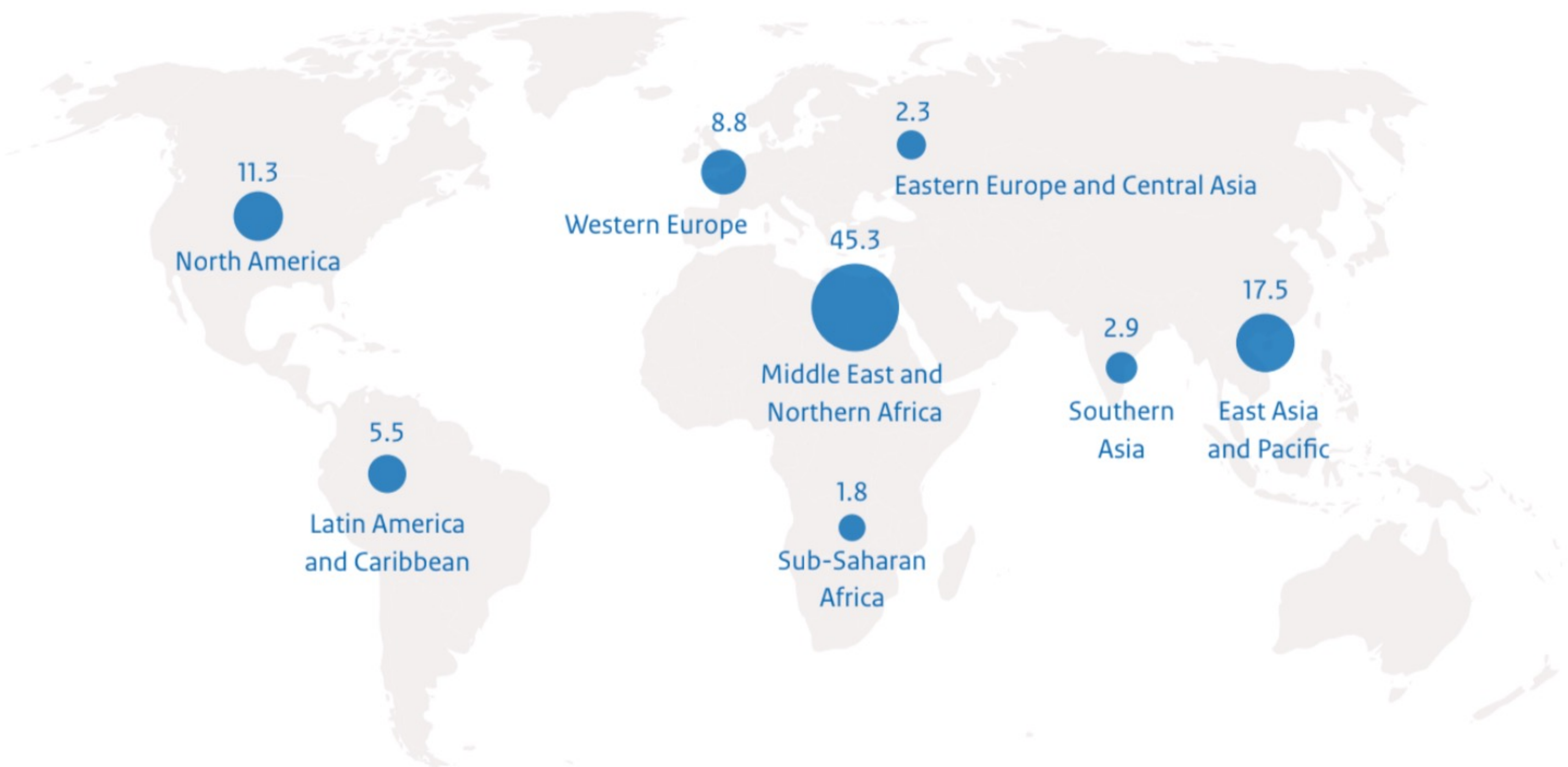
Projected Global Land use distribution (2070)



Projected Global Population distribution (2070)

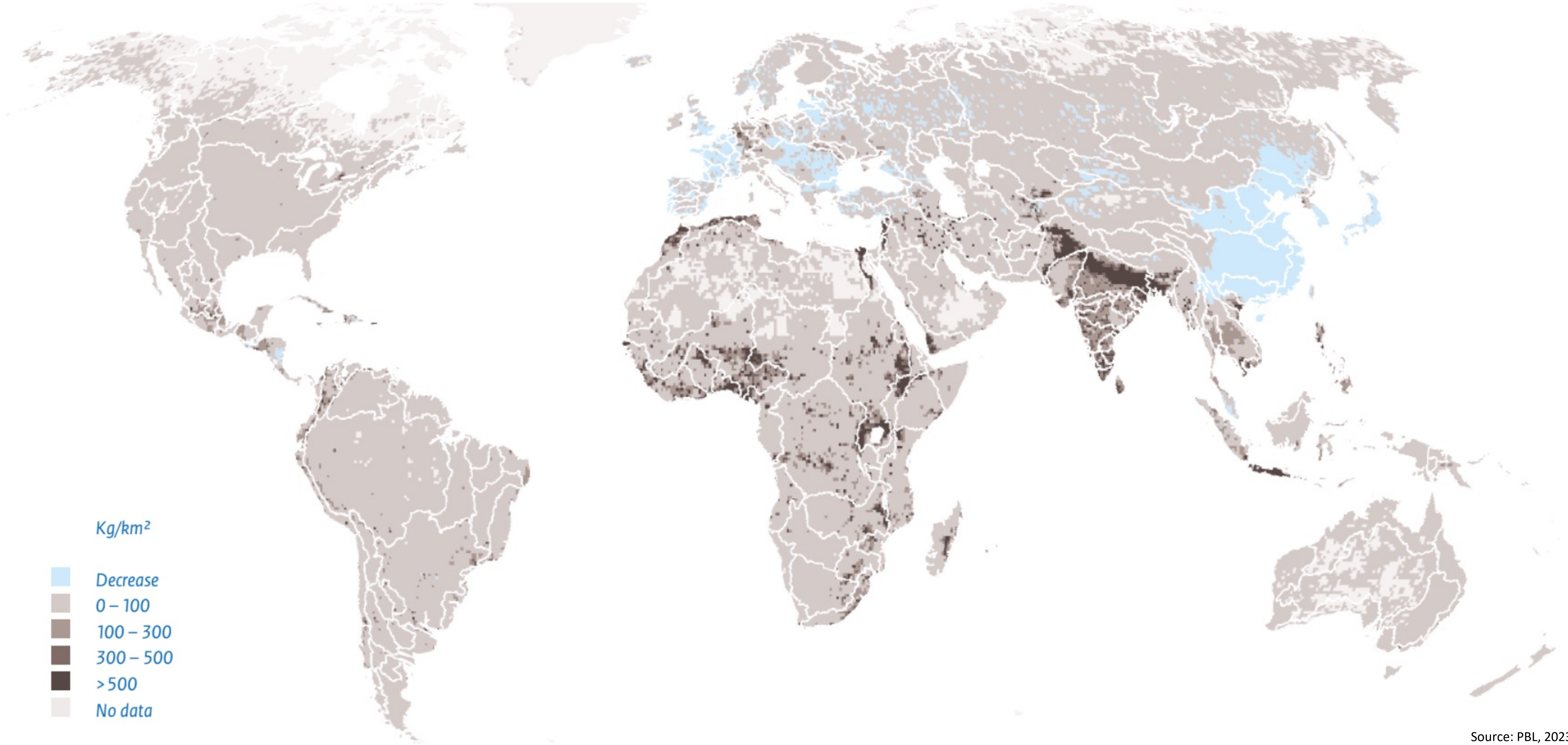
Source: PBL/IMAGE, 2023

Water quality constraints: Desalination capacity (m. m³/day)(2019)



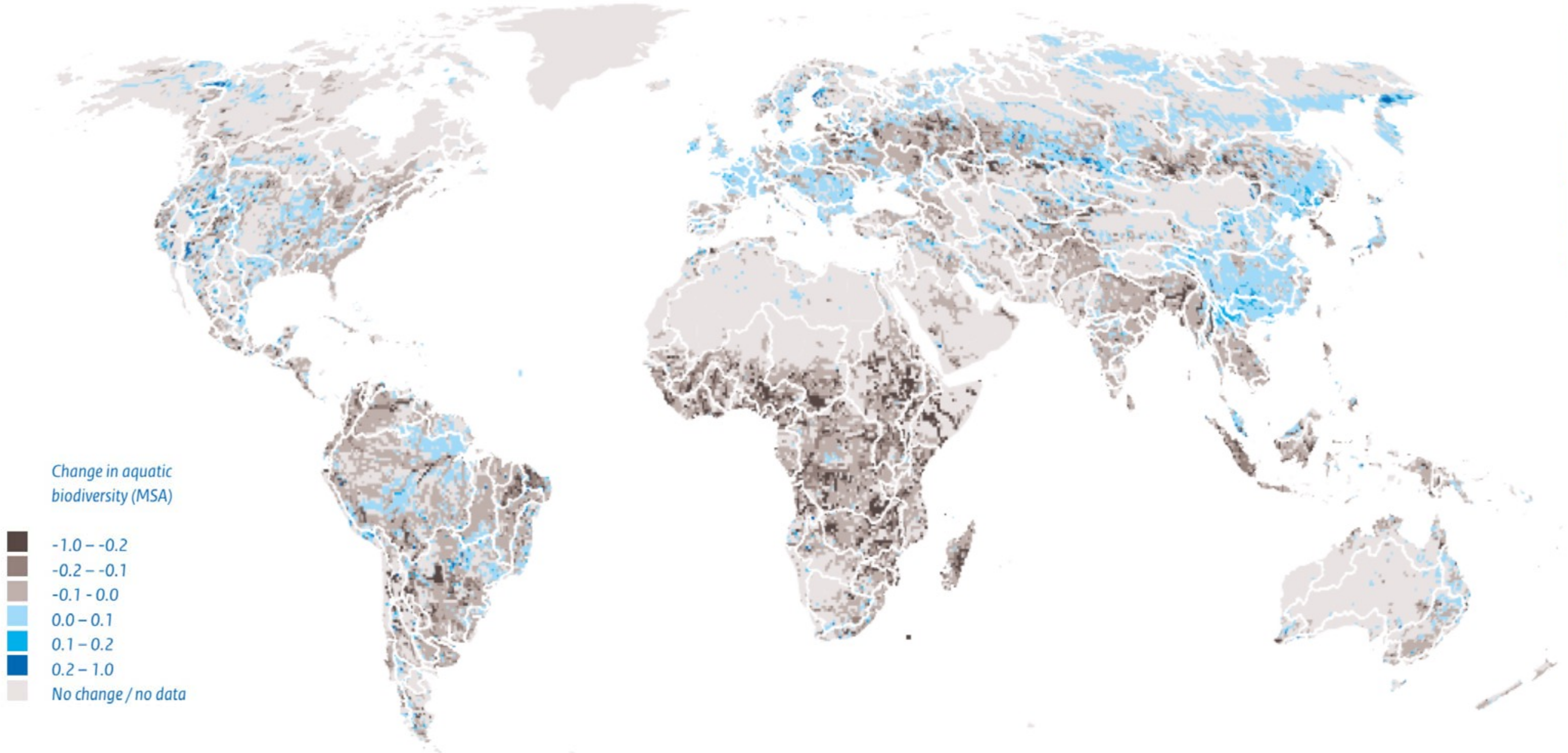
Source: Jones et al., 2019

Changes in Urban Nitrogen release (2020-70)



Source: PBL, 2023

Aquatic Biodiversity changes (2015-70)



Source: PBL/GLOBIO, 2023

Climate Resilient Development: mapping the WSS solution space

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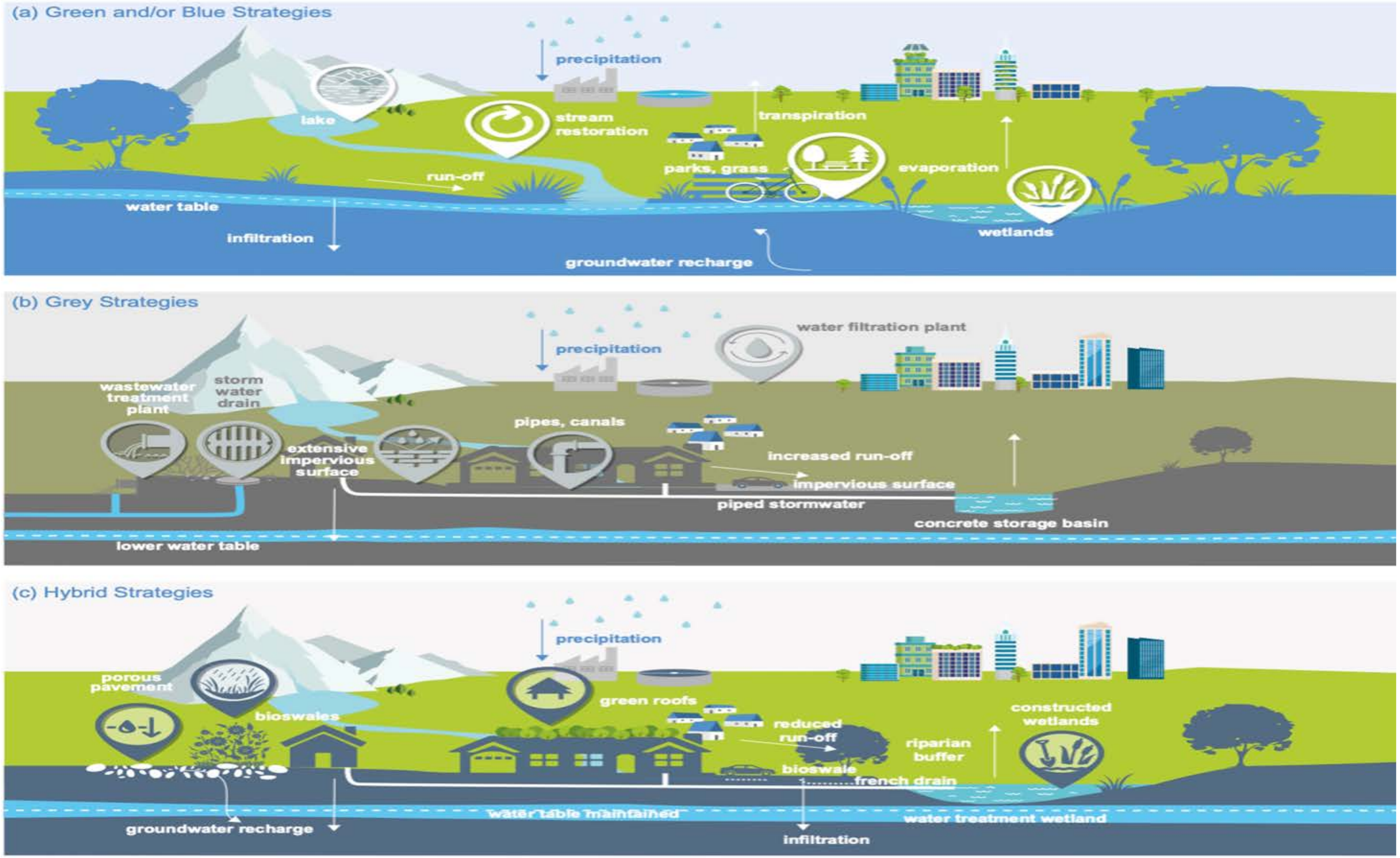
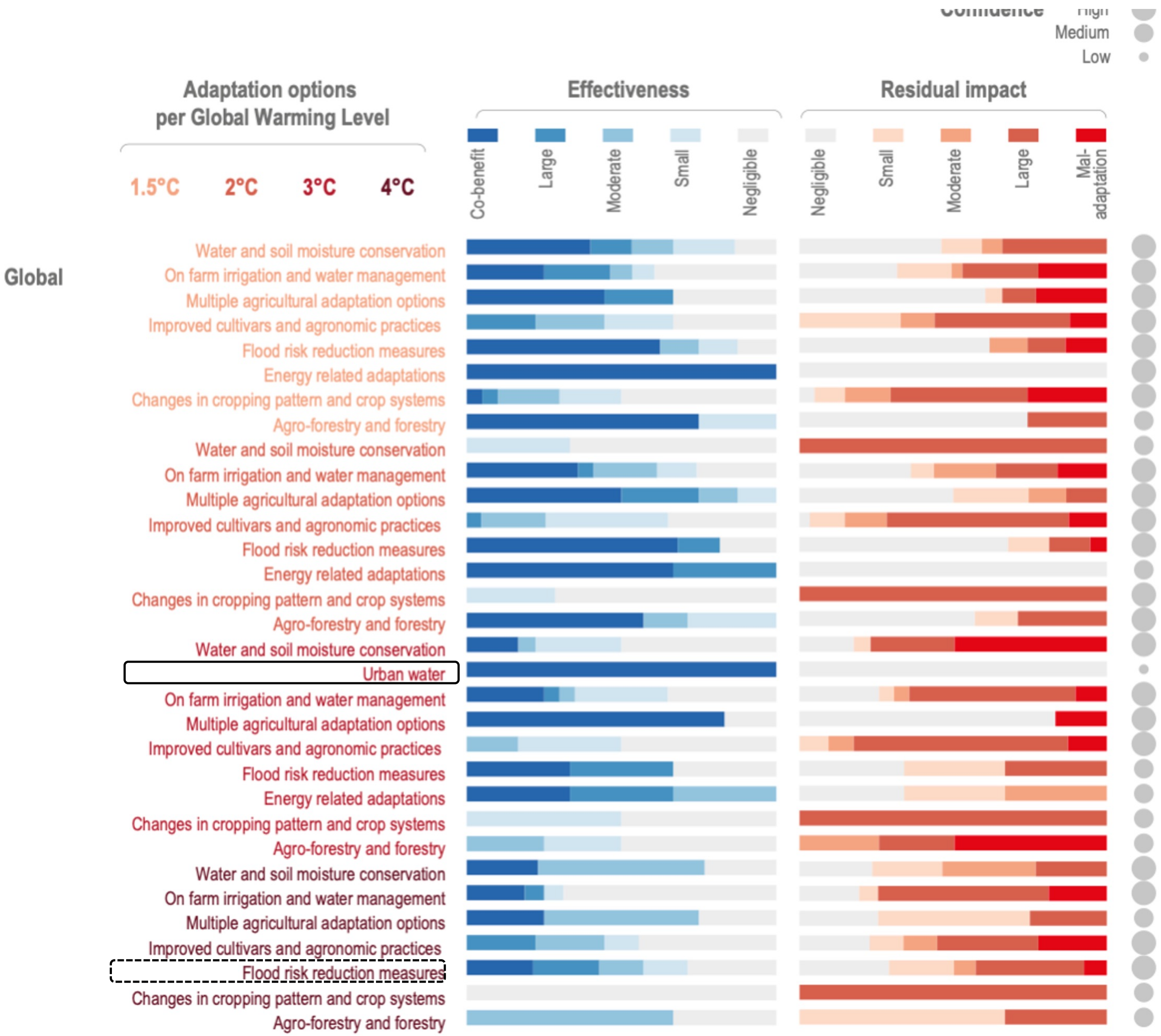
Strategies to address the various colours and hues of water (2015-70)



Source: IPCC 2022, WGII

Water-related Climate adaptation Options (2015-70)



Source: IPCC 2022, WGII

Where do we need to get?

GLOBAL COMMISSION on the ECONOMICS OF WATER

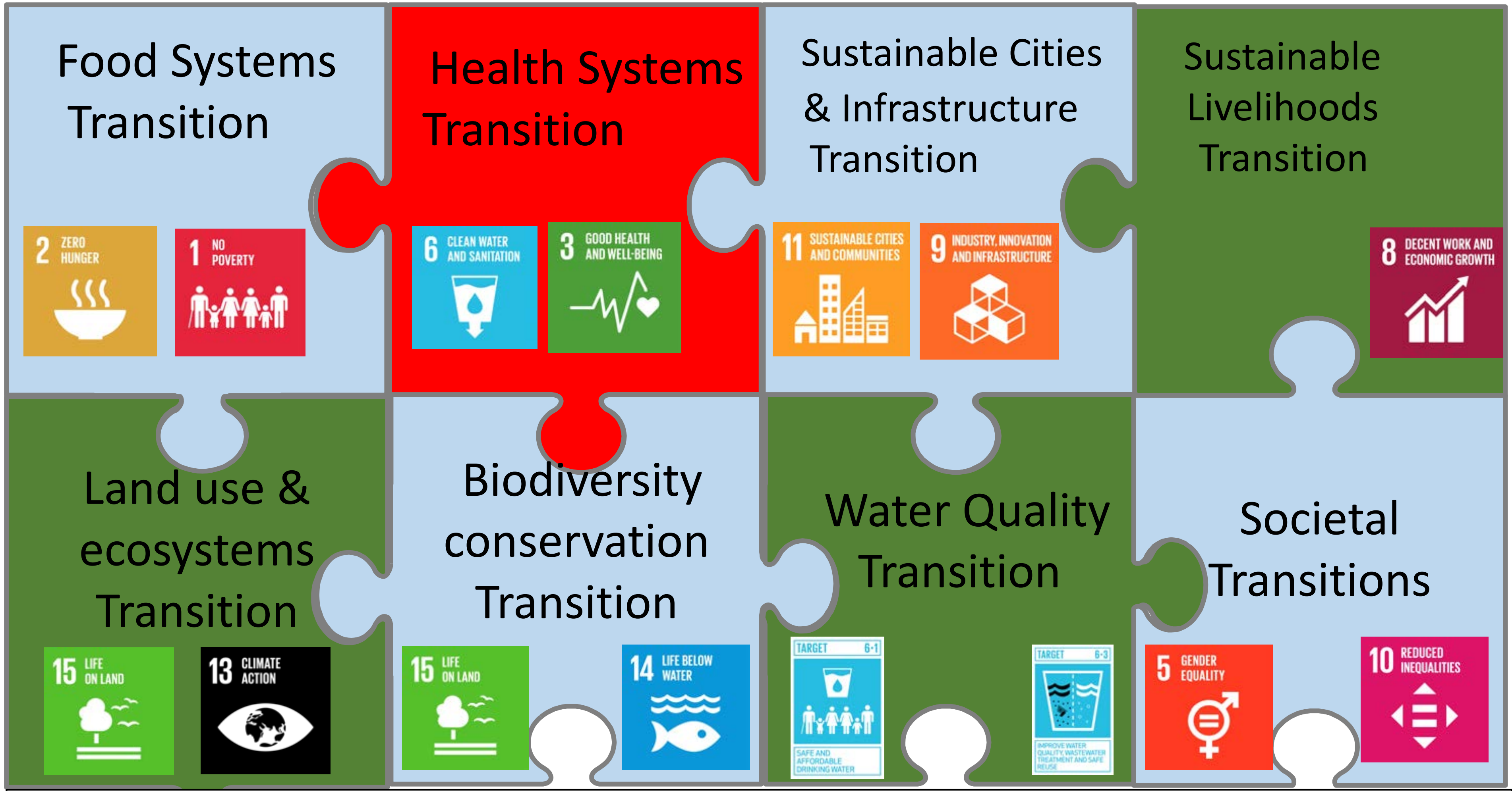
The safe and just delivery of human well-being & ecosystem health by 2050 is fundamental to our future.

This must be met within global water limits.

Transformational change, from the local to the global.

Water SDGs + Climate Action + Biodiversity conservation

How can we implement Transformational WSS change?



Governance & Regulation + Finance + Institutional Capacity + Technology & Innovation

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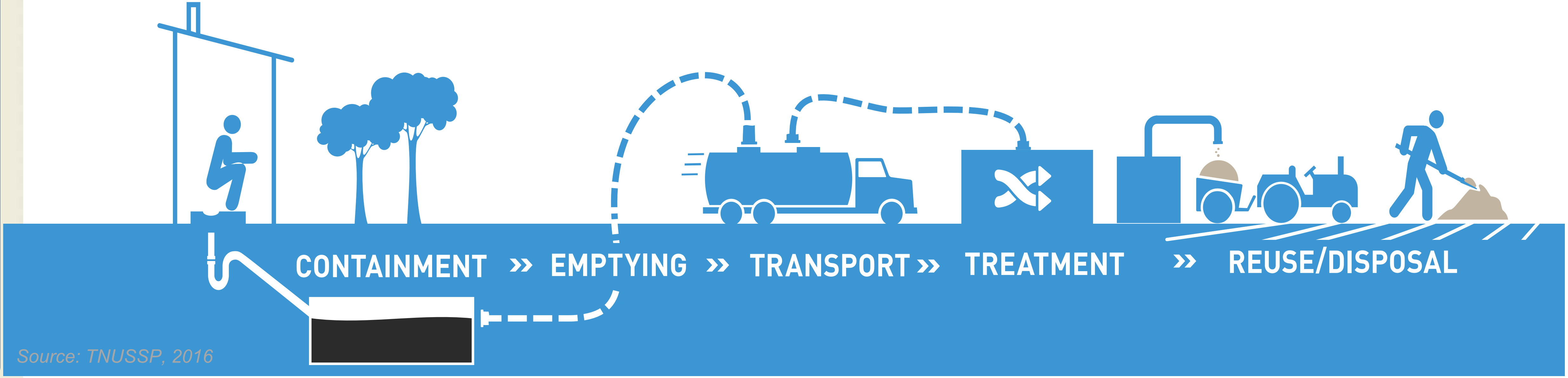
TN US SP

Scaling Inclusive Sanitation in Tamil Nadu, India

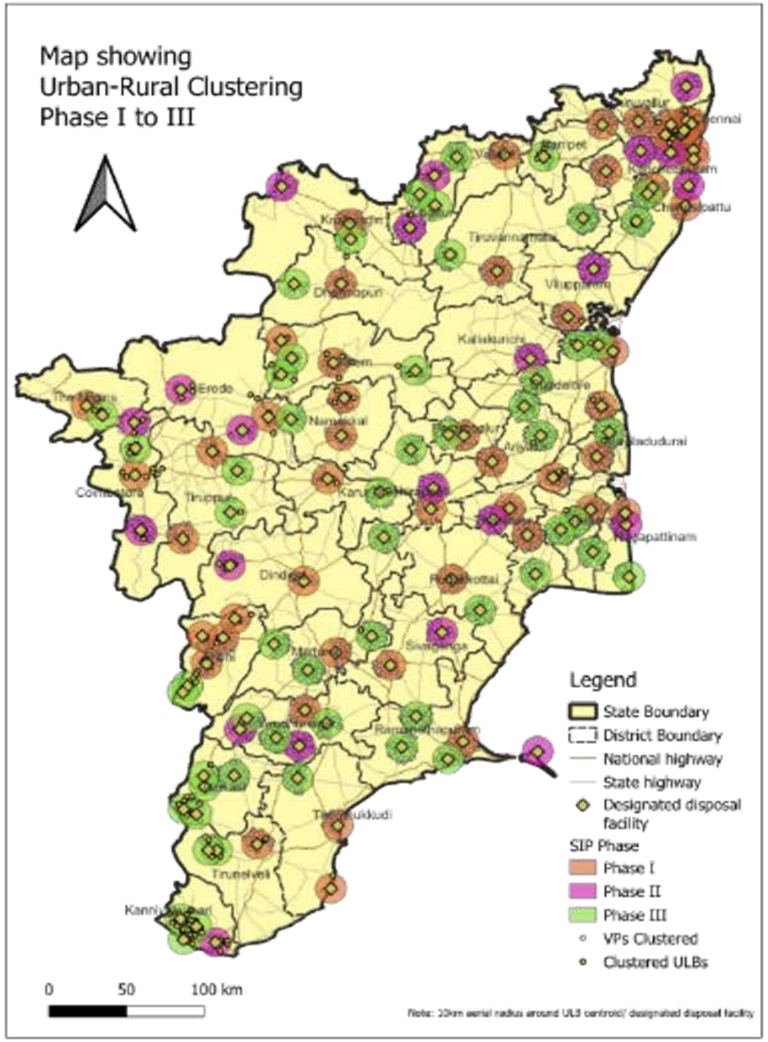
1. Sanitation for All - Now
2. Full Cycle of Sanitation
3. Across Cities

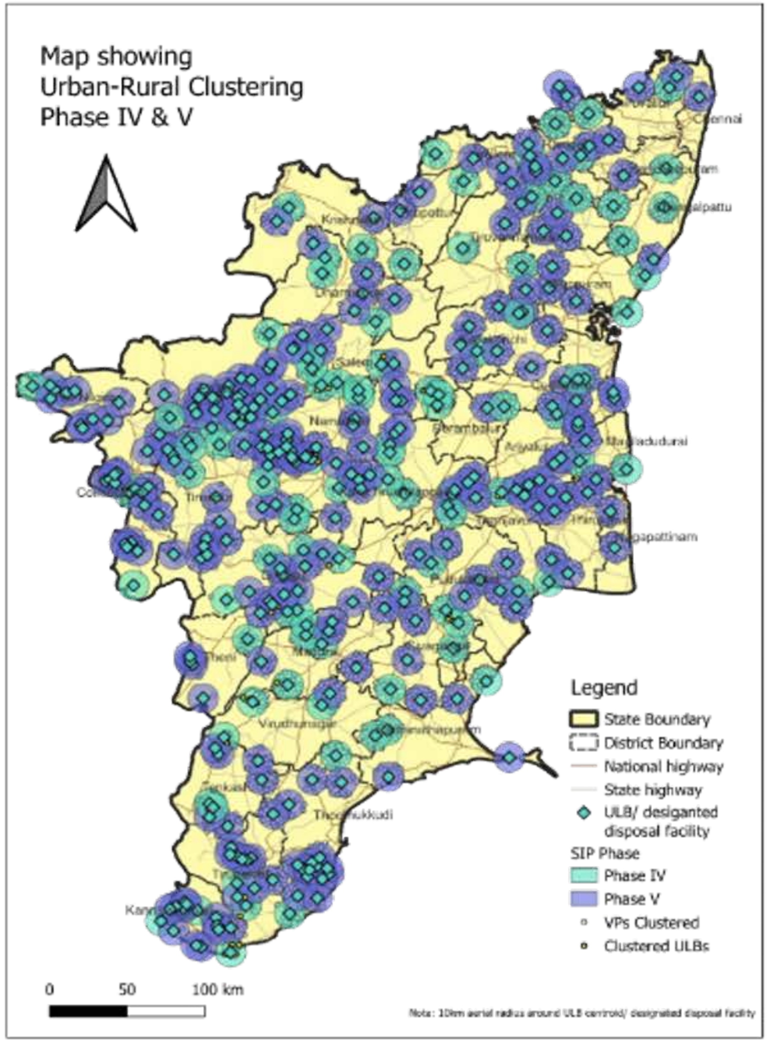
6 CLEAN WATER AND SANITATION

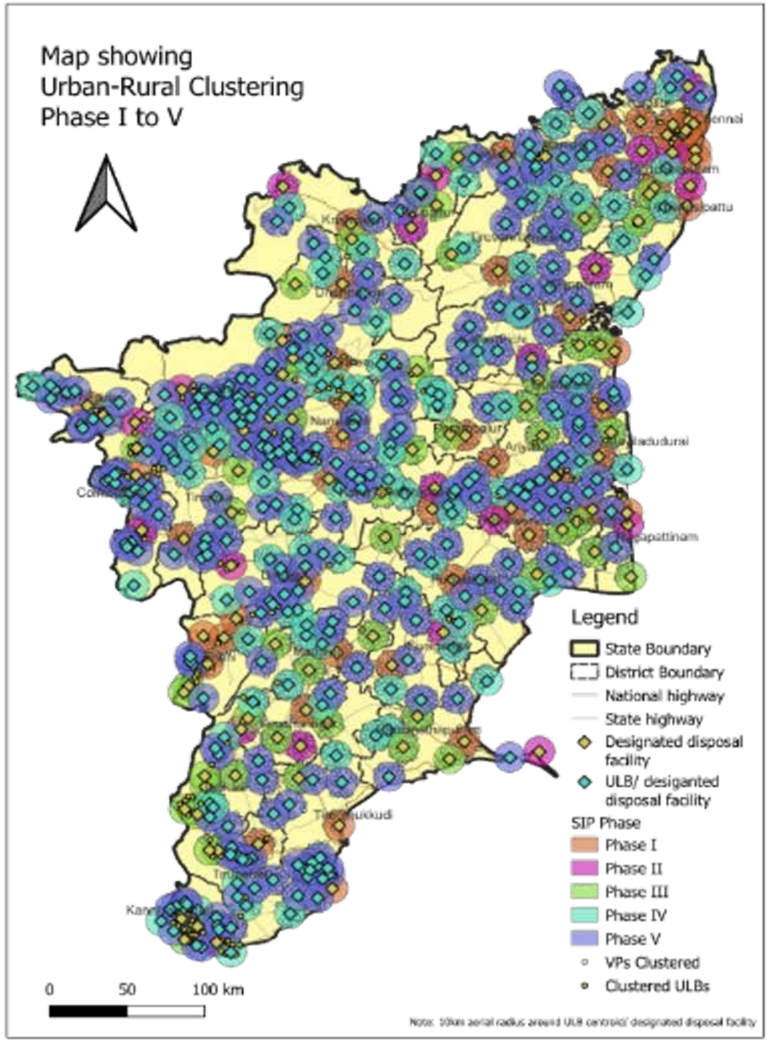


Source: TNUSSP, 2016

Spatial Coverage of FSM in Tamil Nadu: ~16 million people







Source: TNUSSP Analysis, 2022

Impact at the State Level: Population served: ~16 million

Scaling and Sustaining FSM

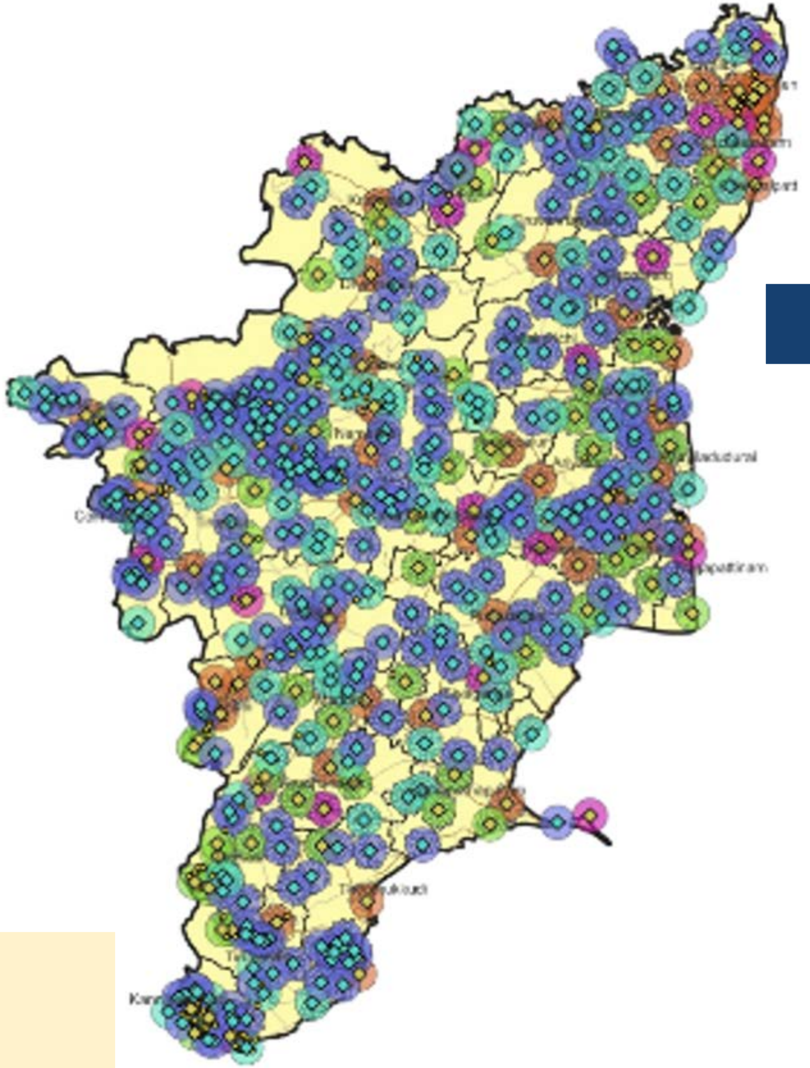
- Significant **investment** in treatment infrastructure.
- **Quality Assured** Implementation:

  51 FSTPs (1.5 MLD capacity)

  Co-treatment at 59 STPs (1,200 MLD capacity)

Strengthened Institutional FSM capacity

Enabling Inclusive FSM



Challenges

- Sustaining operations & maintenance
- Regulating non-standard on-site systems
- Regulating de-sludging operations including occupational health, safety of workers
- Securing land for setting up treatment facilities

State Investment Plan (SIP): Phase-wise Scale-up

1. Expand existing FSTP treatment capacity through **Co-treatment**
2. Create new Fecal Sludge Treatment Plants **(FSTPs)** across the state
3. Scale access to treatment through the **Cluster Approach** across the urban-rural continuum

Details	Phase I	Phase II	Phase III	Phase IV	Phase V	Urban-Rural	Grand Total
	Co-treatment		New FSTPs				
No. of treatment facilities	65	28	56	103	250	-	502
Total ULBs covered	102	40	121	136	250	-	649
Cumulative population coverage	**40%**	**60%**	**75%**	**81%**	**100%**	-	**26,577,880**
Village Panchayats	1,199	533	1,338	2,053	4,221	3,181	12,525

Crowding-in Public investment: ~ INR 500 crores (USD ~60 m)

Impact of TNUSSP-CWIS

ACCESS	CONTAINMENT	COLLECTION & CONVEYANCE	TREATMENT & REUSE
Improving safe sanitation for urban poor	Improving Onsite Sanitation Systems (OSS) for Large Generators and Individual Household Toilets (IHHT)	Light-touch regulation of private desludging operators	Improved treatment capacity, covering ~15 million urban population through cluster approach
Enabling Community and Public Toilet (CTPT) management	Enabling periodic desludging for CTPT	Monitoring of disposal	Demonstrating reuse methods
		Improved services for urban poor in select locations trialed	Treatment technologies adapted to specific requirements

Institutional strengthening and improved governance across the State, Strengthened eco-system & capacity of stakeholders, Behavior Change Communication

3 GOOD HEALTH AND WELL-BEING

5 GENDER EQUALITY

6 CLEAN WATER AND SANITATION

8 DECENT WORK AND ECONOMIC GROWTH

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

11 SUSTAINABLE CITIES AND COMMUNITIES

TN: Legal and Regulatory Reform

Operative Guidelines for Septage Management
2014

2015
TNUSSP-TSU launched
Advisory committee, State/ City working groups

State Investment Plan
(GO (Ms) No. 88)
2018

Tamil Nadu Combined Development and Building Rules
2019

Byelaws for Septage Management
2020

2020
MoU for Cluster Approach
Standard Licensing Agreement for private de-sludging operators
(GO (Ms) No. 2D 35)

Faecal Sludge and Septage Management Chapter (TN District Municipalities Act, City Corporation Acts, Tamil Nadu Urban Local Bodies (Amendment) Act)
2022

Septage Management Rules*
(GO (Ms) No.183)
2023

2023
Operative Guidelines for Septage Management **Revised**
(GO (Ms) No. 1)

TNUSSP: Climate resilience & Emission-reduction questions

- **Health-benefits**

- **Water efficiency: keep water-carriage running**
  - Data on water efficiency & quality
  - Recycling and reusing water: financial viability for industrial and agriculture use?
  - Solids → regenerative agriculture or biochar

- **Emission reduction: net-zero WSS services?**
  - Decarbonisation of infrastructure: embodied energy & Carbon
  - Decarbonisation of Operations
  - The business case for emission reduction?

- **Infrastructure Resilience**
  - Prepare for extreme drought and benchmark with desalination
  - Prepare for flooding & storm surge – planning intervention & critical infrastructure resilience
  - Prepare for planned withdrawal & relocation

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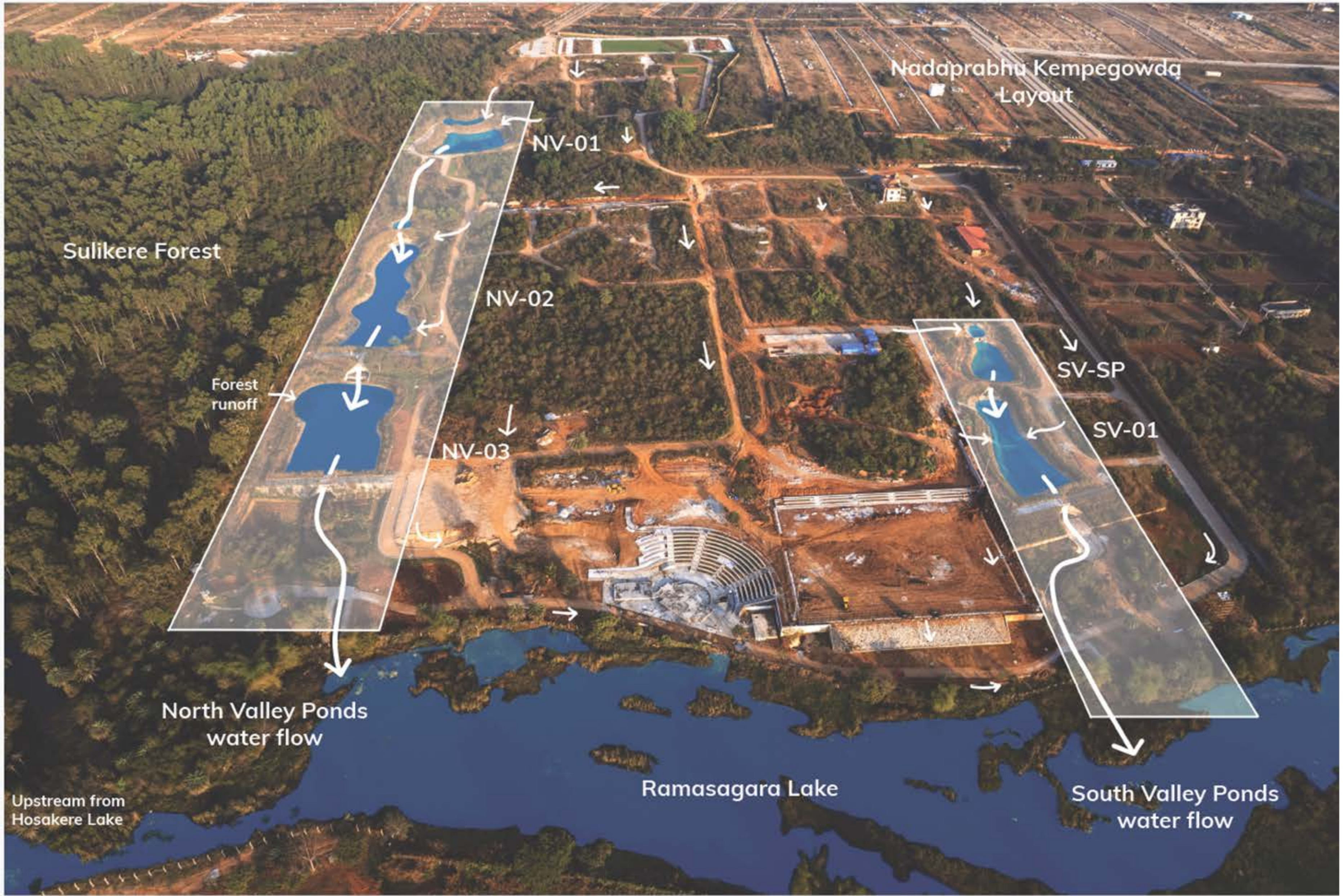
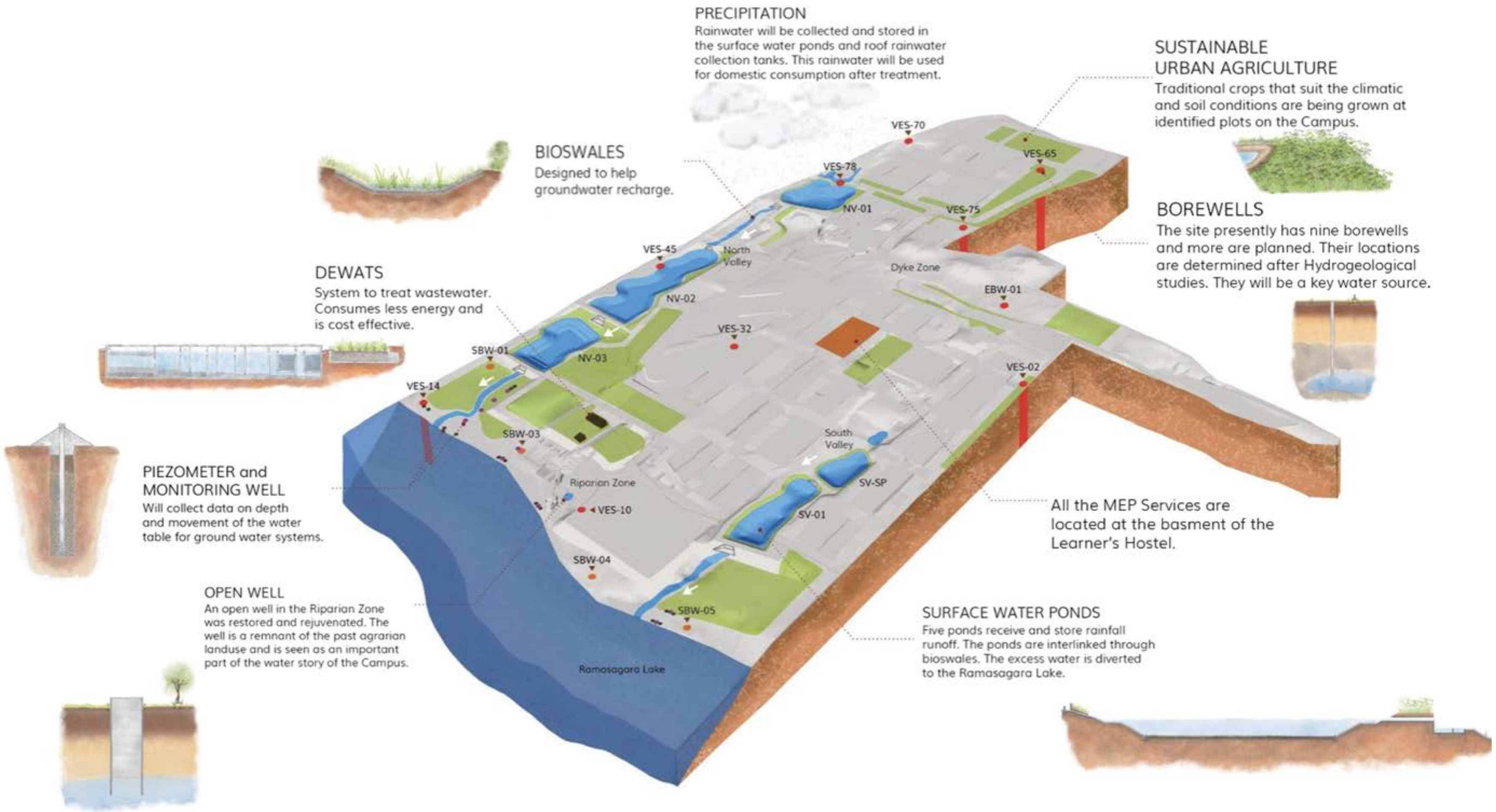
IIHS Campus, Kengeri: Surface Water Flows



IIHS Campus, Kengeri: integrating four major Water systems

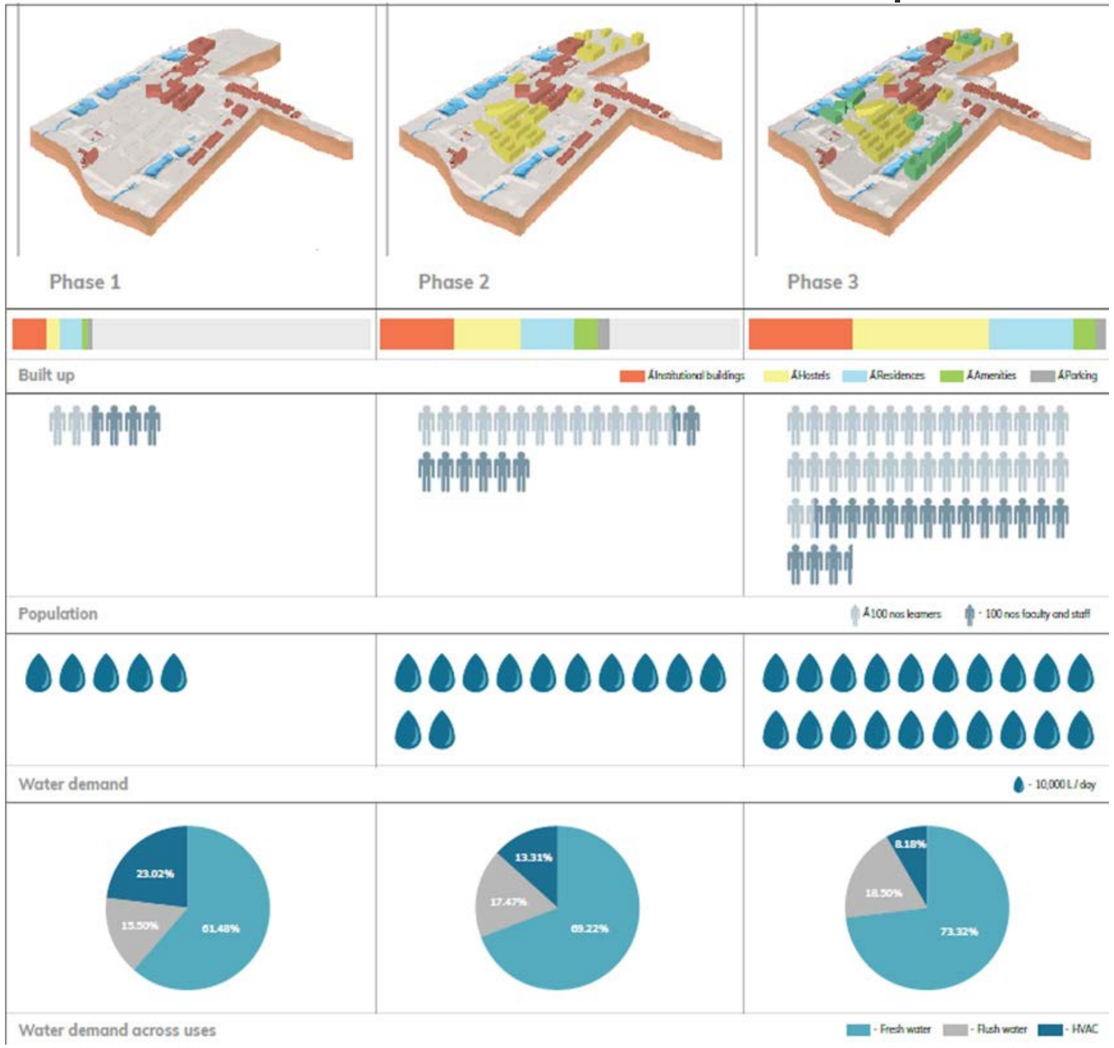


Conjoint Water Use

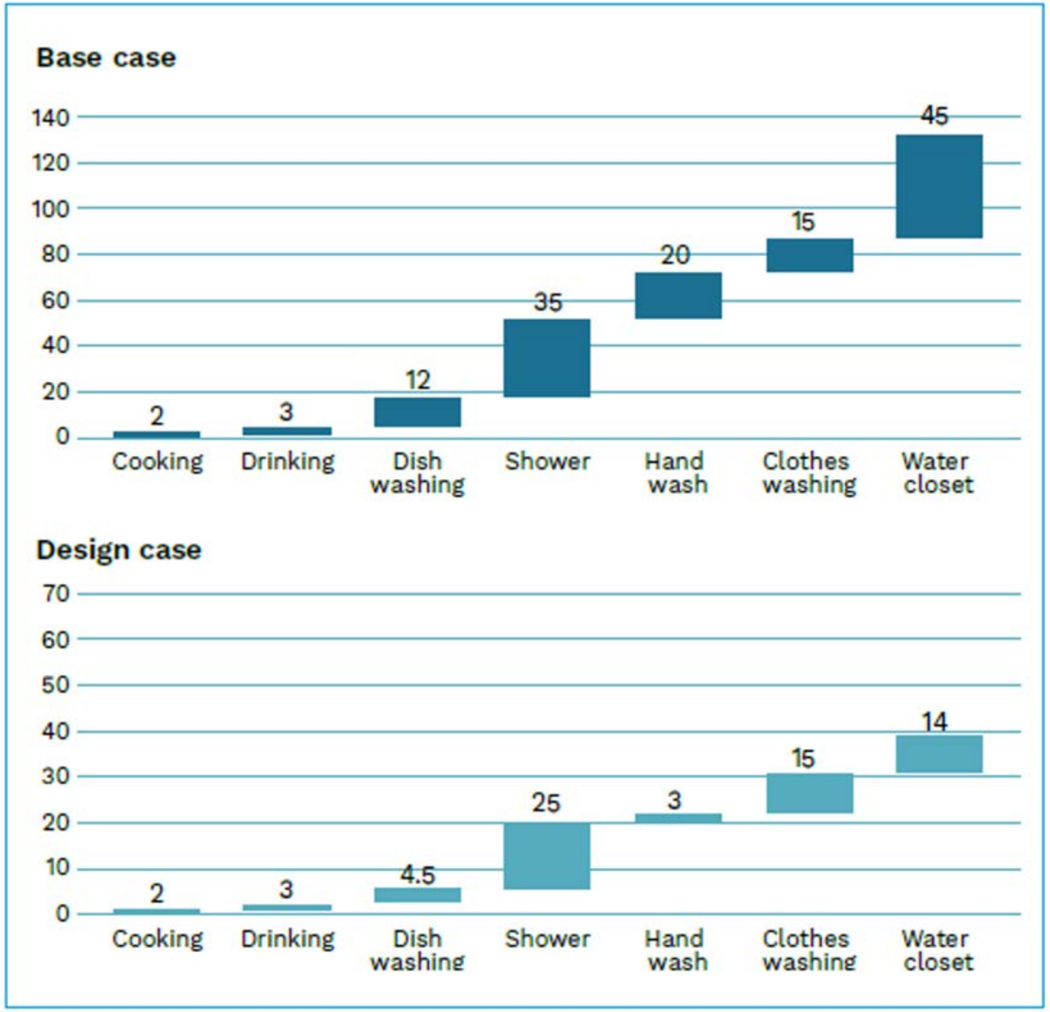
- Surface water ponds
- Shallow groundwater
- Deep groundwater
- Treated tecycled wastewater

IIHS Campus, Kengeri: Factor 2+ water efficiency

Phase-wise area, population and water demand for the Campus



Base case and design case water consumption for different end-uses



IIHS Campus: Climate resilience & Emission-reduction

- Net-zero energy and commercial viability with conjunctive use
- Net-zero water (up to what densities, dual piping, storage & grid connectivity)
- **Regenerative agriculture & biodiversity restoration**
- Near closed-loop recycling & reuse
- Biological → Technolgical treatment system
- Operation & Control systems
- Standards, measurement of water quantity & quality
- Lifestyle & behaviour change

Conclusions

A few WASH-Climate Resilience & GHG Emission-reduction questions

- **WASH** has to be **embedded in the local water cycle** and the larger **Water, Climate, Nutrition security & Biodiversity agenda =** transform ‘Planning’ & ‘Development’
- **Severe gaps in the WASH-Climate evidence chain & narrative**
  - Health impacts, ‘cost-benefit’ and (multi-dimensional) viability
  - Mitigation: small fraction of $C0_2$ + CH_4 emissions. No discussion on embodied C & Scope 3. No discussion on Carbon storage. No surprise that finance is negligible
  - Adaptation:
  - Loss & Damage: conversation hasn’t even started
  - Vulnerability reduction:
  - Culture: gender and caste-dynamics
- **Operationalising Climate Resilience in WASH systems**
  - Drought-resilience: the septage vs. sewerage debate
  - Flood- & SLR-resilience:
  - Storm-resilience: coastal area
  - Nature based Solutions: Blue-Green-Grey-Digital infrastructure and services
- **Urban-Rural linkages: Regenerative Agriculture & Biodiversity restoration & conservation**
  - Recycling and reuse of blue water → green water
  - N and P discharge and nutrient recycling → regenerative agriculture