Welcome to this week's presentation & conversation hosted by the **Canadian Association for the Club of Rome**, a Club dedicated to intelligent debate & action on global issues.

The views and opinions expressed in this presentation are those of the speaker & do not necessarily reflect the views or positions of CACOR.

Food, Energy and Water Security.

Our speaker today is Dr. Quentin Grafton, Professor and Laureate Fellow; Chairholder UNESCO Chair in Water Economics and Transboundary Water Governance. He is a graduate with a B.Ag. Econ (Massey), MS (Iowa State University), PhD (University of British Columbia)

DESCRIPTION: The what, the why, and the how of the world water crisis as presented to Climate Change Canada, and at the recent United Nations water conference in New York City.

The presentation will be followed by a conversation, questions, & observations from the participants.

CACOR acknowledges that we all benefit from sharing the traditional territories of local Indigenous peoples (First Nations, Métis, & Inuit in Canada) and their descendants.

Website: canadiancor.com
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2023 Dec 06 Zoom #174

‘Too Much, Too Little and Too Dirty’ Water

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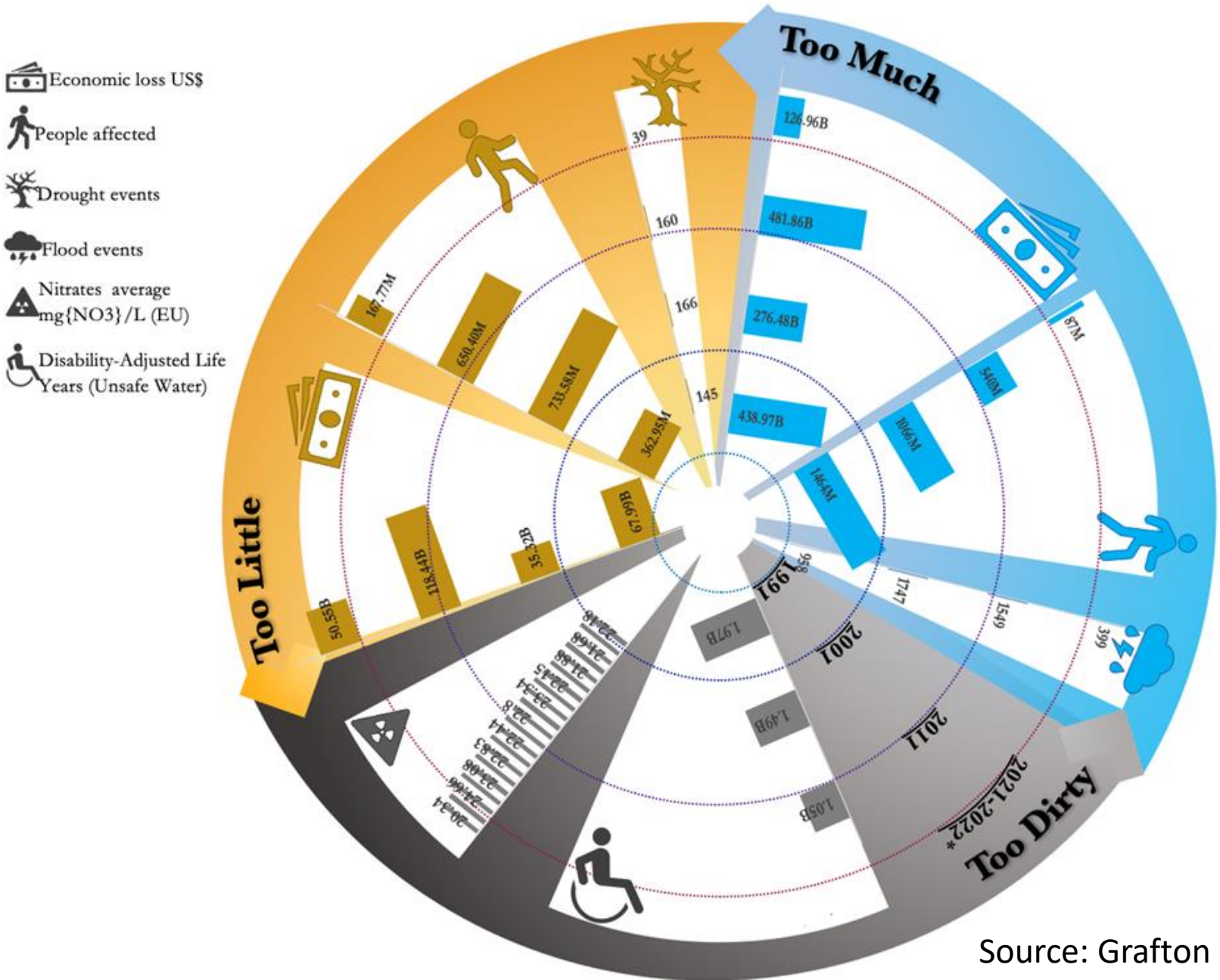
for
Club of Rome (Canada)
6 December 2023

Outline

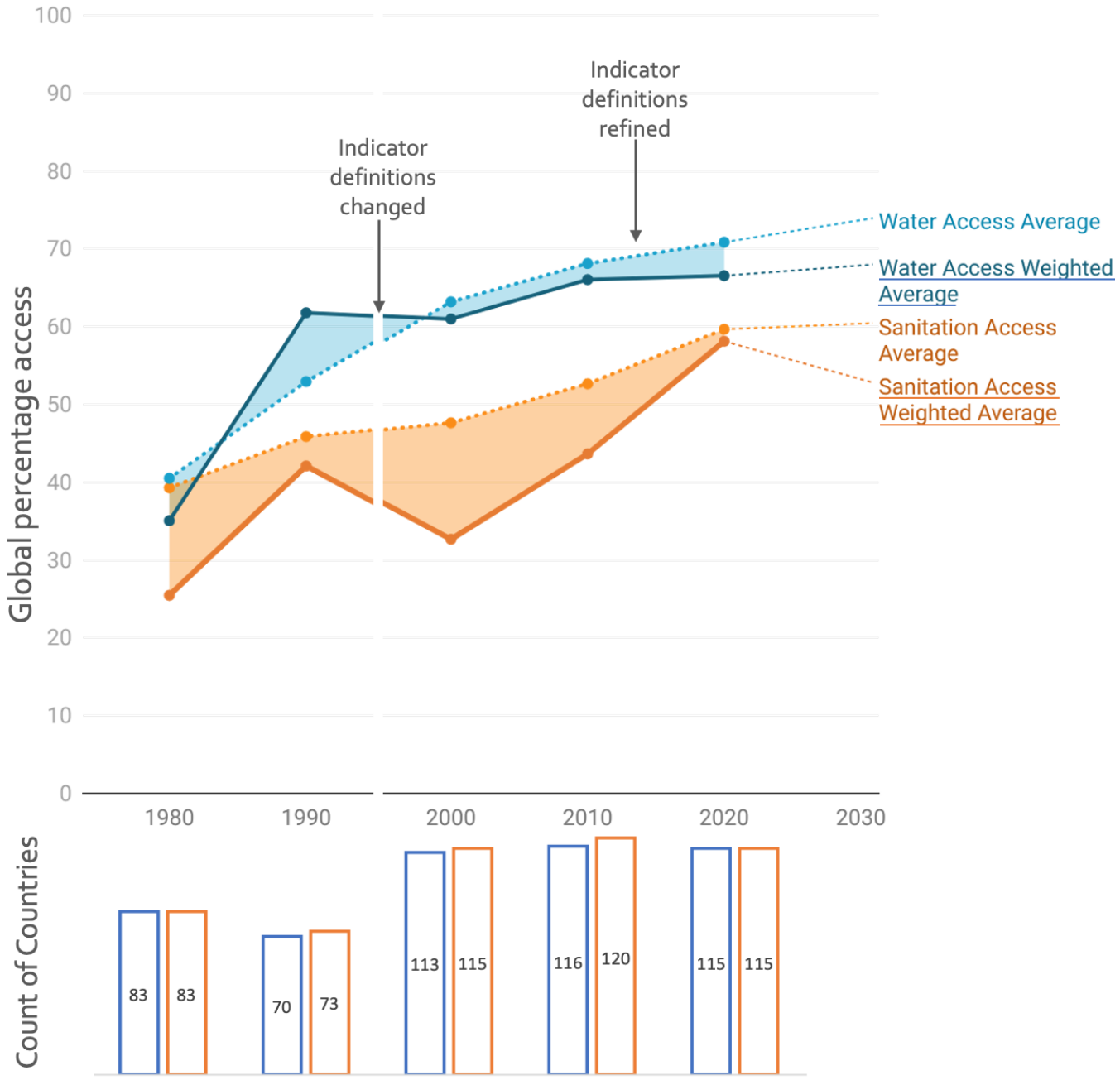
I. Crisis of ‘Too Much, Too Little and Too Dirty’ Water
II. Water Limits and Climate Change
III. The ‘Guess Who’ of Water
IV. Connecting Water to Food, Energy, Environment…(Nexus)
V. Water Futures

I. Too Much, Too Little and Too Dirty Water

World Water Crisis



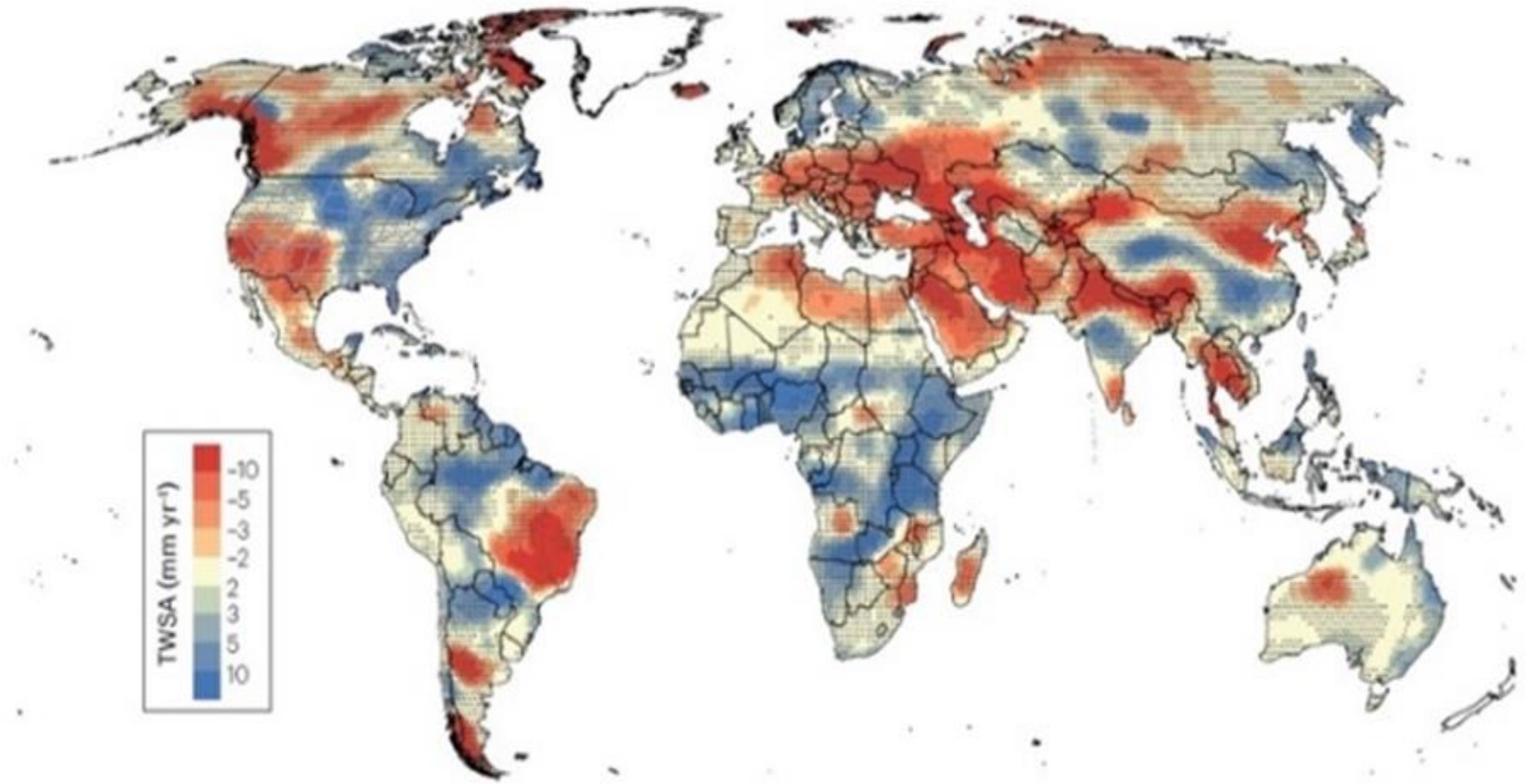
Source: Grafton and Fanaian (2023, Figure 1)



Global access to safely managed water supply and sanitation: Average vs Weighted average by population

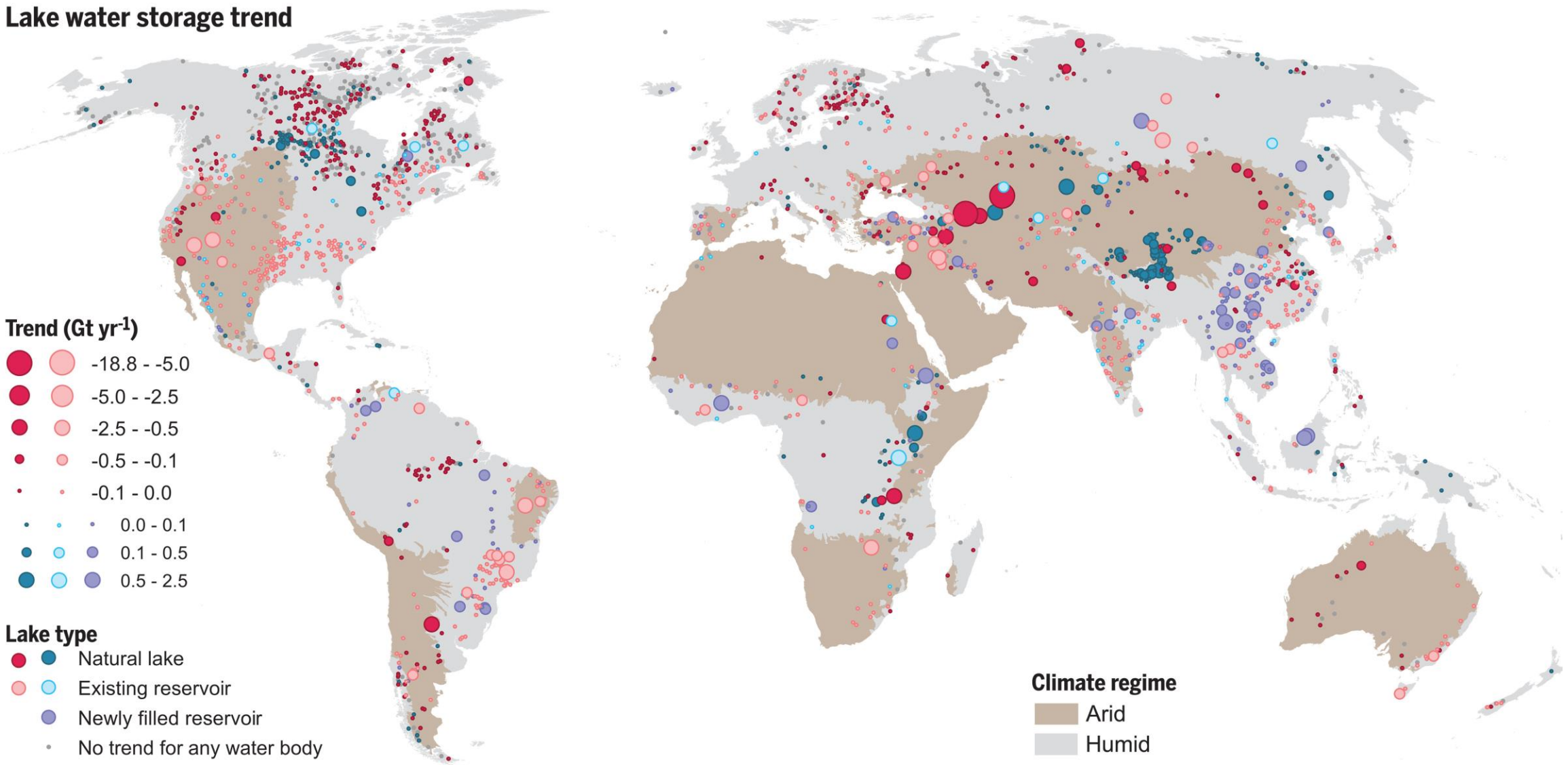
Source: Grafton et al. (2023b)

Trends in Total Water Storage Anomalies (2002-2022)



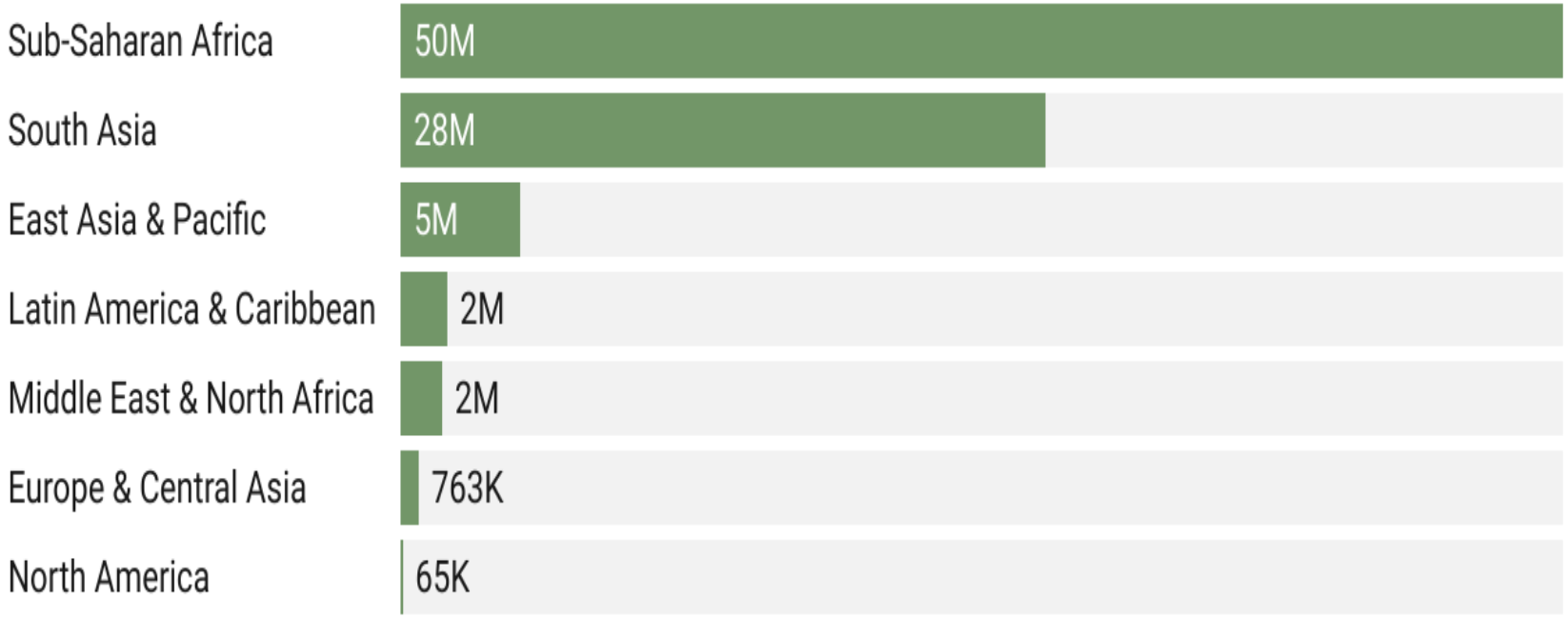
Source: Scanlon et al. (2023)

Δ 1,058 Natural Lakes & 922 Reservoirs (1992-2020) Water Storages

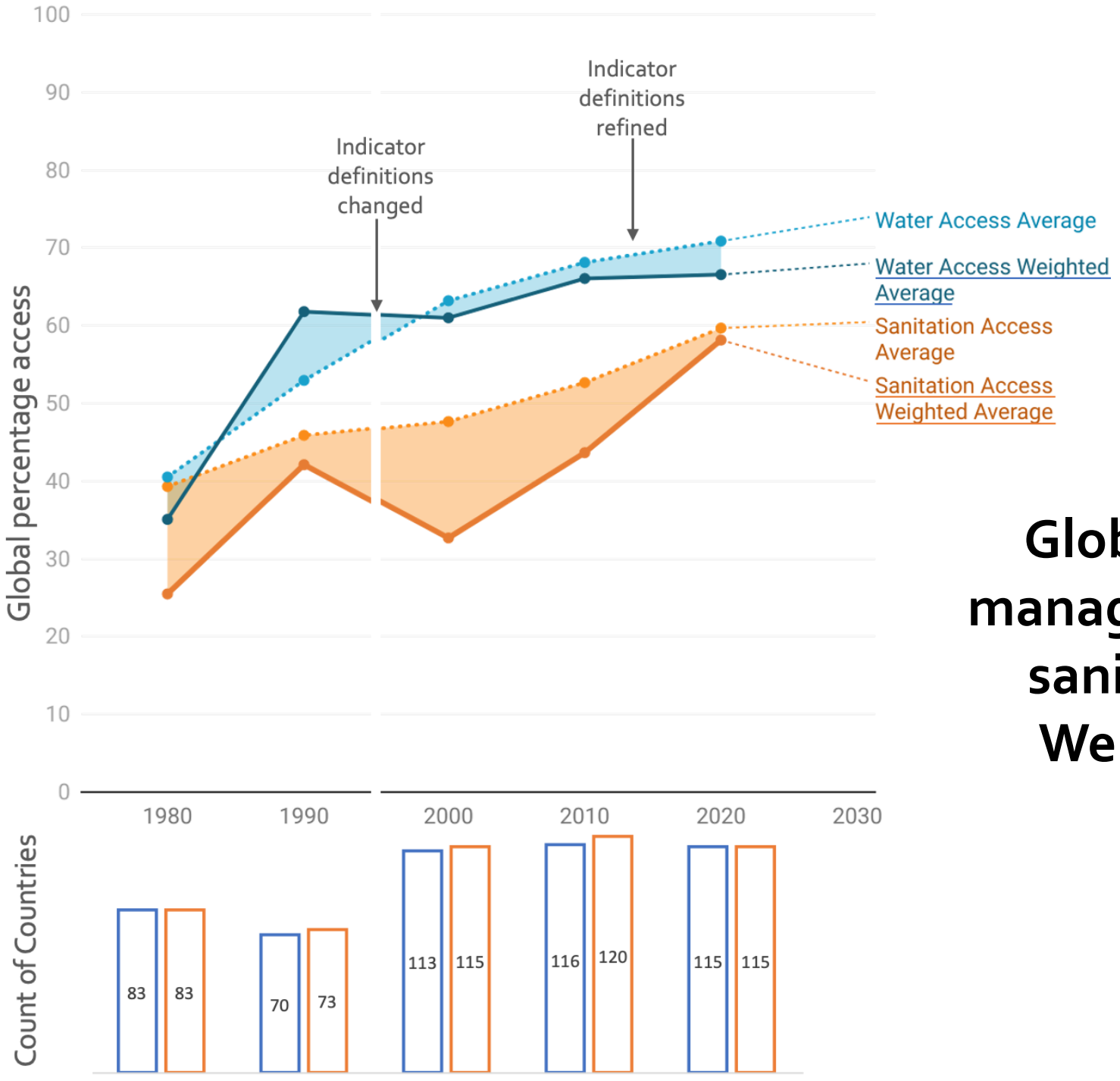


Source: Yao et al. (2023)

Regional Unsafe Water Related Disabilities (DALYs)



Data Source: Global Burden of Disease Study (2019)

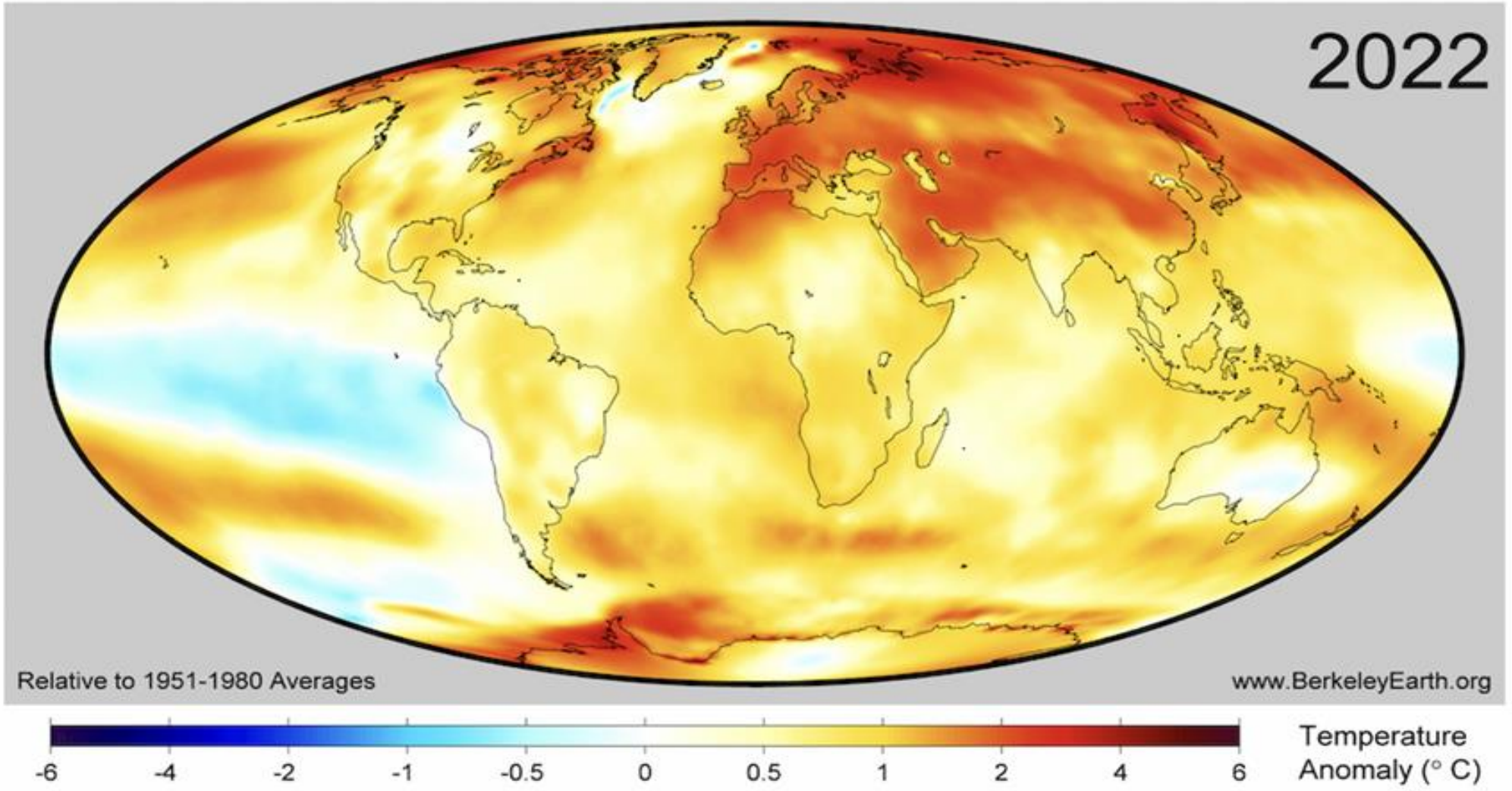


Global access to safely managed water supply and sanitation: Average vs Weighted average by population

Source: Grafton et al. (2023c)

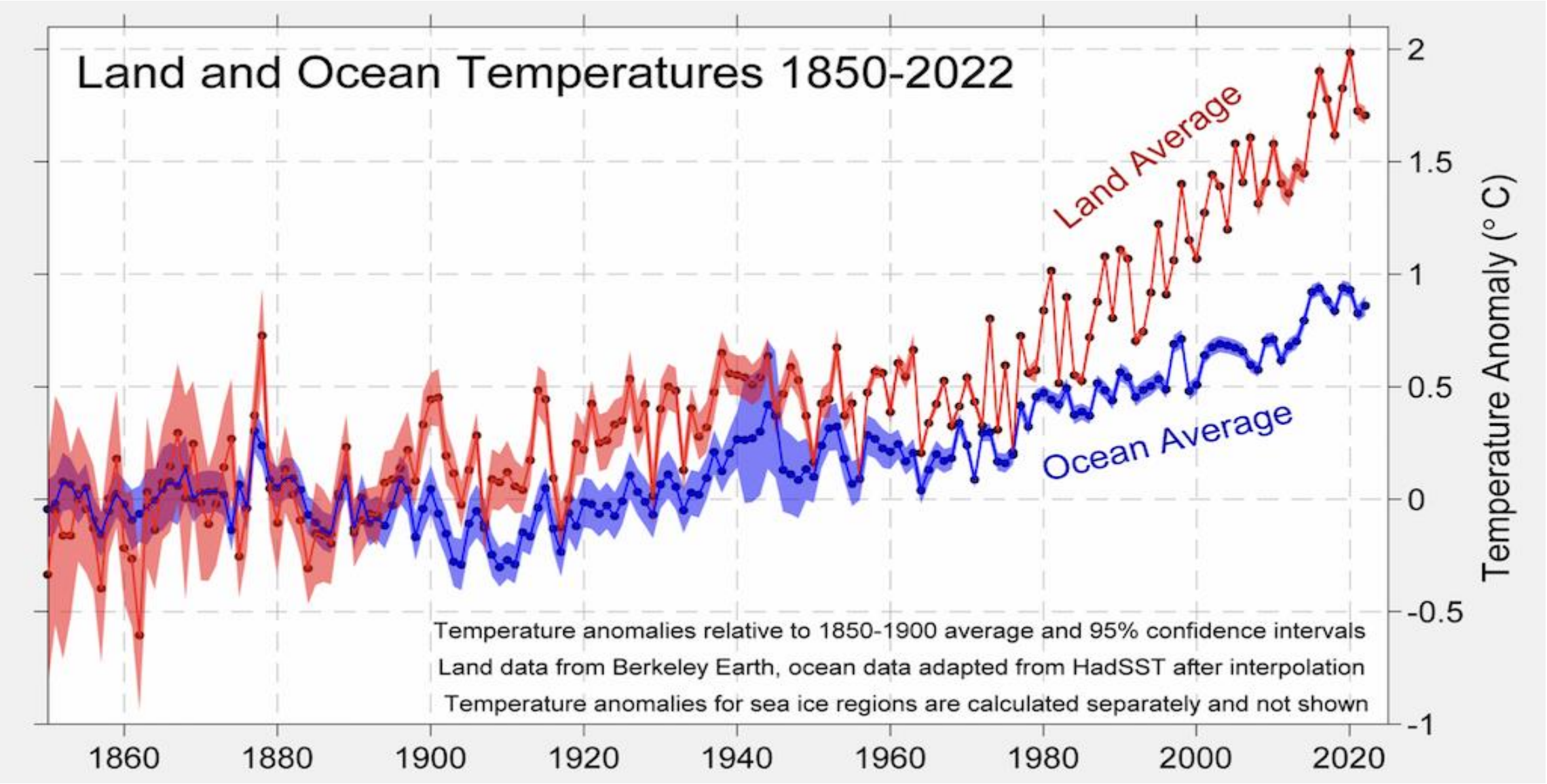
II. Water Limits and Climate Change

2023 will be hotter than 2022..



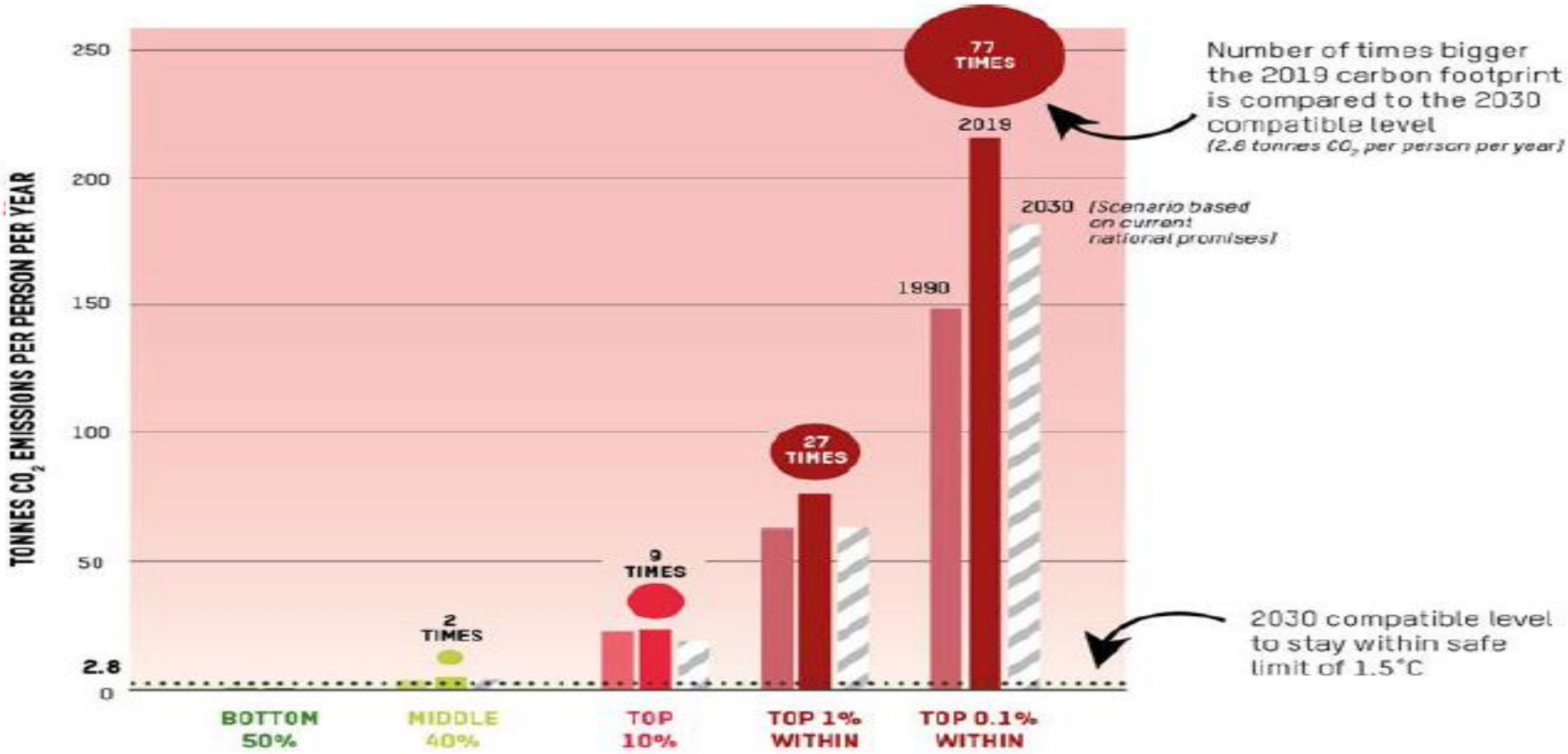
"…stabilization at today's greenhouse gas levels (at 405 ppmv at time of writing) may already commit Earth to an eventual total warming of **5 degrees Celsius (range 3 to 7 degrees Celsius, 95 per cent interval) over the next few millennia** as ice sheets, vegetation and atmospheric dust continue to respond to global warming." Snyder (2016)

And it's getting hotter

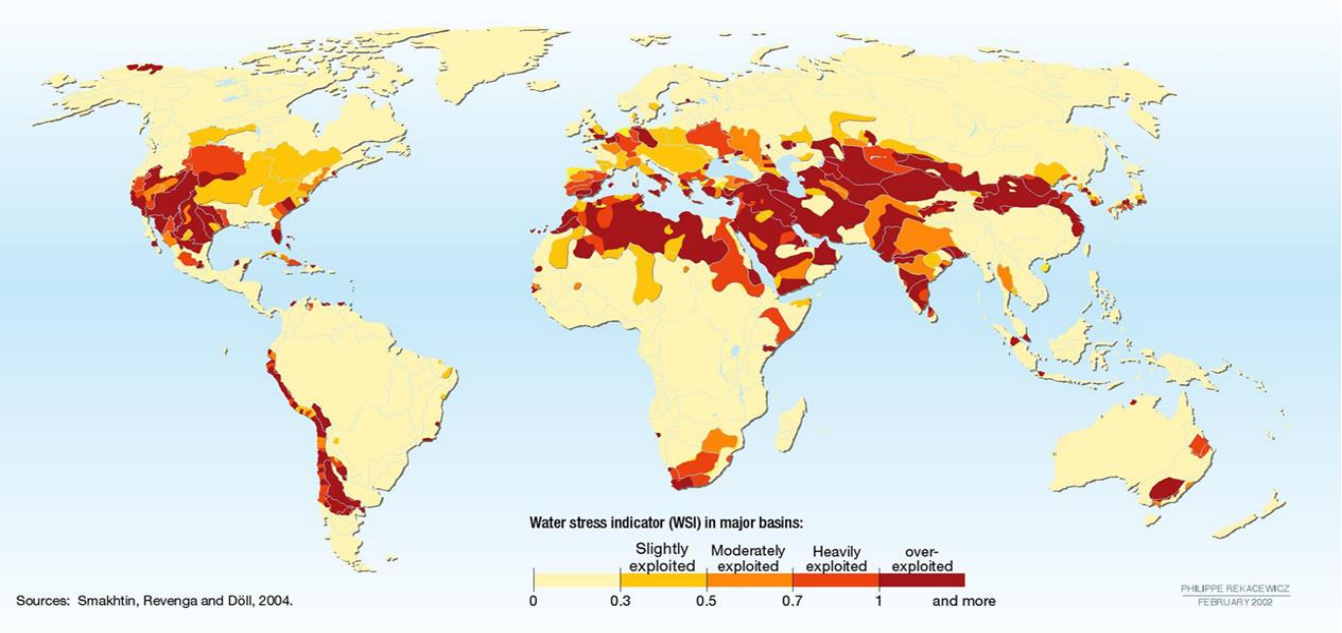


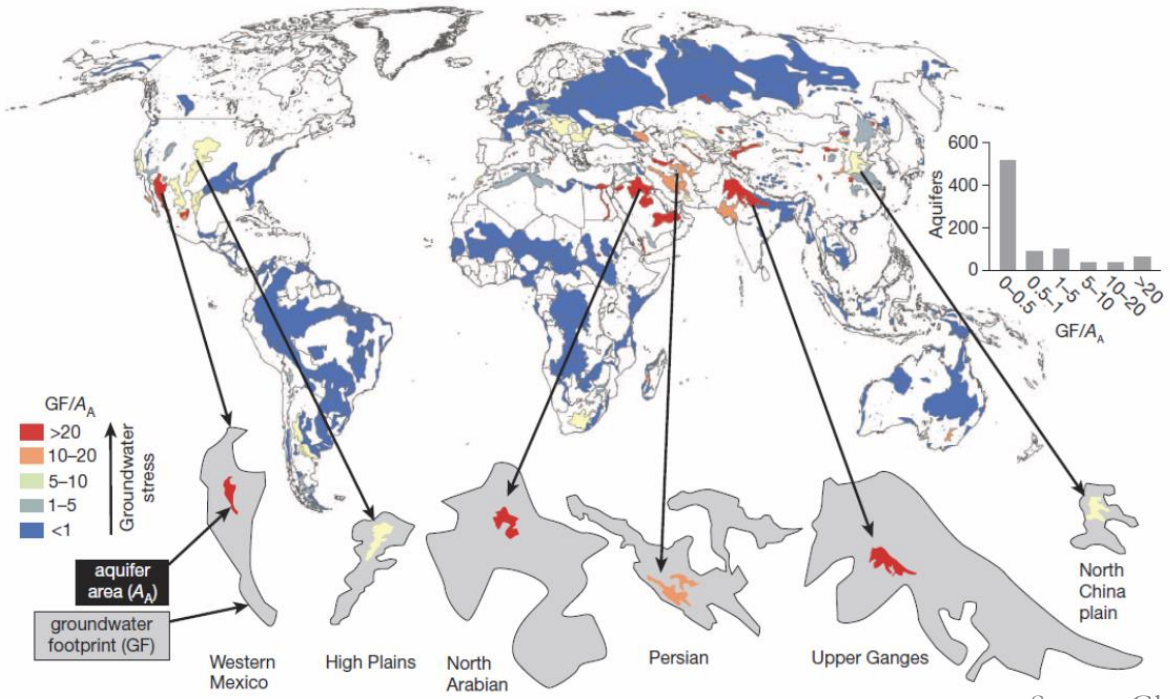
Source: https://www.carbonbrief.org/state-of-the-climate-how-the-world-warmed-in-2022/

Carbon Emissions & Per Capita Income



Source: Khalfan et al. (2023)



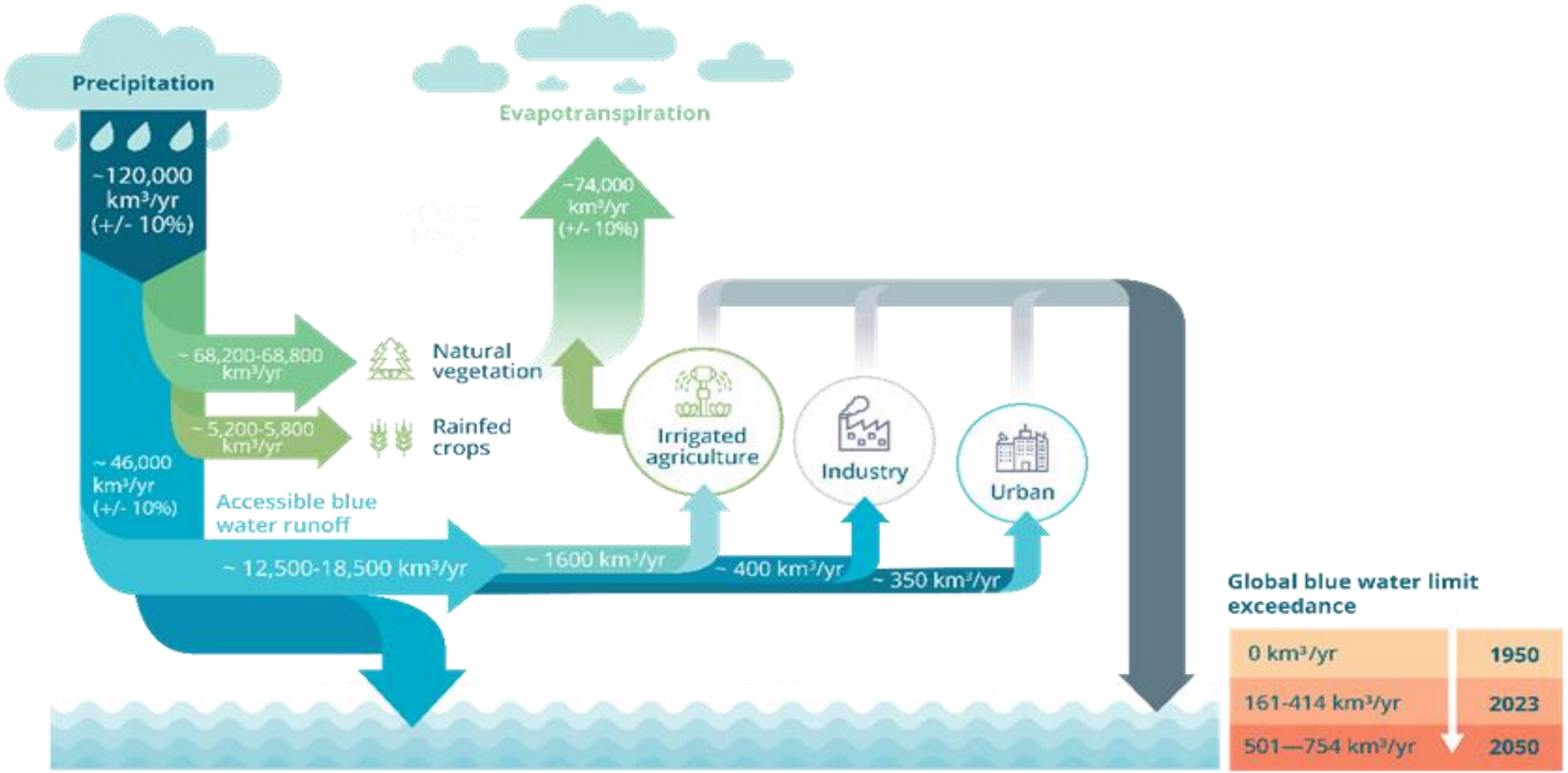


Climate Change changes everything but…

- Water insecurity is NOW
- Flooding is NOW
- Drought is NOW
- Unsustainable water use is NOW (and for past forty years…)
- Sea level rise is new and will, among other consequences, impose huge damages on wetlands and their ecosystem services
- Increased glacial melt is new (and now)

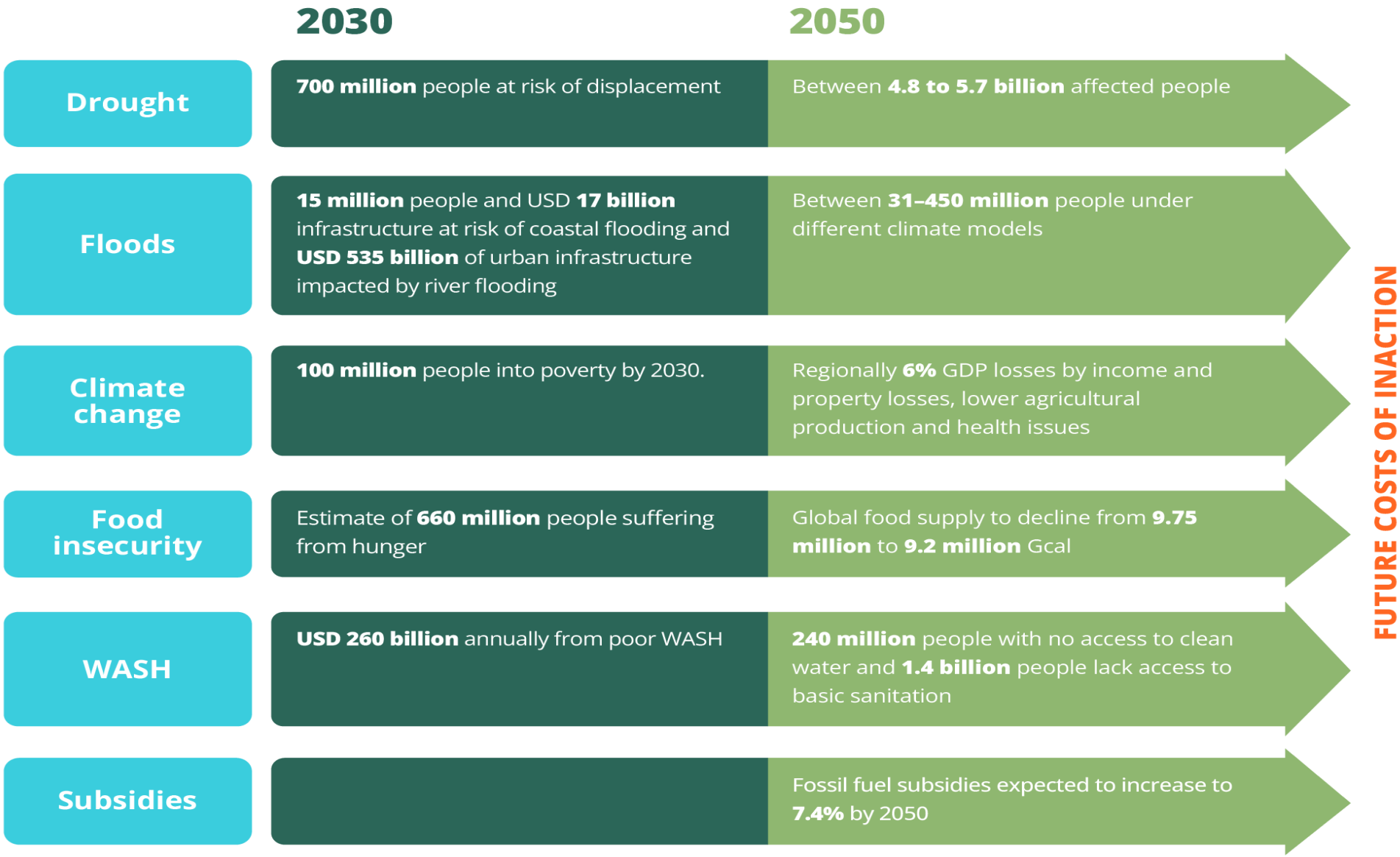
Source: Gleeson et al. (2012)

Water Flows and Consumption



Source: Grafton, Krishnaswamy and Revi (2023)

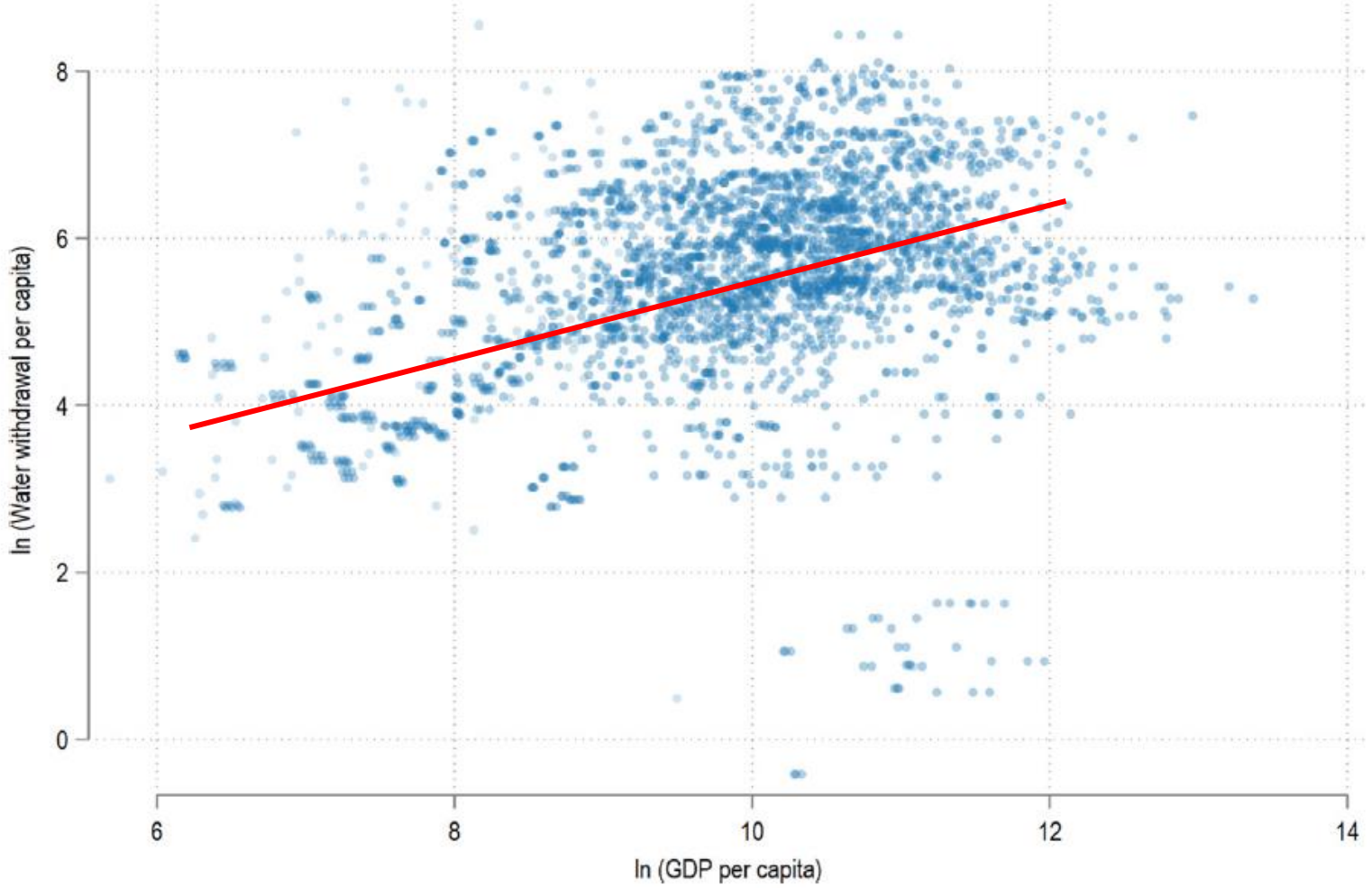
Global Costs of Inaction: 2030 & 2050



Source: Grafton et al. (2023a)

III. The ‘Guess Who’ of Water

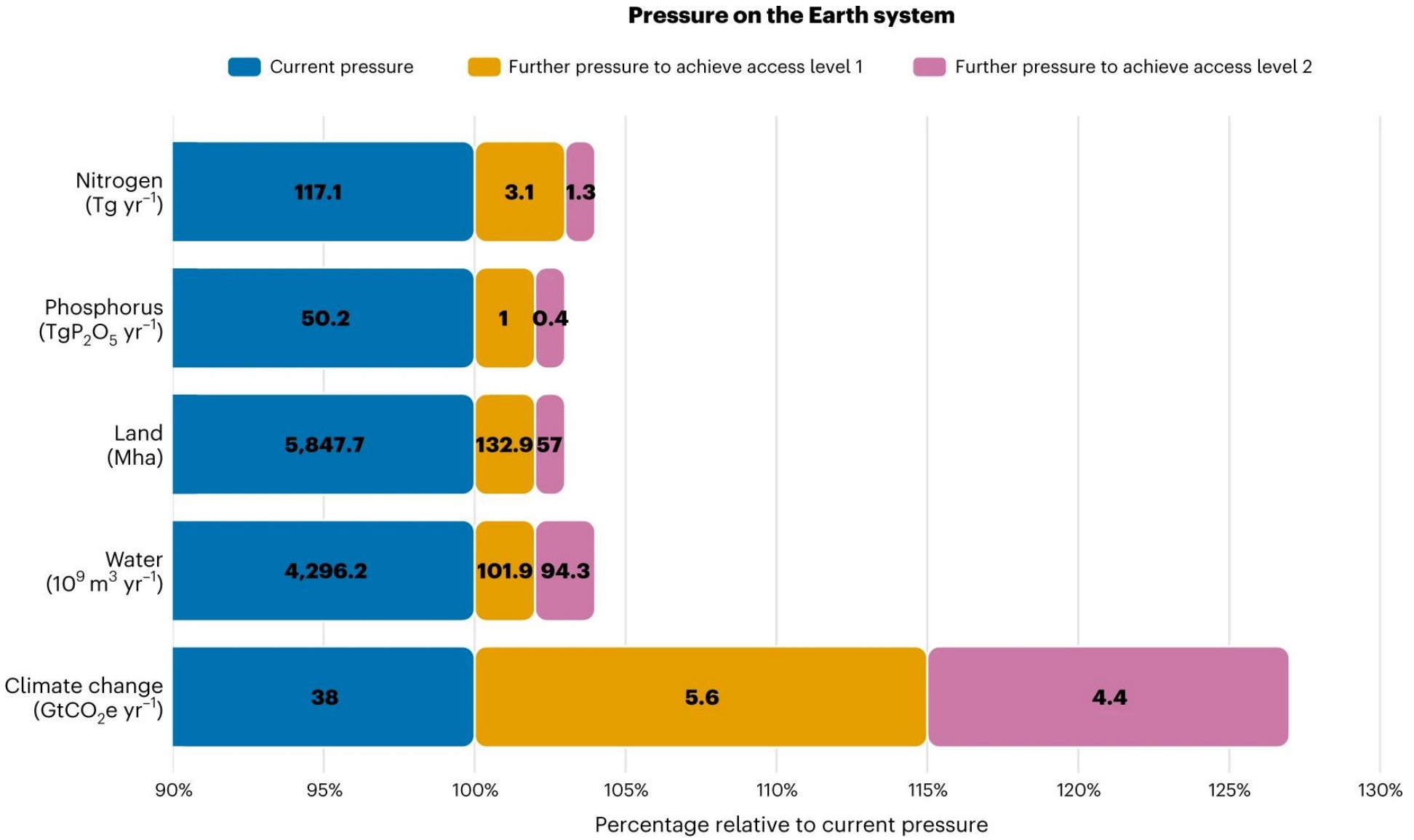
Water withdrawals per capita versus GDP per capita



Per capita water withdrawals are measured in cubic meters and GDP is measured in Billion USD

Source: Dalstein and Naqvi (2022)

Delivering Justice and Earth Pressures



Source: Rammelt et al. (2023)

Towards Water Justice: Goals, Decision-Making and Outcomes

Source: Grafton and Fanaian (2023, Figure 3)

Forms of Water Justice (& social, climate, etc.)

(1) **DECISION-MAKING** (**WHO** gets heard and who makes and influences decisions)
Deliberative and/or Procedural and/or Recognition justice

(2) **FAIRNESS & EQUALITY** (**WHAT** gets shared):

Distributive and/or Retributive justice

(3) **UNDERSTANDING** (**WHICH** knowledge & experiences are accepted, or not)
Epistemic justice

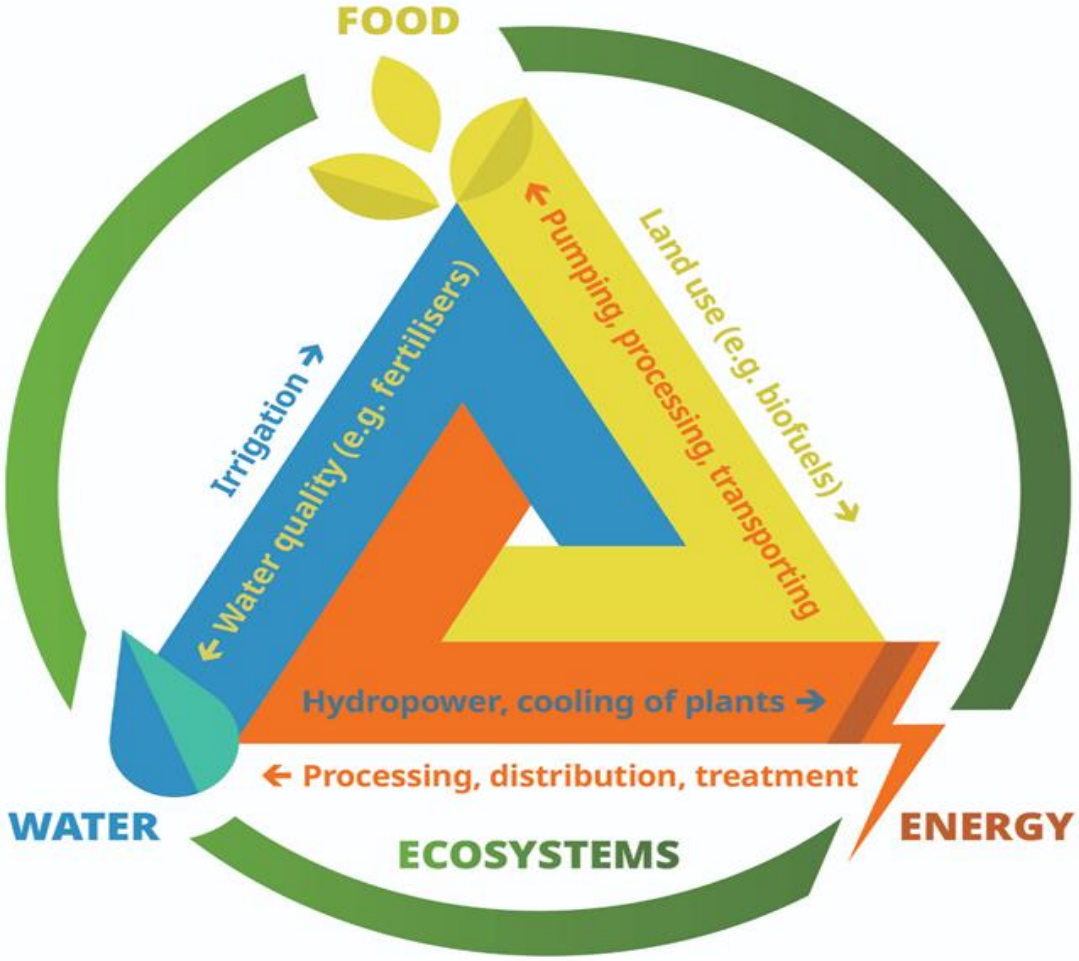
(4) **RECONCILIATION** (**WHEN** do past & current wrongs get corrected)

Restorative Justice

Source: Grafton (2023, this presentation)

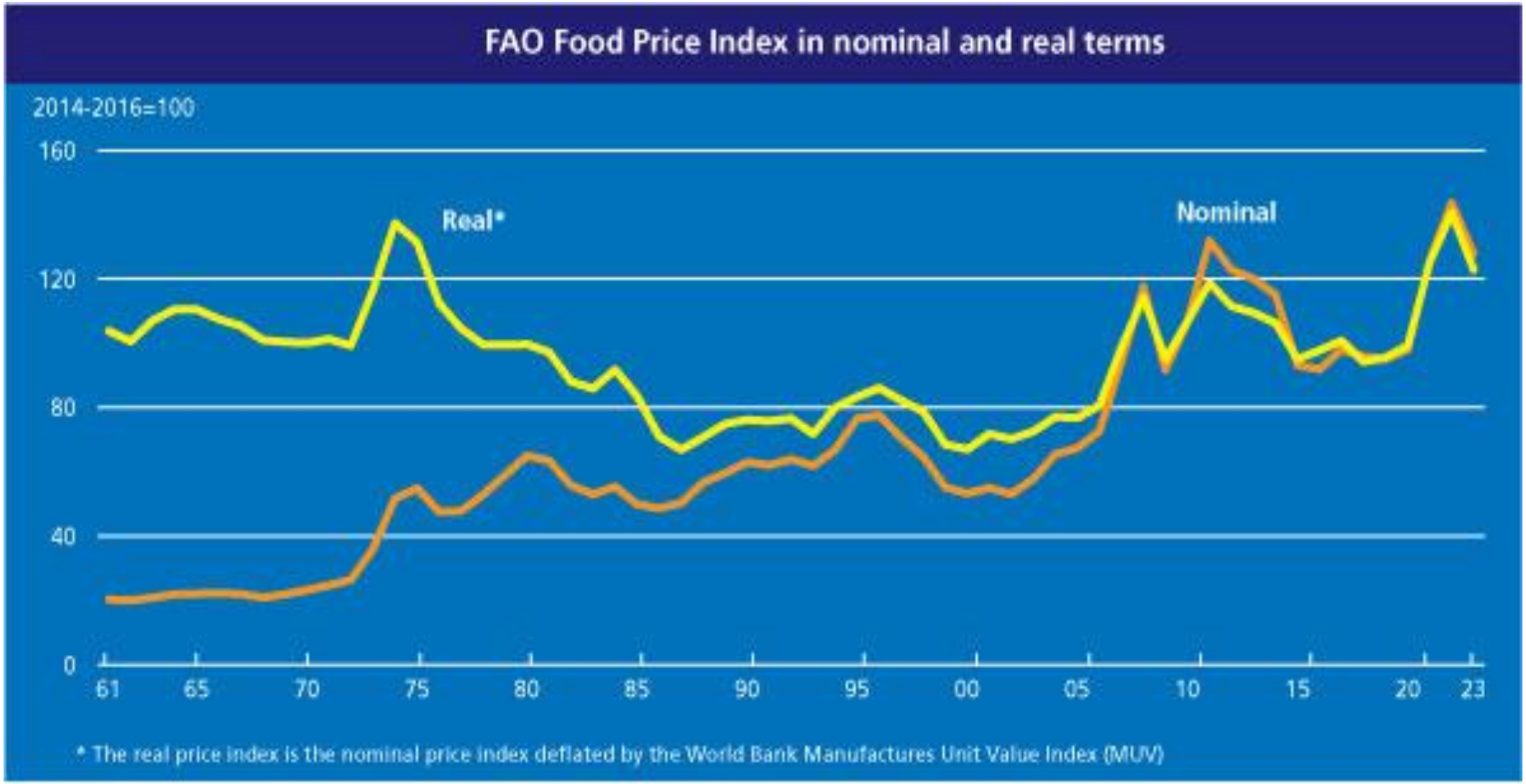
IV. Connecting Water to Food, Energy, Environment…

Connecting the dots: The Nexus



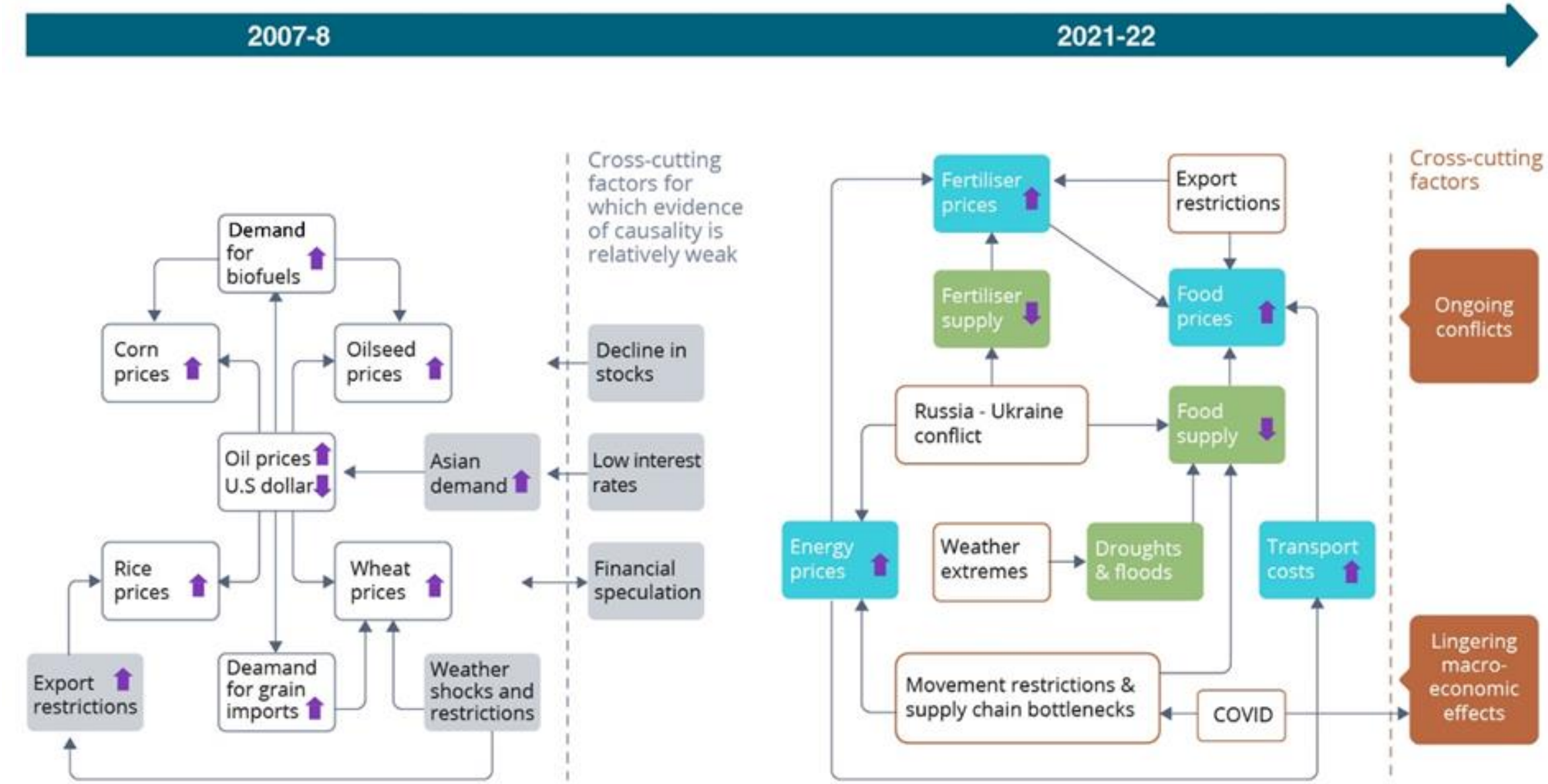
Source: GWP (2019)

FAO Global Food Price Index: 1960-2023



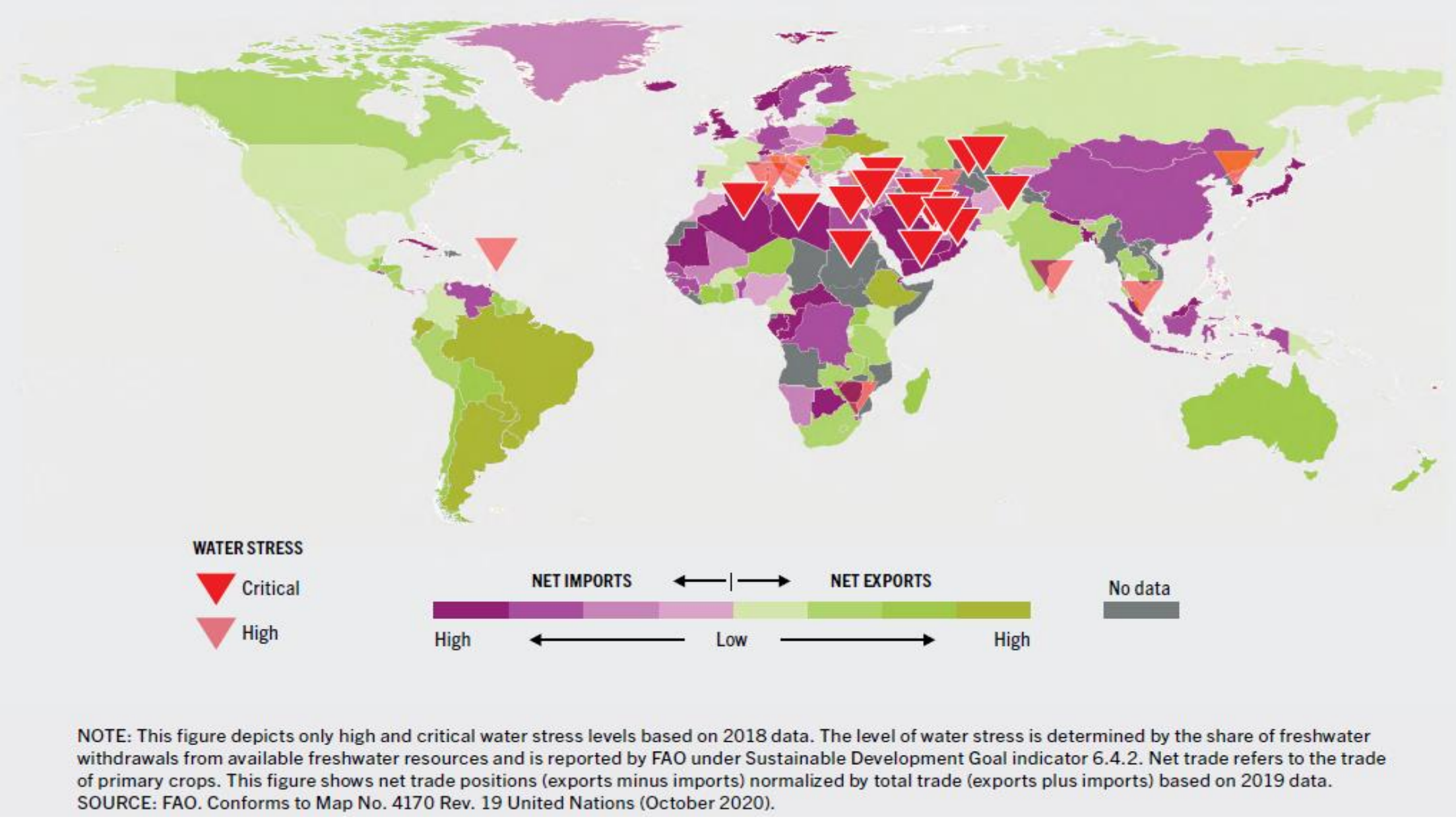
Source: https://www.fao.org/worldfoodsituation/foodpricesindex/en/

Water-Energy-Food-Ecosystem Nexus



Source: Heady and Fan (2010) & Katic and Grafton (2023)

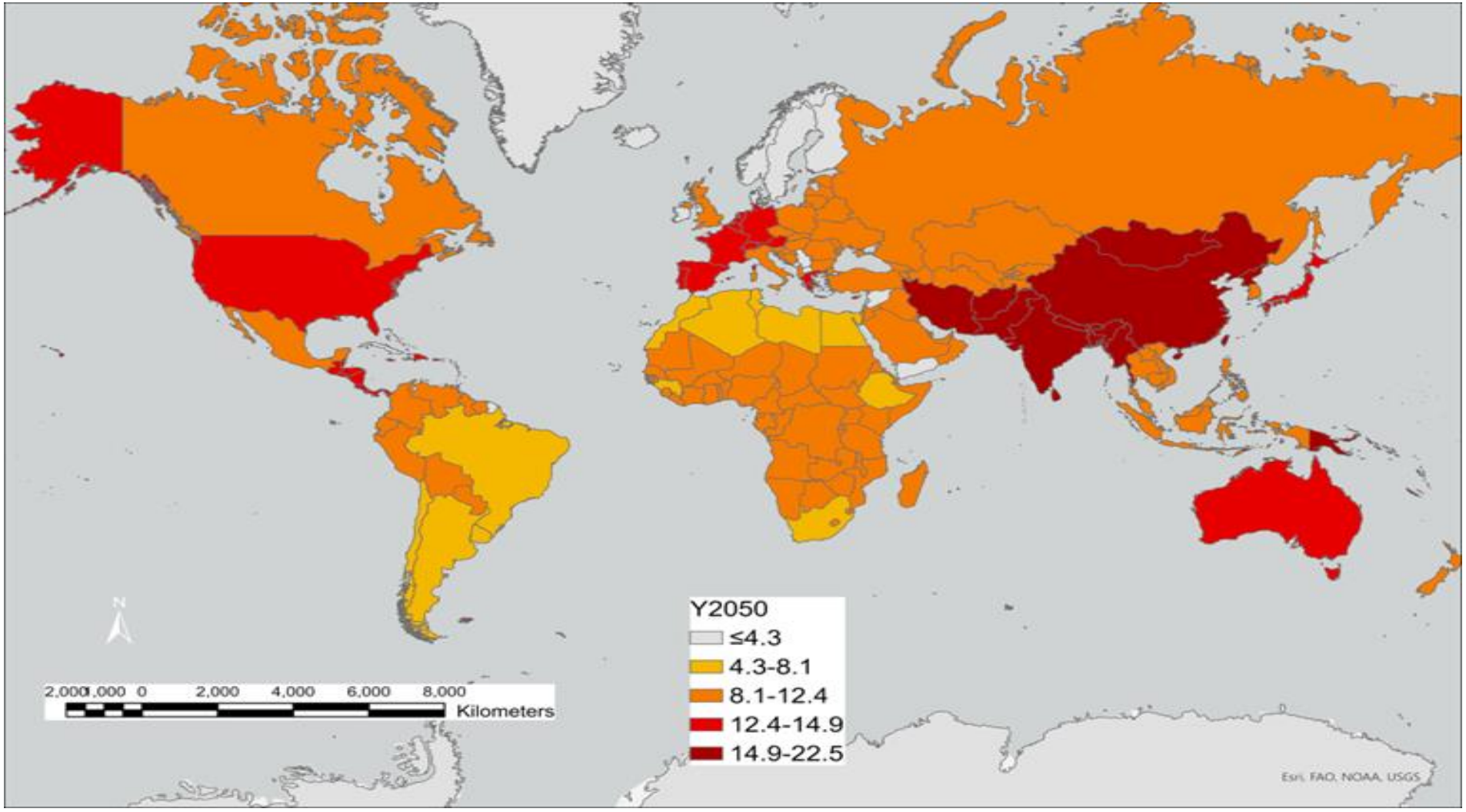
Water Stress and Net Food Trade (2018 and 2019)



NOTE: This figure depicts only high and critical water stress levels based on 2018 data. The level of water stress is determined by the share of freshwater withdrawals from available freshwater resources and is reported by FAO under Sustainable Development Goal indicator 6.4.2. Net trade refers to the trade of primary crops. This figure shows net trade positions (exports minus imports) normalized by total trade (exports plus imports) based on 2019 data.
SOURCE: FAO. Conforms to Map No. 4170 Rev. 19 United Nations (October 2020).

Source: Jafari et al. (2022)

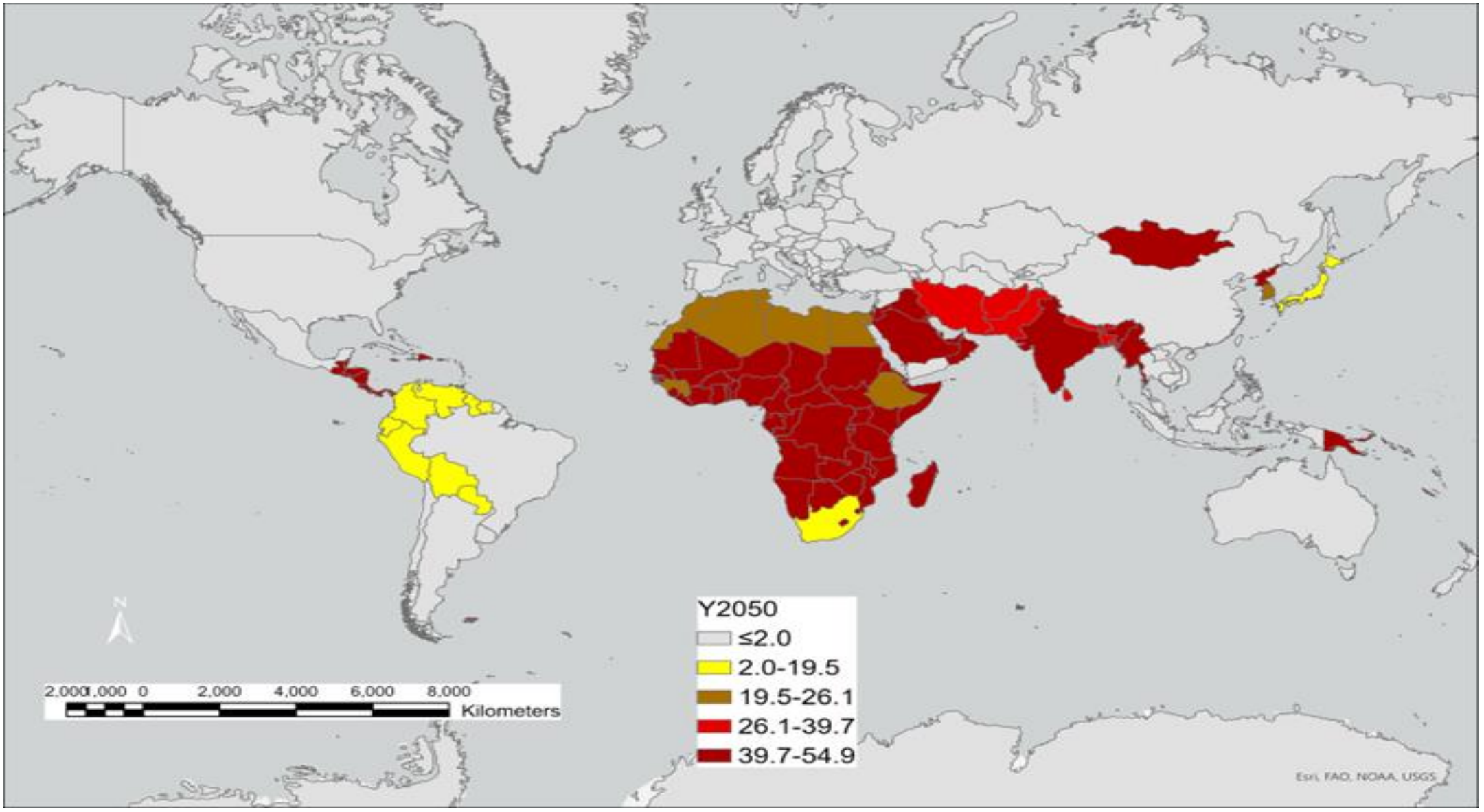
Reduction of Regional Food Supply (RCP8.5-SSP3) (% thous GCal): 2050



Note: % thous giga-calorie fall in food output (compared to baseline) due to water and heat stress on agricultural production in 2050.

Source: Kompas et al. (2023, Figure 7)

Regional Food Insecurity (RCP8.5-SSP3) (%pop): 2050



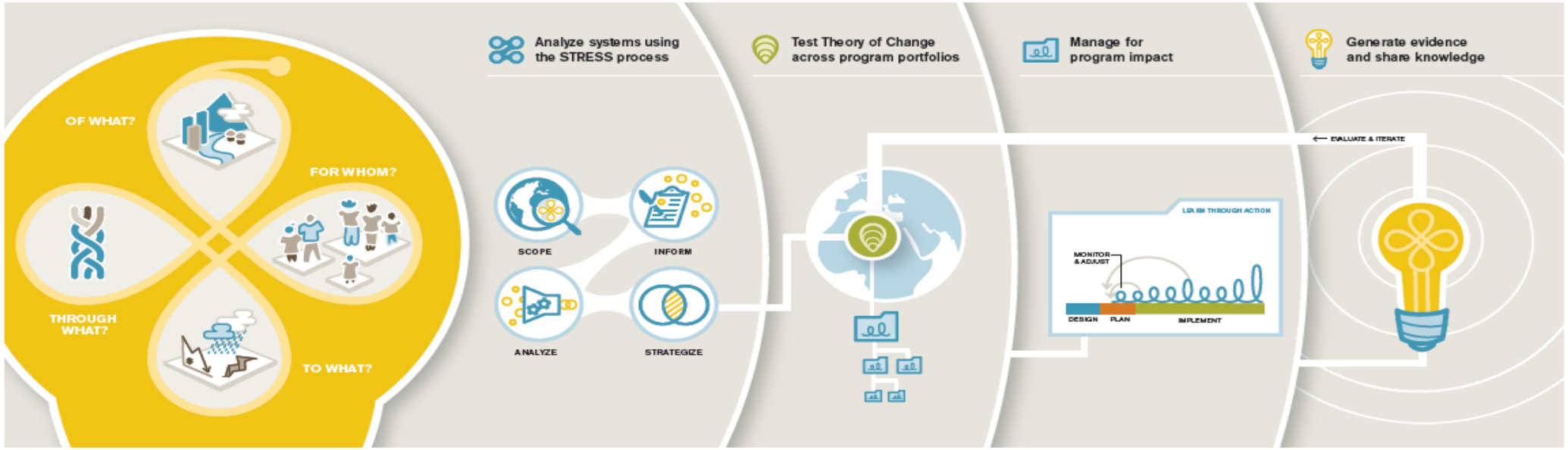
Source: Kompas et al. (2023, Figure 10)

V. Water Futures

Responding to Nexus Risks

Source: Grafton et al. (2023, Figure 2.4)

A Resilience Framing



Guiding Questions

Four guiding questions help identify vulnerabilities and capacities to influence resilience strategies.

+ Of What?
+ For Whom?
+ To What?
+ Through What?

Three Capacities

Resilience requires short-term absorptive and medium-term adaptive capacities, supported by the long-term capacity to transform the underlying cultural, institutional and learning dynamics within the system. Strengthen all three to equip households, communities and systems to manage shocks and stresses.

STRESS Process

Strategic Resilience Assessments lead to a Theory of Change by taking a systems approach to collecting and analyzing data across scales and sectors.

Theory of Change

The Theory of Change articulates a measurable path to a desired impact, which is then tested through program portfolios and interventions.

Adaptive Management

Resilience programs are guided by adaptive management practices. This ensures that measurement is in place to inform adjustments, make strategic changes or rethink the Theory of Change. Continually monitor, adjust and iterate to create deeper and wider impact.

Evidence-Based Learning

Progressively build an evidence base by testing what works on the ground. This is key to unlocking social learning – the sharing of both scientific and local knowledge between individuals, communities and institutions.

Source: Mercy Corps (2023, p. 2)

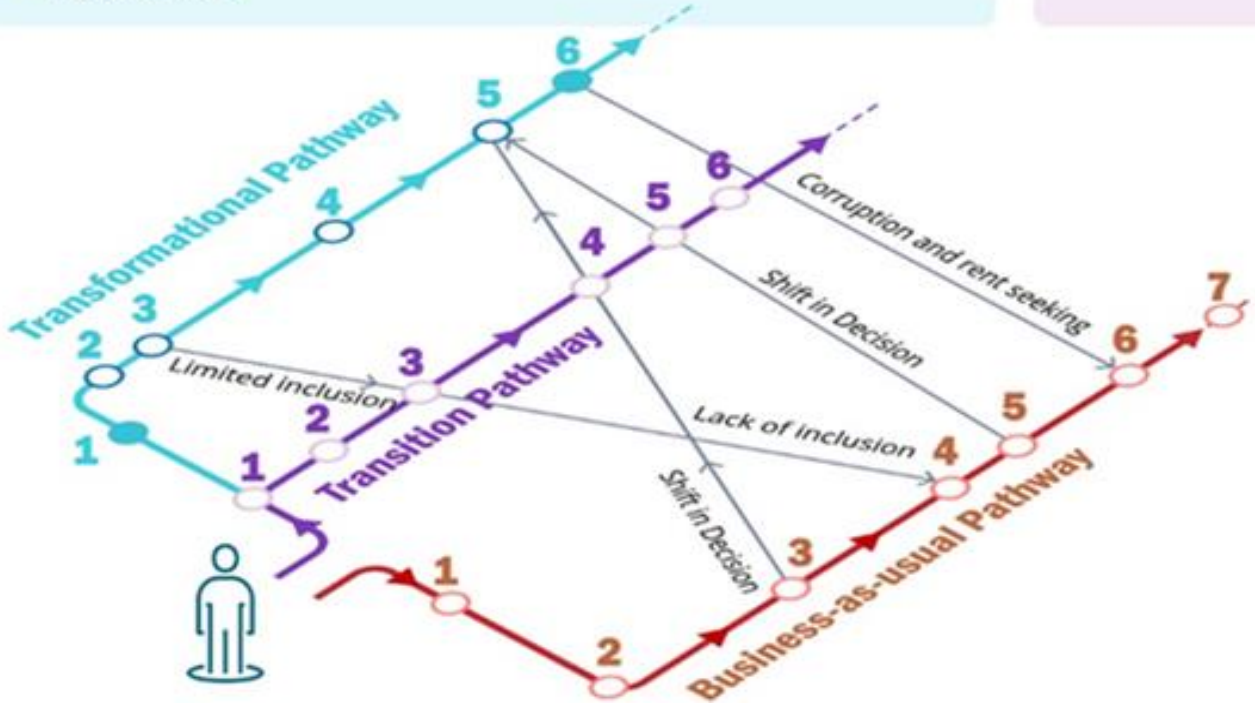
Transitional & Transformational Pathways

Transformational Pathway

1. Multiple values of water become inherent
2. Diverse Valuation processes
3. Inclusive and less opaque decision-making
4. Water infrastructure design centred on just and equitable distribution
5. Improved regulatory systems (soft infrastructure) to conserve and enhance green and grey infrastructure.
6. Mixing green, soft and grey infrastructure delivers resilient community and ecosystem.

Transition Pathway

1. Learning about different water values
2. Experimenting with diverse valuation processes
3. Explore revised regulatory oversight
4. Participatory discussion for decision-making
5. Expand investments for mixed infrastructure (grey + green)
6. Explore opportunities for integrating green, grey and soft infrastructure



Business-as-usual Pathway

1. Market/economic value dominance
2. Only cost-benefit market valuation used
3. Decision processes-top-down favouring centralized grey infrastructure (dams, massive, piped supply systems)
4. Thin-market justice & opaque decision-making processes.
5. New infrastructure to address ageing grey infrastructure and cascade risk.
6. More grey infrastructure and lock-in
7. Increase in water risk, investment costs and water consumption

Source: Grafton et al. (2023, Figure 3.8)

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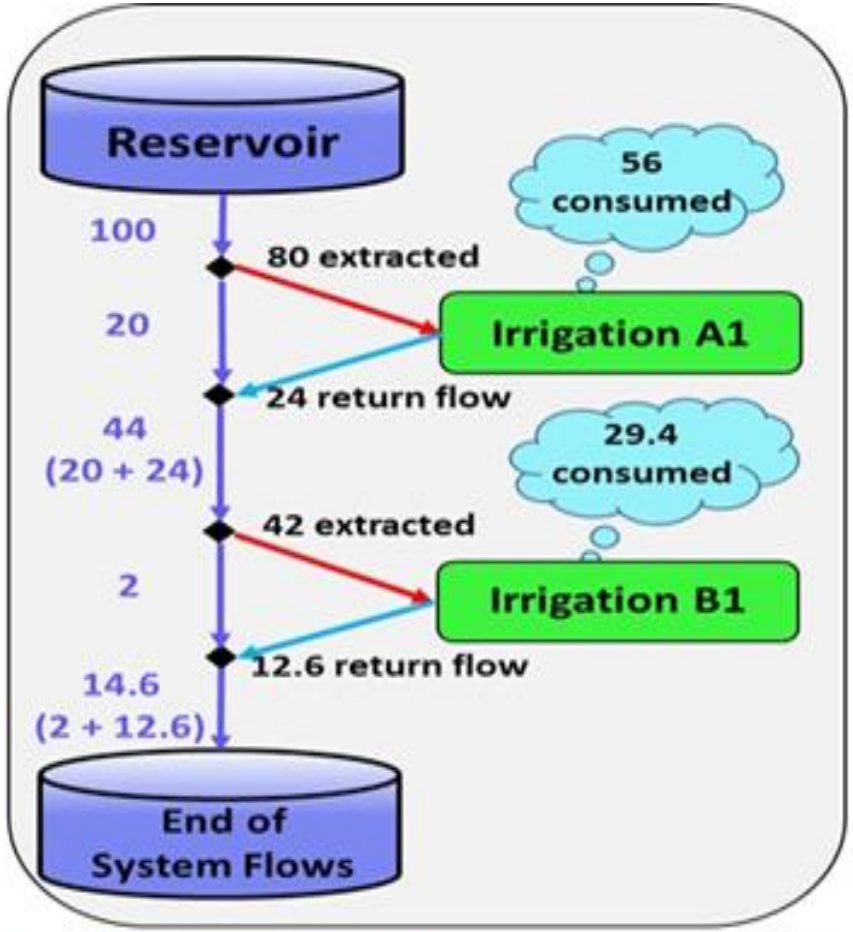
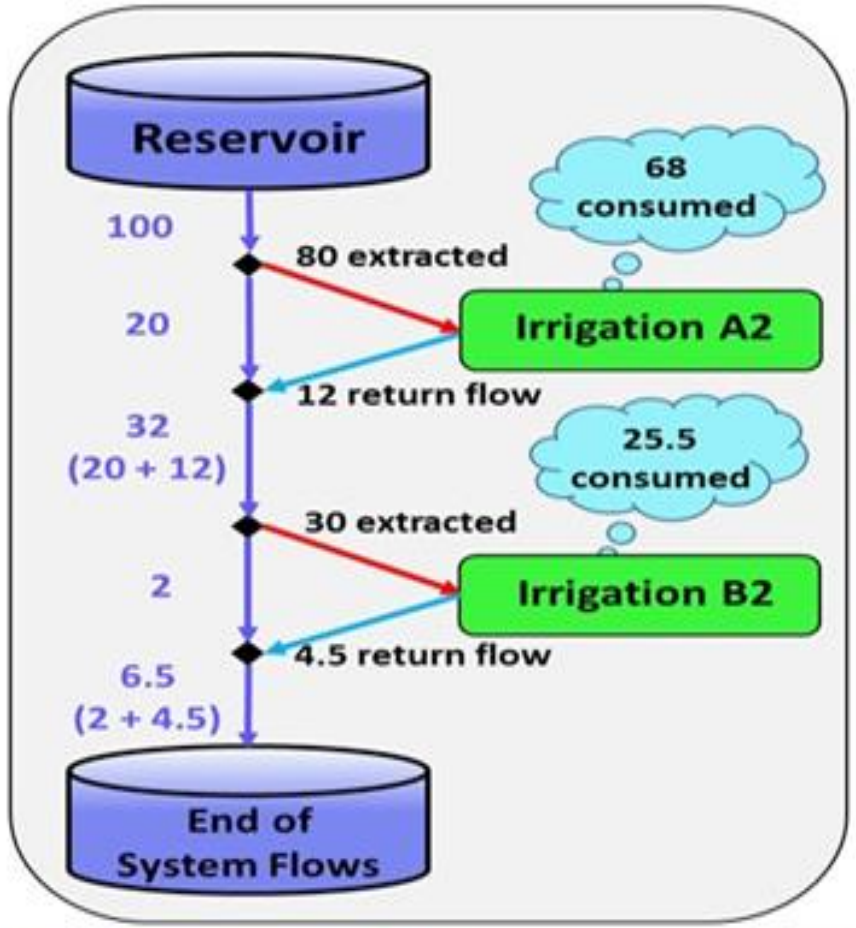
Additional Slides

Irrigation Efficiency, Return Flows & End-of-System Flows



Irrigation Efficiency: 70%
Total (A1 + B1) Extractions = 80 + 42 = 122
Water Consumed (A1+ B1) = 56 + 29.4 = 85.4
Return Flows (A1 + B1) = 24 + 12.6 = 36.6
End of System Flows = 14.6



Irrigation Efficiency: 85%
Total (A2 + B2) Extractions = 80 + 30 = 110
Water Consumed (A2 + B2) = 68 + 25.5 = 93.5
Return Flows (A2 + B2) = 12 + 4.5 = 16.5
End of System Flows = 6.5

Source: Perry et al. (2023)

Water Pricing Challenges

Price of water in centralised distribution networks is often too low to cover both operation and maintenance, and future capital investment and maintenance costs

Price of water is, typically, not equitable across users: households usually pay higher prices than farmers and industry; price of non-piped water commonly higher than price of piped water in low-income countries

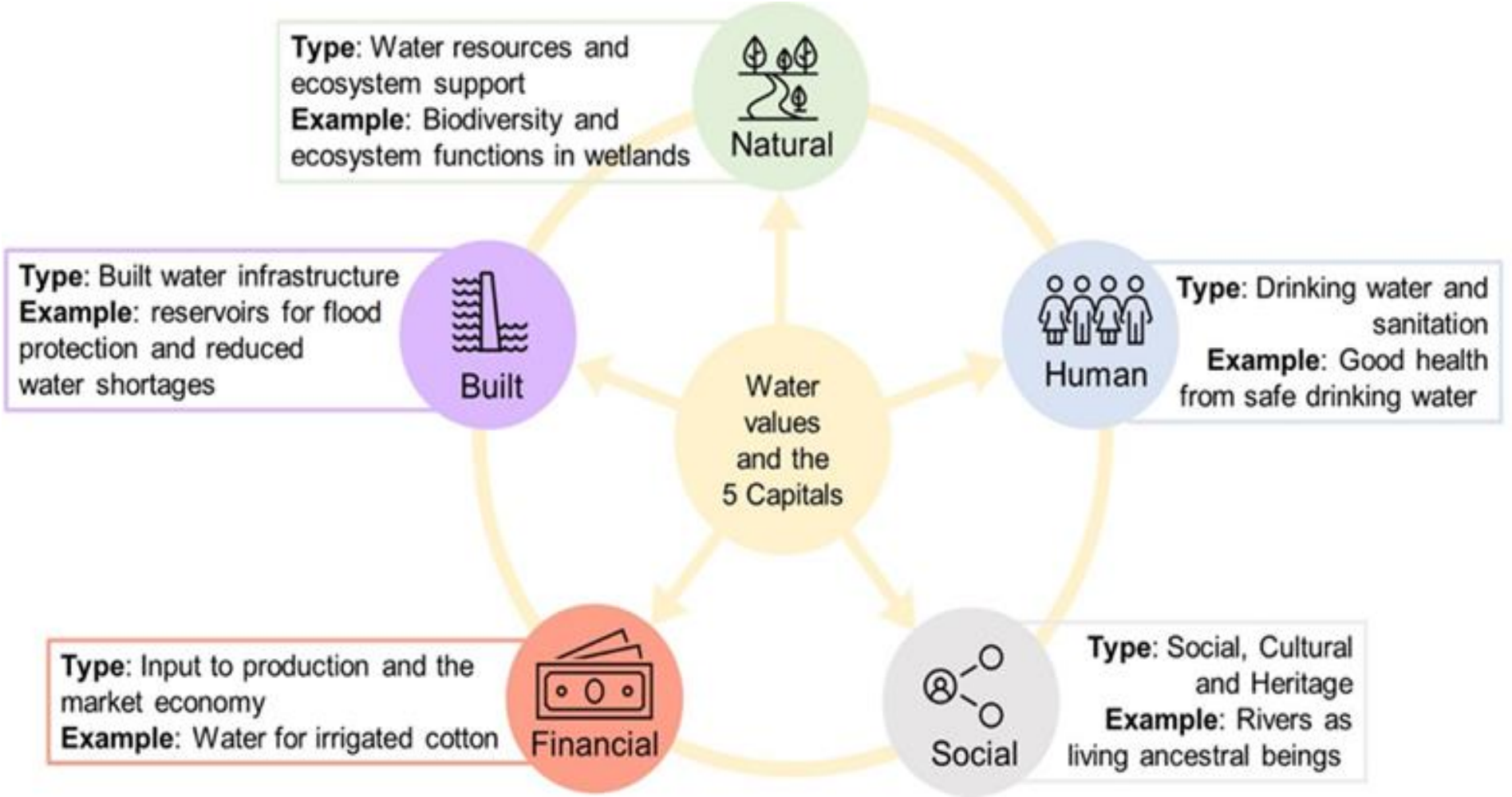
Because water is under-priced, **cost recovery and economic efficiency objectives are not achieved** (the price fails to send a sufficient signal on water scarcity to users)

Increasing Block Tariffs often fail in targeting subsidised water prices to poor households and distort price signal

Complexity of water pricing/tariffs combined with its low level may explain that **water demand is usually found to be price inelastic (% decline in consumption is less than % increase in price)**

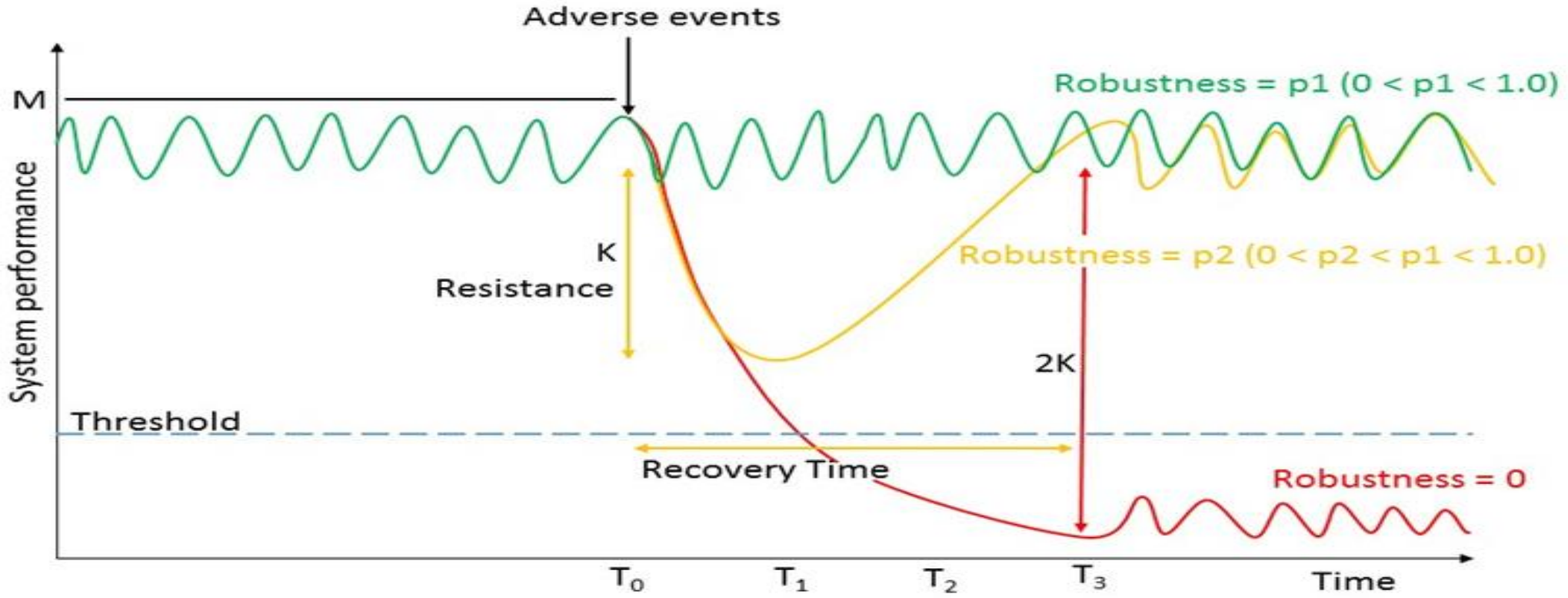
Source: Wheeler et al. (2023)

Water Values and the Five Capitals



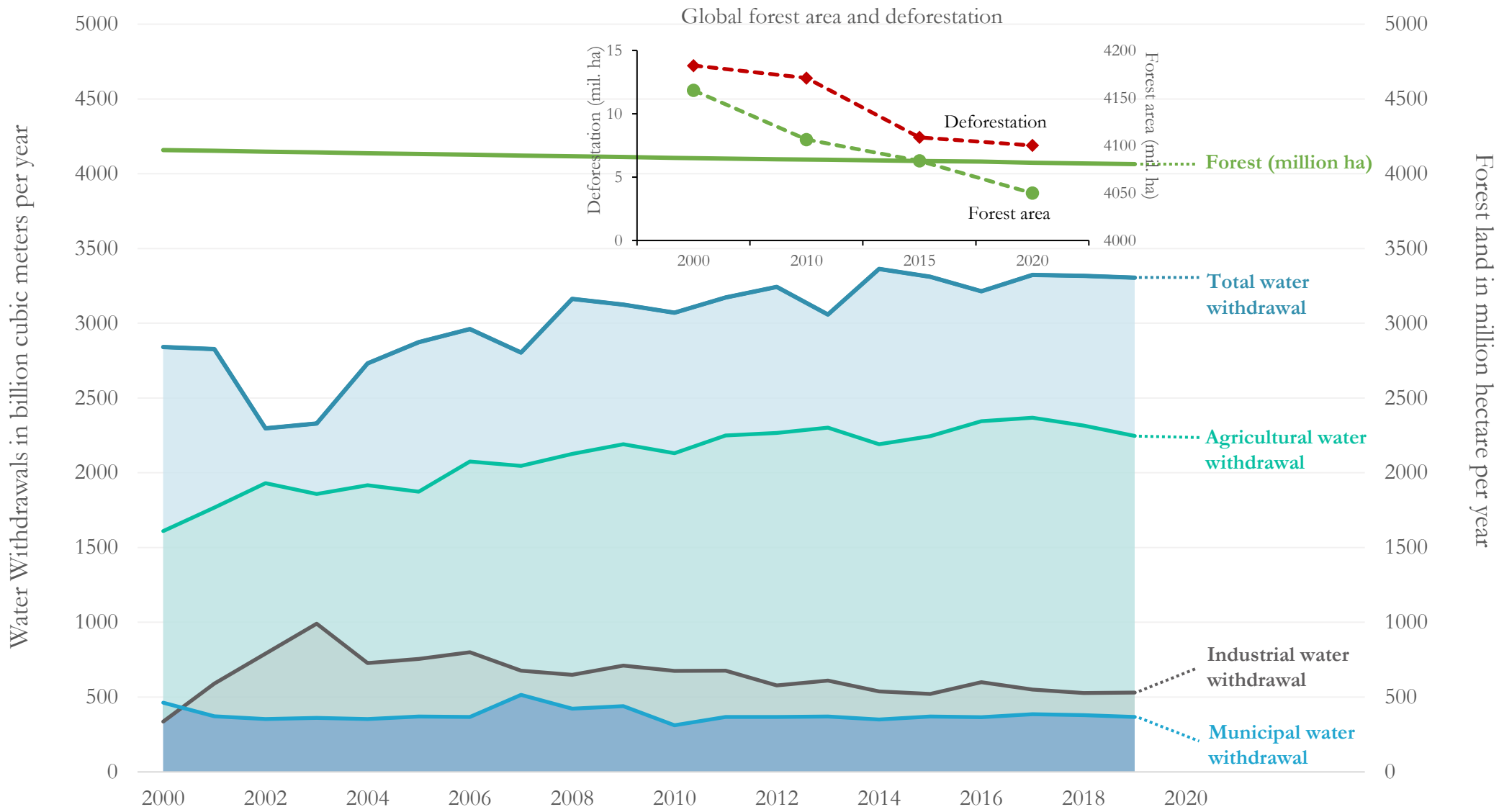
Source: Grafton et al. (2023b)

Promoting Resilience (Resistance, Recovery Time and Robustness)



Source: Grafton et al. (2019, p. 910).

Global Water Withdrawals (bill Cu. M/year) and Global Forest Area (mill ha.)



Source: Grafton et al. (2023)