

# Water: The Looming Threat

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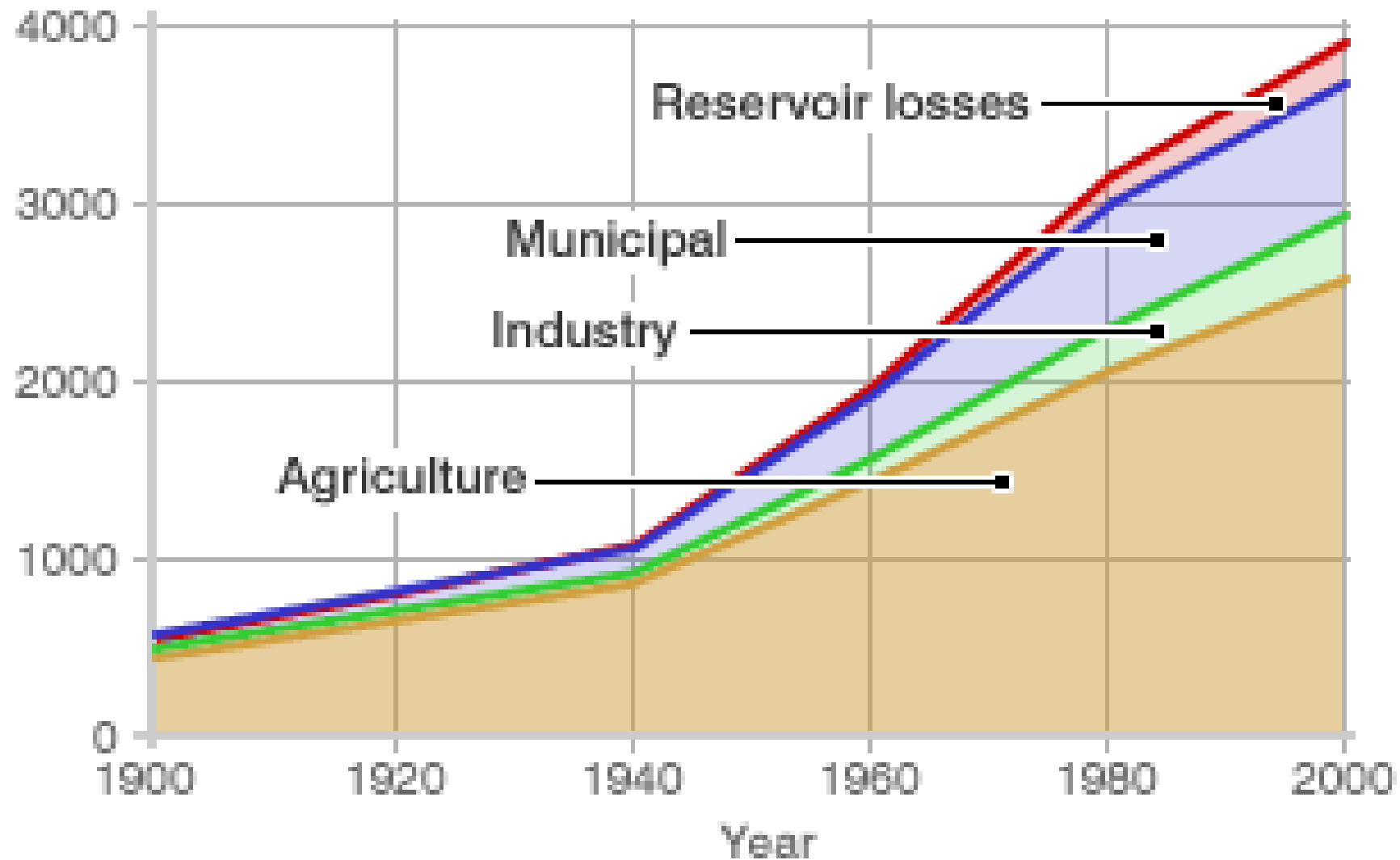
# Appreciating Water

- ▶ We never know the worth of water till the well runs dry. (Scottish Proverb)
- Of the Well we see no want, till either dry, or Water skant. (British version)



# Estimated annual world water use

km<sup>3</sup> per year



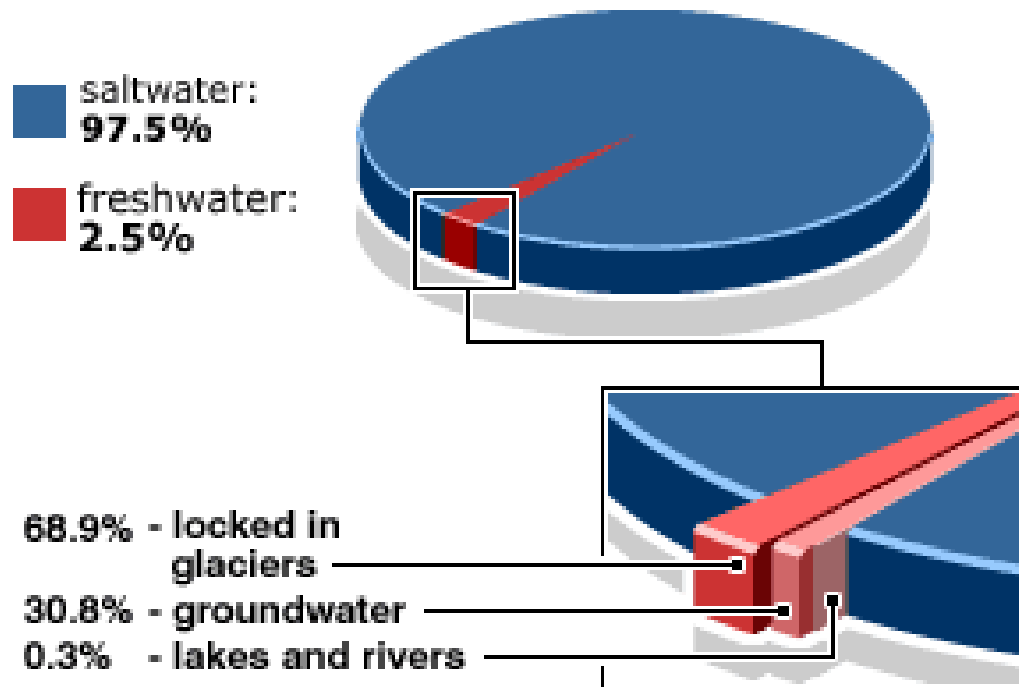
SOURCE: FAO Aquastat

But there's so much water!





# But there's so much water!



# Is there REALLY a water shortage?

Total Water: 1.4 quintillion

Fresh Water: 35 quadrillion

Surface: 100 trillion

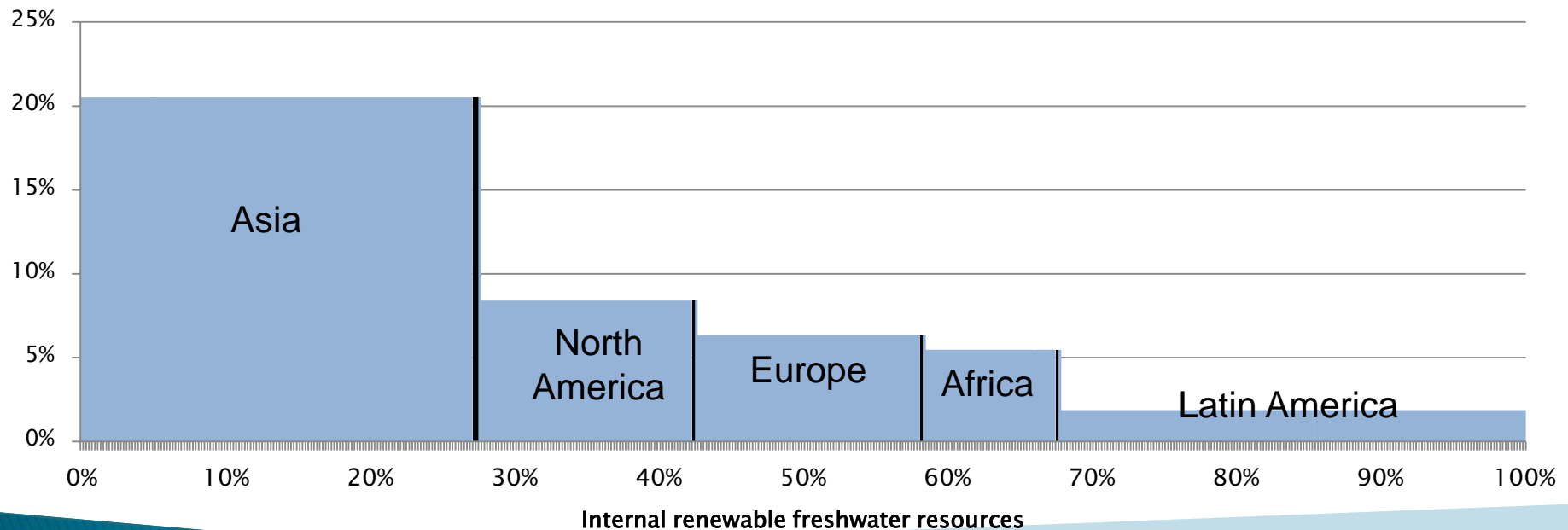
Renewable:  
44 trillion

Withdrawal:  
4 trillion

(in m<sup>3</sup>)

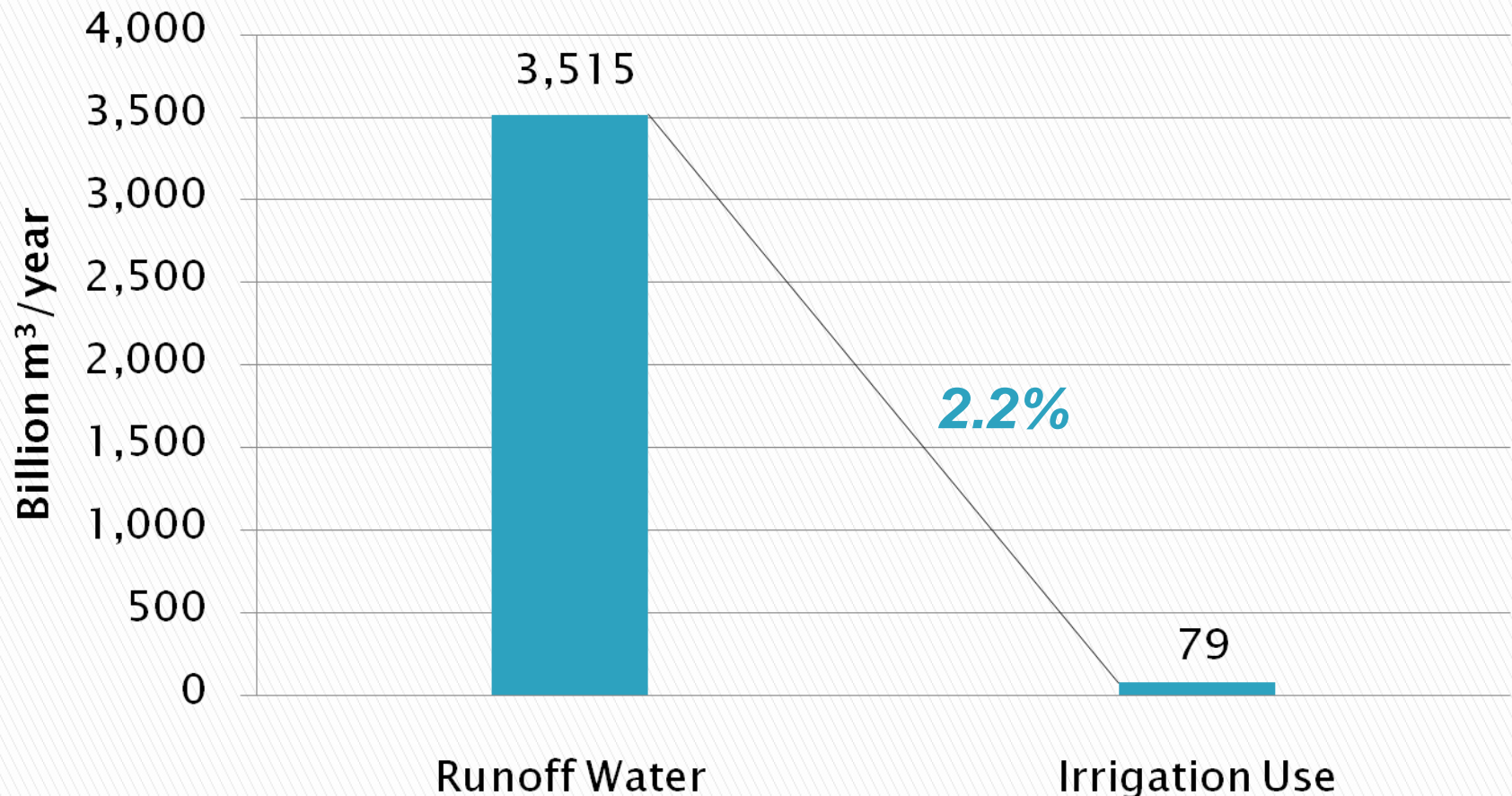
# Water resources seem sufficient...

**Freshwater Withdrawal**  
(% of available: ~44 Trillion m<sup>3</sup>)



# No problem even in Africa!

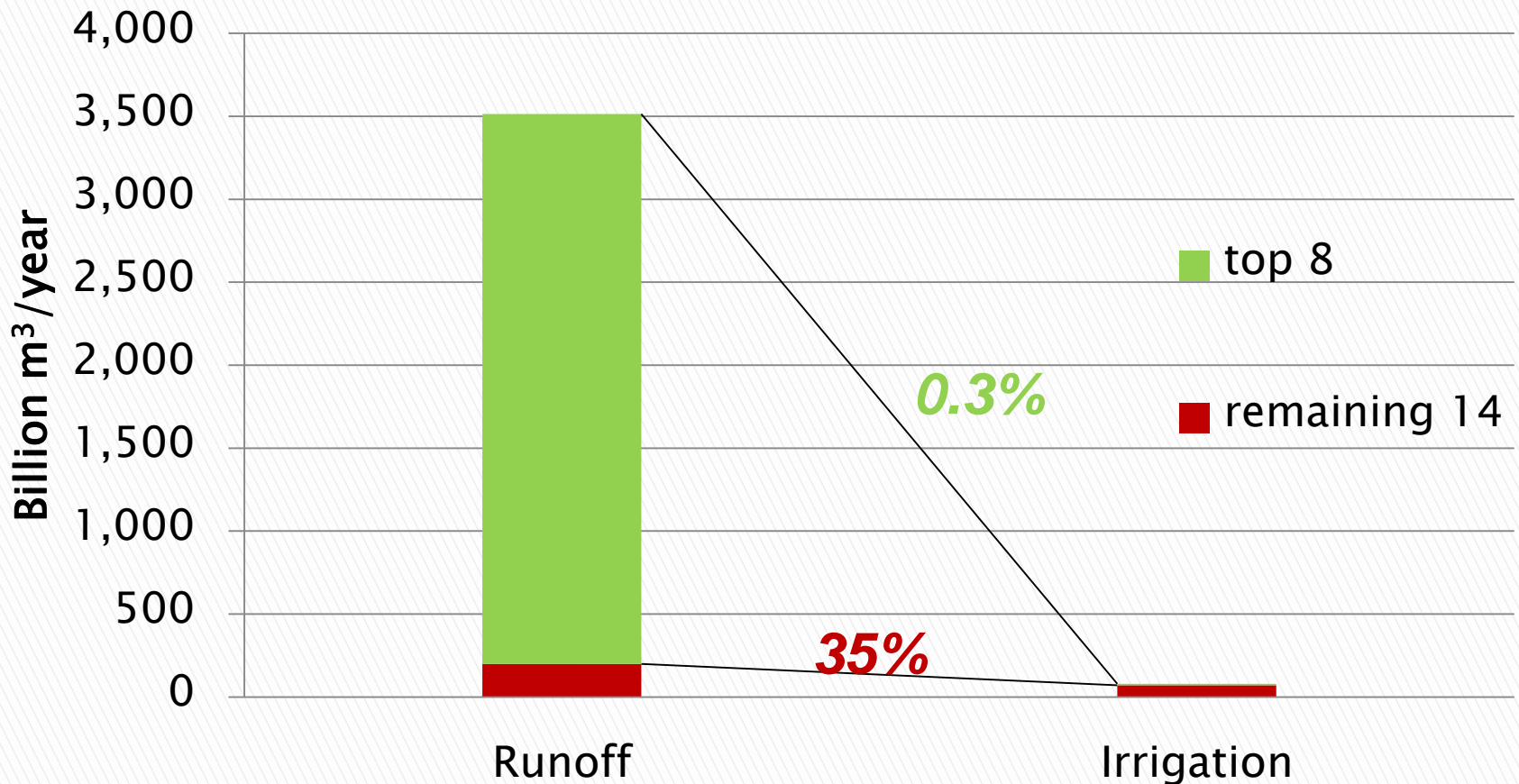
Africa Water Situation: Top 22 river basins



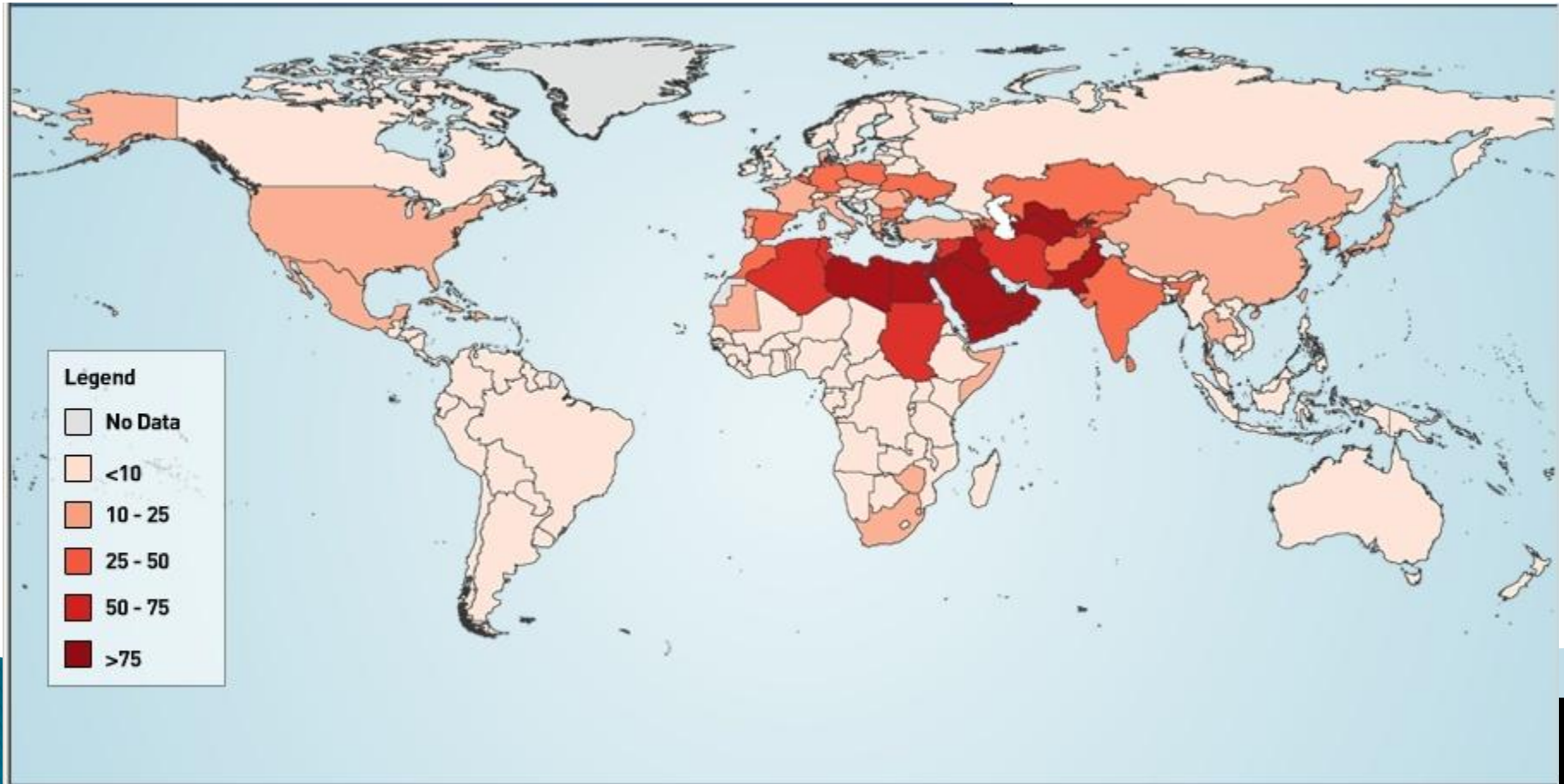


# Yet averages lie!

## Africa Water Situation: Top 22 river basins



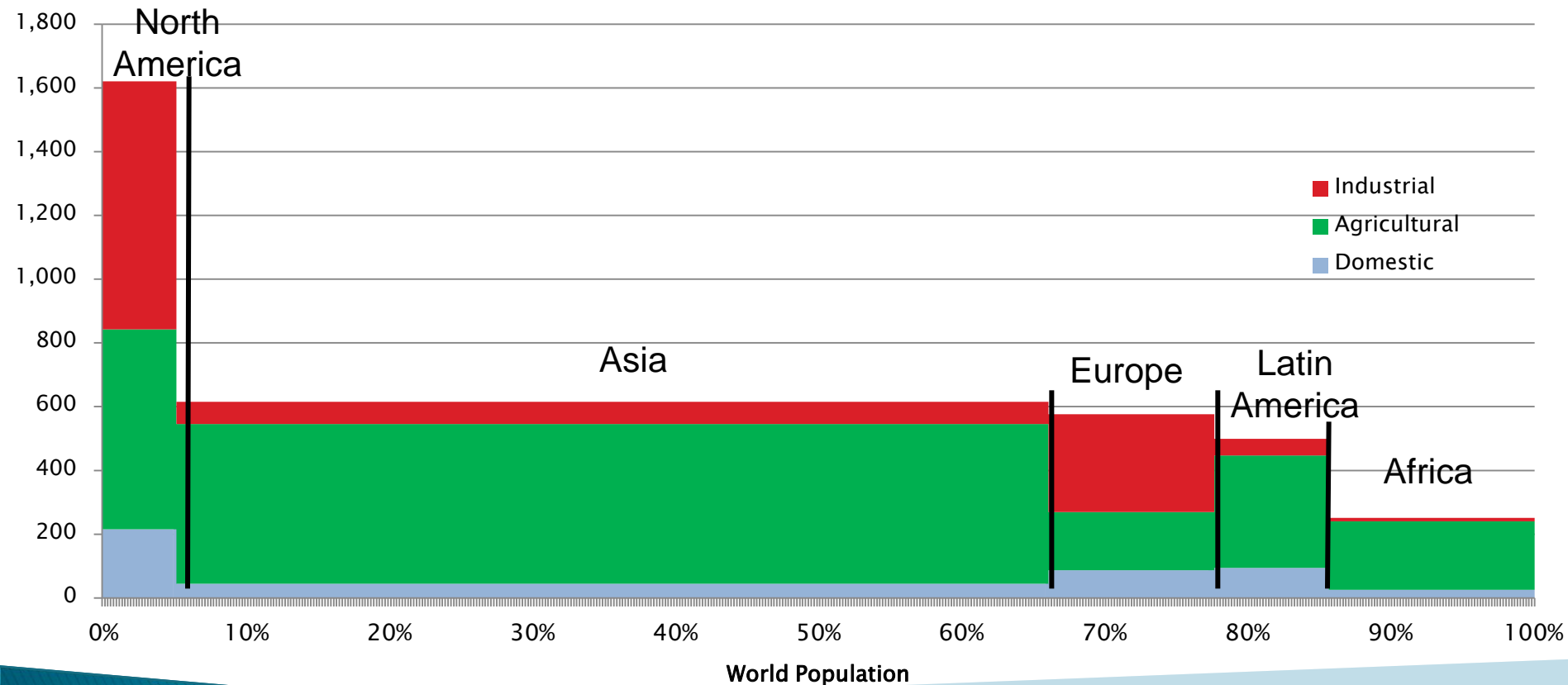
# Proportion of renewable water resources withdrawn



Source: AQUASTAT

# Differing needs

Freshwater Withdrawal ( $\text{m}^3$  per capita p.a.)





# The Global Need for Water

- ▶ Critical water shortage in many parts of the world:
  - 1.1 billion people do not have access to adequate supplies of safe water
  - Thousands of children and adults die every day due to water related diseases
  - Many more suffer from a range of related debilitating illnesses
- ▶ Fresh water (available per capita) is declining as:
  - Population increases
  - Developing nations improve their quality of life and level of industrialization
  - Climate changes (?)
  - Salinity levels in many fresh water aquifers increases

Even conservative projections – 1-2% water demand growth p.a. due to population growth, improved standard of living, increased irrigation, and climate change -- suggest water scarcity rates may double within 20 years

# The Looming Threat

Predicted water scarcity and stress in 2025



# The twin challenges

	Water	Energy
Criticality	Existential need	Key resource
Urgency	Current killer	Projected threat
Cost	Cheap (1 x)	Expensive (10x)
Supply	Renewable resource	Limited reserves (fossil fuel)
Availability	Globally available	Concentrated supply (fossil fuel)



# If only global water supply were controlled by THESE guys...



Water: The Looming Threat Friday, August 7, 2009

# Opportunities

- ▶ Desalination market:
  - 0.5% globally, projected to grow to 2% within a decade
  - Heaviest users: Middle East, Australia
  - Applications: sea water, brackish water, recycling
- ▶ Technologies
  - Established: Multistage flash (heat), Freeze, and Reverse Osmosis (size separation)
  - Emerging: Forward osmosis, charge separation (electrodialysis, deionization, ion exchange)
- ▶ Success factors: cost, energy intensity, scale



# Barriers to innovation

- ▶ “Industry” structure: fragmented, local markets served by regulated monopolies
- ▶ No arbitrage => lack of pricing signal
- ▶ Rights, entitlements, and quotas => lack of pricing signal
- ▶ Risk aversion => conservative investment profile (unless...)



# The Looming Threat



- ▶ Horrible human crisis—rapidly getting worse
- ▶ Global challenge comprised of local crises
- ▶ Fundamentally different from the energy challenge
  - Viable technical solutions...
  - ... which the market fails to deliver!

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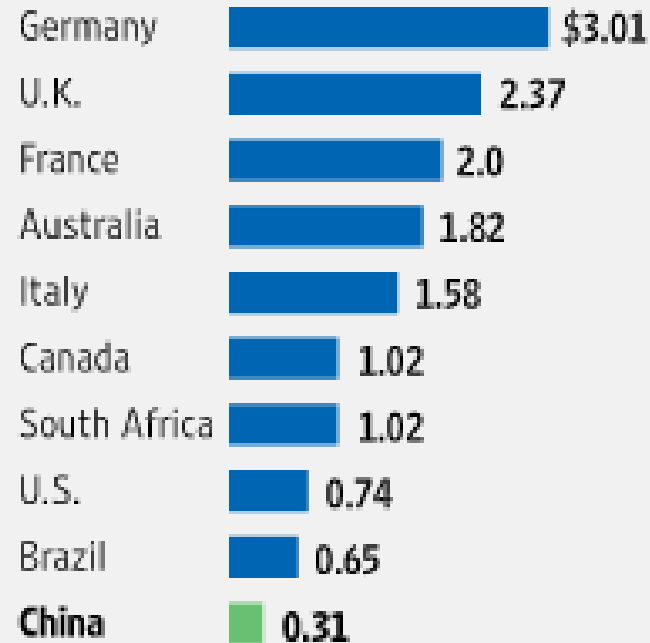




# Pricing

## Inexpensive resource

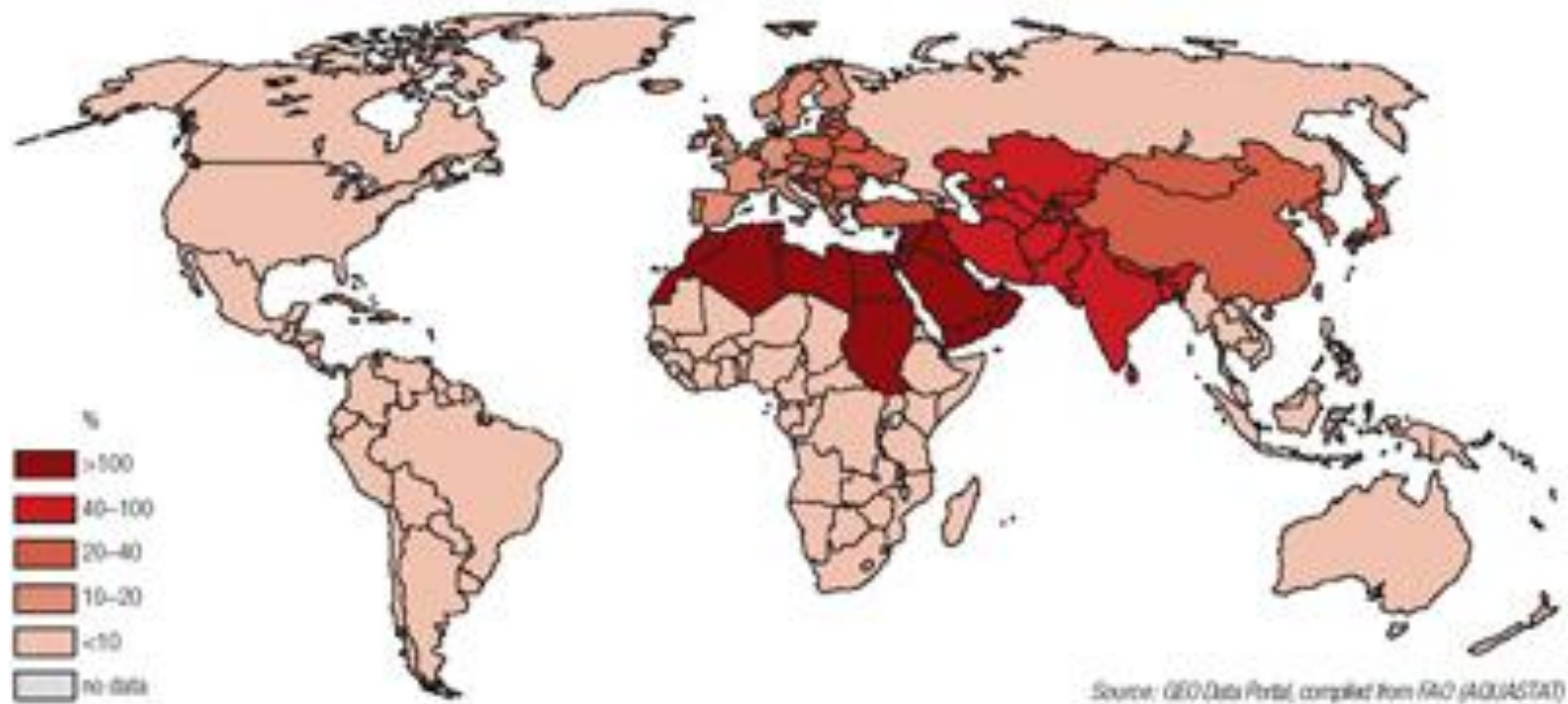
Price of water, in U.S. dollars per cubic meter



Source: Deutsche Bank



# Water use as % of renewable water resources



# Water Wars

*"Whiskey is for drinking; water is for fighting over." (attributed to Mark Twain)*





# Water Footprint

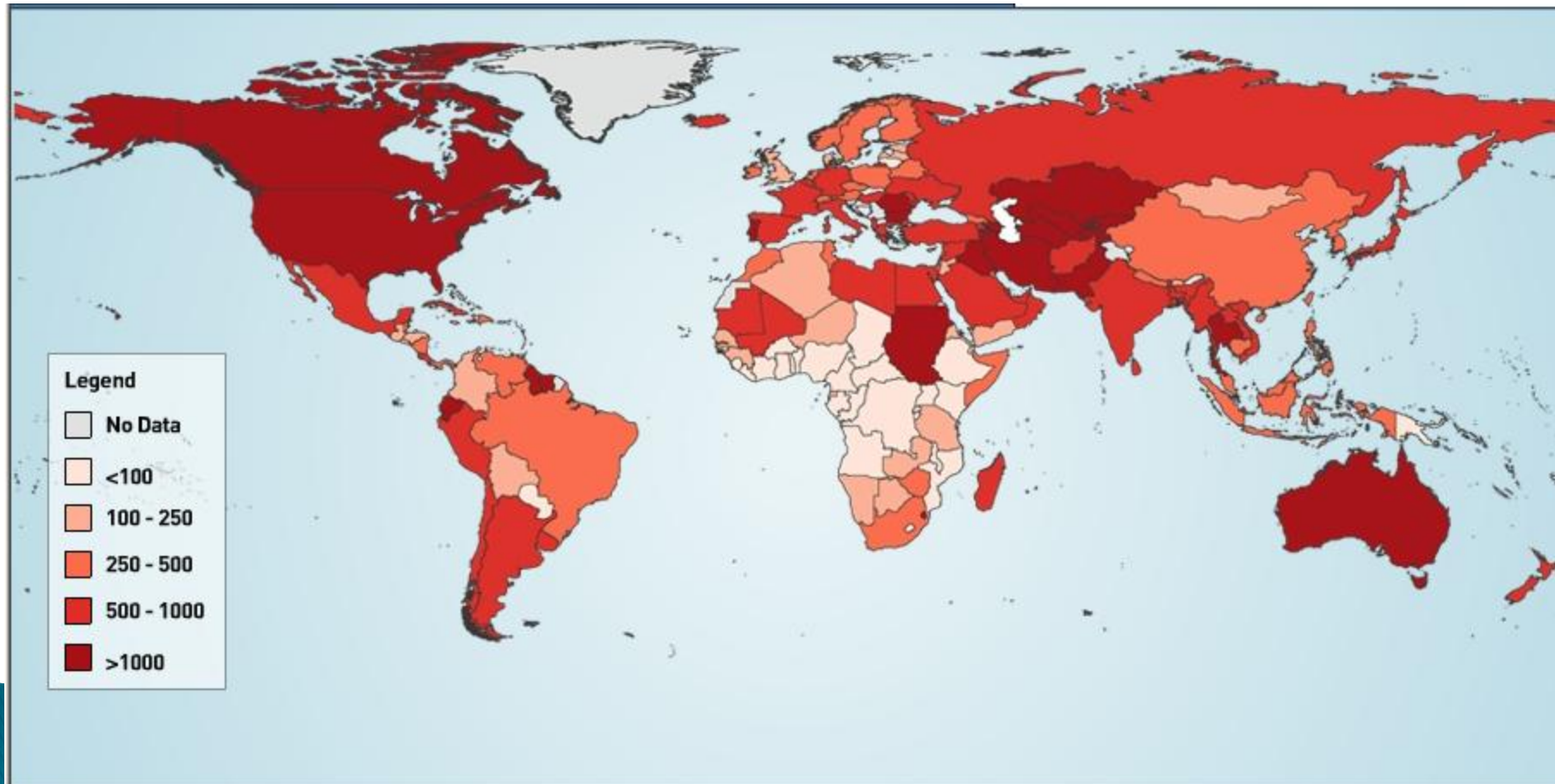
hic

Faced with the growing threat of shortages of fresh water, a handful of companies have started tracking their "water footprints," tallying the amount of water that goes into manufacturing their products. But the measure can be tenuous, since there are no clear standards for what a water footprint should count. **See examples below.**





# Water withdrawal per person (m<sup>3</sup>/year)



Water withdrawal per person (m<sup>3</sup>/year)

Water withdrawn per person for agricultural domestic and industrial purposes (m<sup>3</sup>/year)

Source: AQUASTAT

# Total renewable water resources per person ( $\text{m}^3/\text{year}$ )



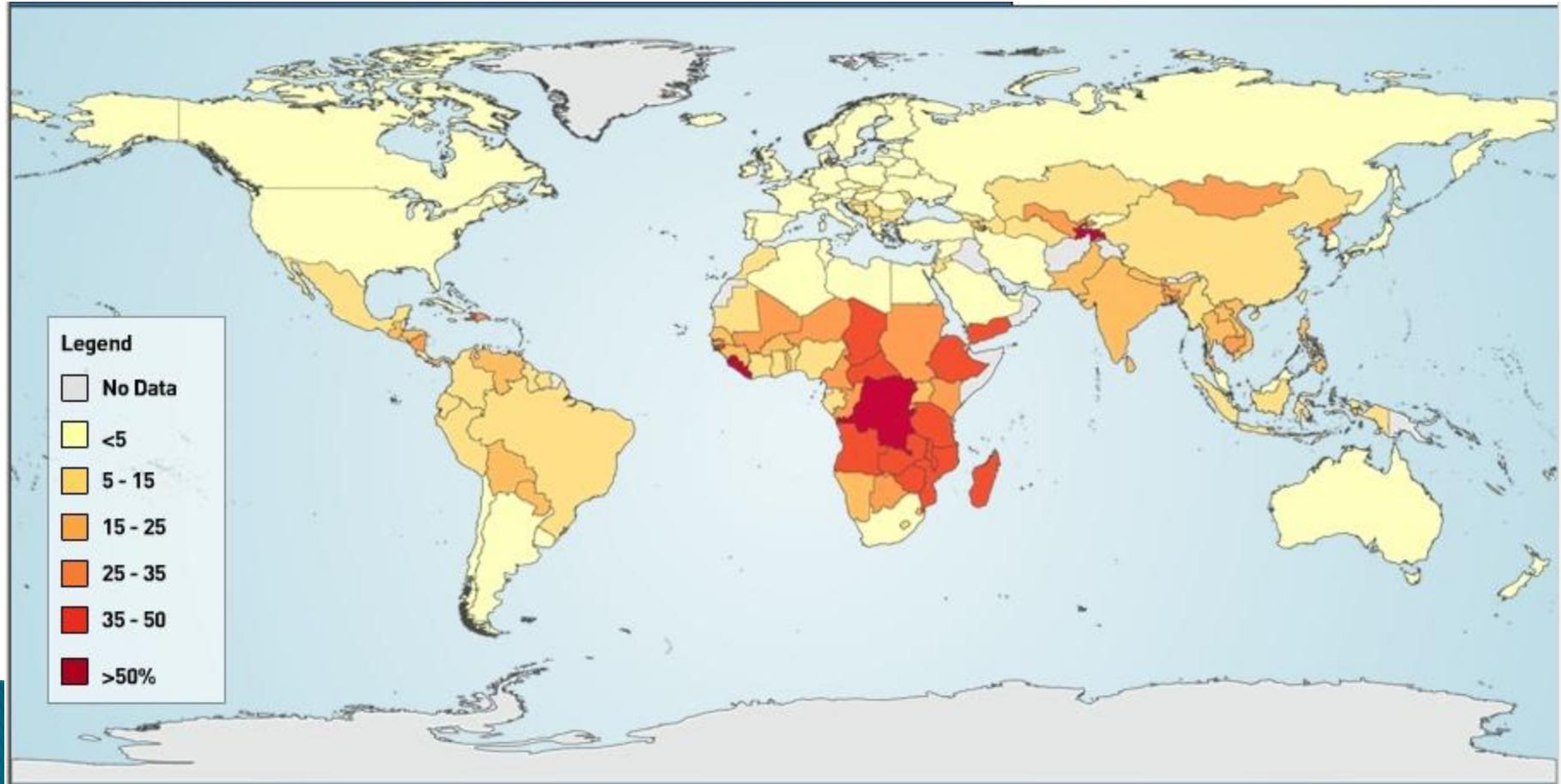
Total renewable water resources per person ( $\text{m}^3/\text{year}$ )

Actual renewable surface water and groundwater resources per person (in 2005)

Source: AQUASTAT



# Undernourished people as % of total populations



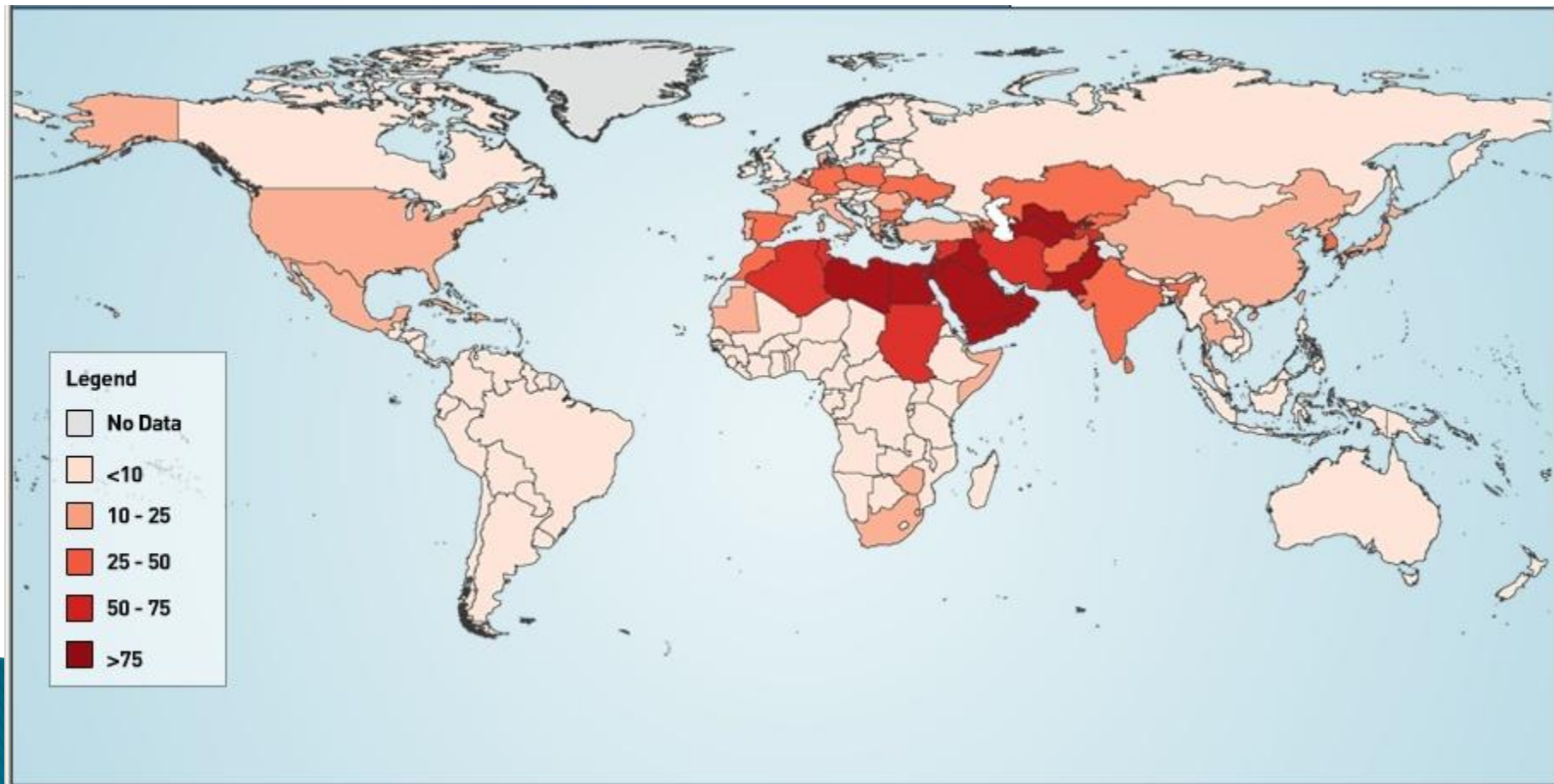
Prevalence of undernourished people as a percentage of total population

(2002 - 2004)

Source: AQUASTAT



# Proportion of renewable water resources withdrawn



Proportion of renewable water resources withdrawn (MDG Water Indicator)

Surface water and groundwater withdrawal as percentage of total actual renewable water resources (around 2001)

Source: AQUASTAT