Water Quality Monitoring and the Impacts of Pollution A global perspective

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UN environment programme

GEMS Water

The GEMS/Water Programme: Capacity development

The UNEP GEMS/Water Capacity Development Centre was established in 2015 in the Environmental Research Institute of UCC

Mission: To develop global capacity to monitor the quality of freshwater in support of environmental assessments at national, regional and global scales

Capacity development activities focusing on low-income countries in the African, Latin America and the Caribbean, and Asia and Pacific regions

UCC University College Cork, Ireland Coláiste na hOllscoile Corcaigh

Government of Ireland

Funded by the United Nations Environment Programme through donations from Irish Aid and the Department of Housing, Local Government and Heritage

Introduction

- Global action needed to address water quality deterioration due to pollution
- Water quality monitoring is essential for sustainable management of freshwater
- Agenda 2030 introduced Sustainable Development Goal 6 – a call for an integrated approach to freshwater management at global scale
- SDG indicator 6.3.2 monitors progress towards good ambient water quality by 2030

Northern Ghana

Water pollution issues on a global scale

- Pathogens
- Organic pollution
- Salinity
- Eutrophication

UNEP 2016. A Snapshot of the World's Water Quality: Towards a global assessment. United Nations Environment Programme, Nairobi, Kenya. 162pp

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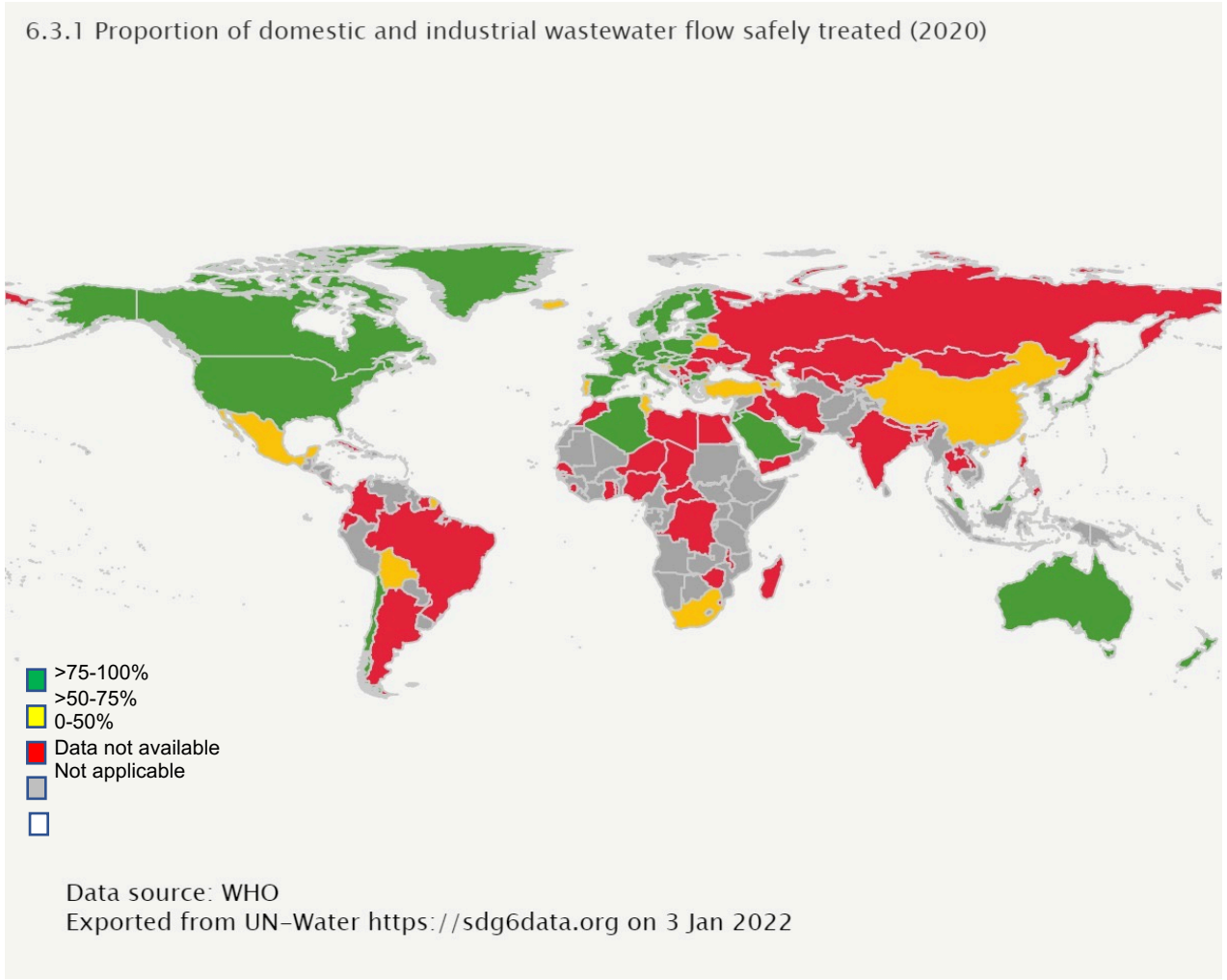
Water use generates wastewater

"The immediate cause of increasing water pollution is the growth in wastewater loadings to rivers and lakes" (UNEP, 2016)

In 2020, around 1 in 4 people lacked safely managed drinking water in their homes and nearly half the world's population lacked safely managed sanitation

(WHO/UNICEF Joint Monitoring Programme (JMP) for Water Supply, Sanitation and Hygiene)

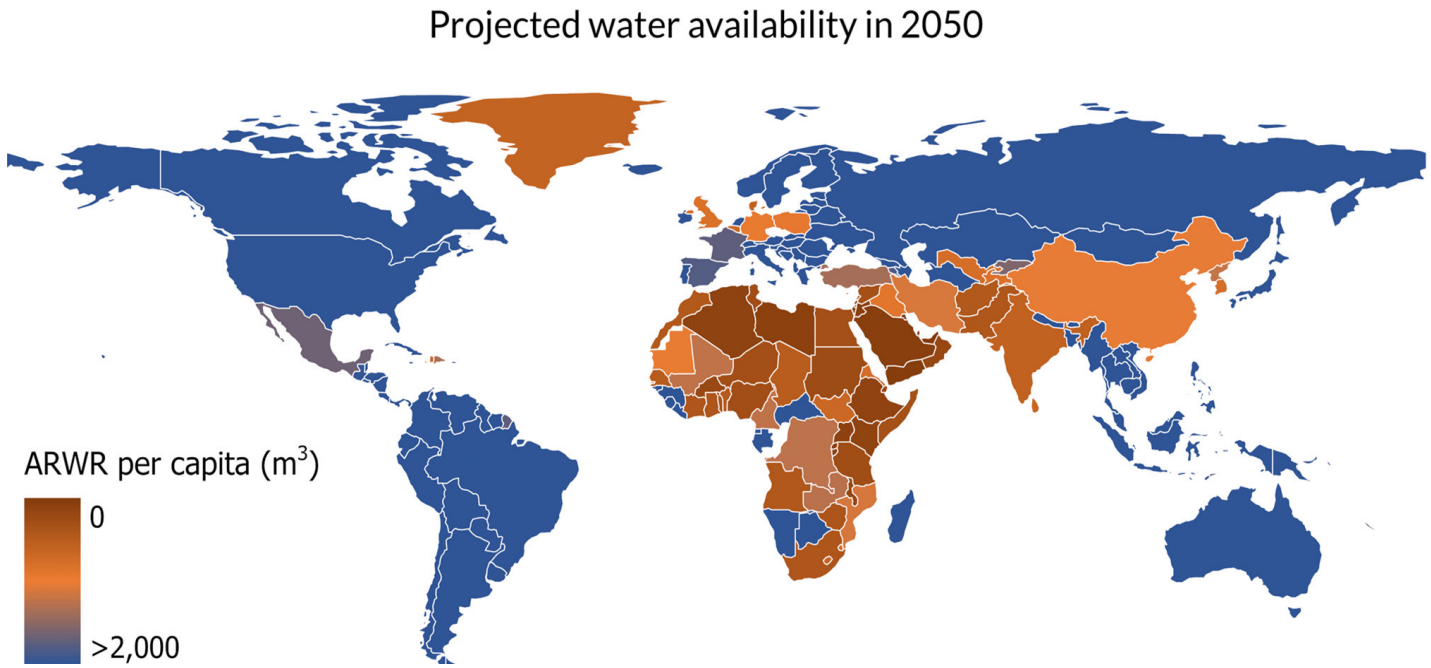


Pollution and water quantity

Pollution affects potential use of the water, as well as the health and integrity of the aquatic ecosystem

Poor water **quality** reduces the **quantity** that is available for use

Water availability including the needs for freshwater ecosystems



Baggio, G., Qadir, M. and Smakhtin, V. 2021 Freshwater availability status across countries for human and ecosystem needs, Science of The Total Environment, 792, 148230 https://doi.org/10.1016/j.scitotenv.2021.148230.

Water quality monitoring - from simple to complex

Regular, standardised measurements of physical, chemical and biological characteristics

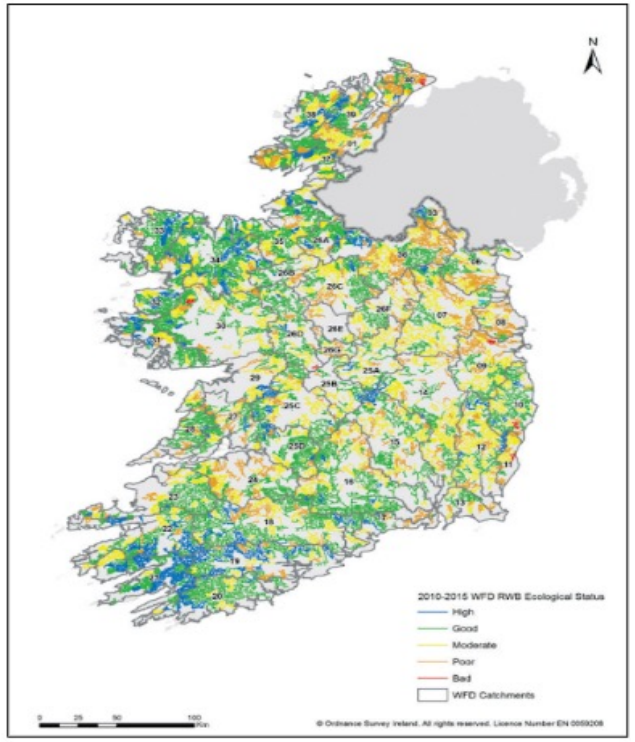
Low tech. to high tech.

In situ measurements

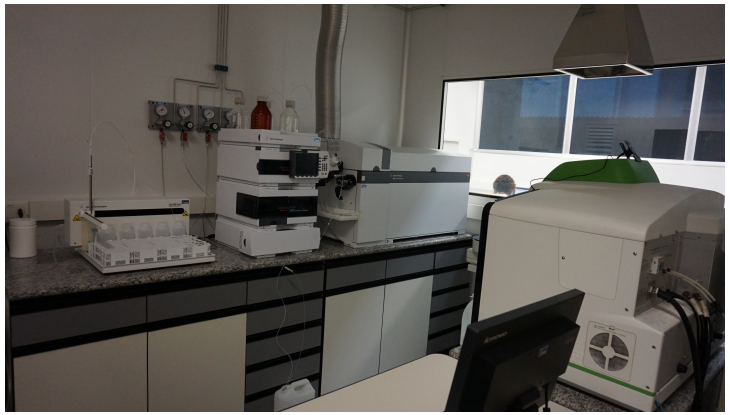
Citizen monitoring with simple test kits

Secchi disc

Monitoring with macroinvertebrates



Ecological status of monitored river water bodies 2010-2015 in Ireland (Fanning et al., 2017).



Laboratory analysis of water samples

Continuous, instantaneous, retrospective

In situ, multiple parameter, continuous monitoring

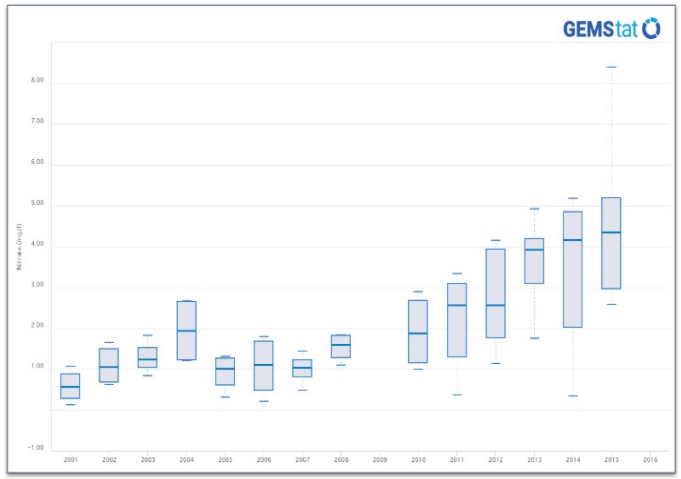
Operational and early warning continuous monitoring

Special event sampling - 24-bottle autosampler (by Hall, David W., USGS, Public domain)

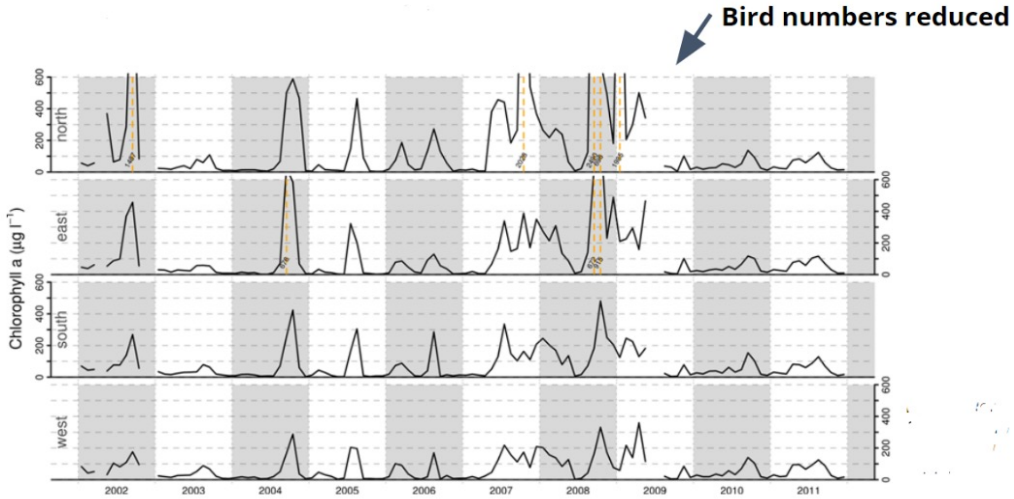
Lake sediment cores Photo: ECAB LAB

Spatial and temporal scales

Cyanobacterial bloom in Lake Ontario as seen from space (by NASA Public Domain)



A single monitoring location showing nitrate data between 2001 and 2015 (Source: GEMStat Data Portal)



Long-term monitoring showing reduction in chlorophyll when bird numbers on a lake were reduced by disease (Stockdale, 2012)

Sustainable use of freshwater requires:

- an understanding of sources and impacts of pollution
- integration of information on quantity and water quality
- monitoring to determine the state of water quality and the location and impacts of pollution

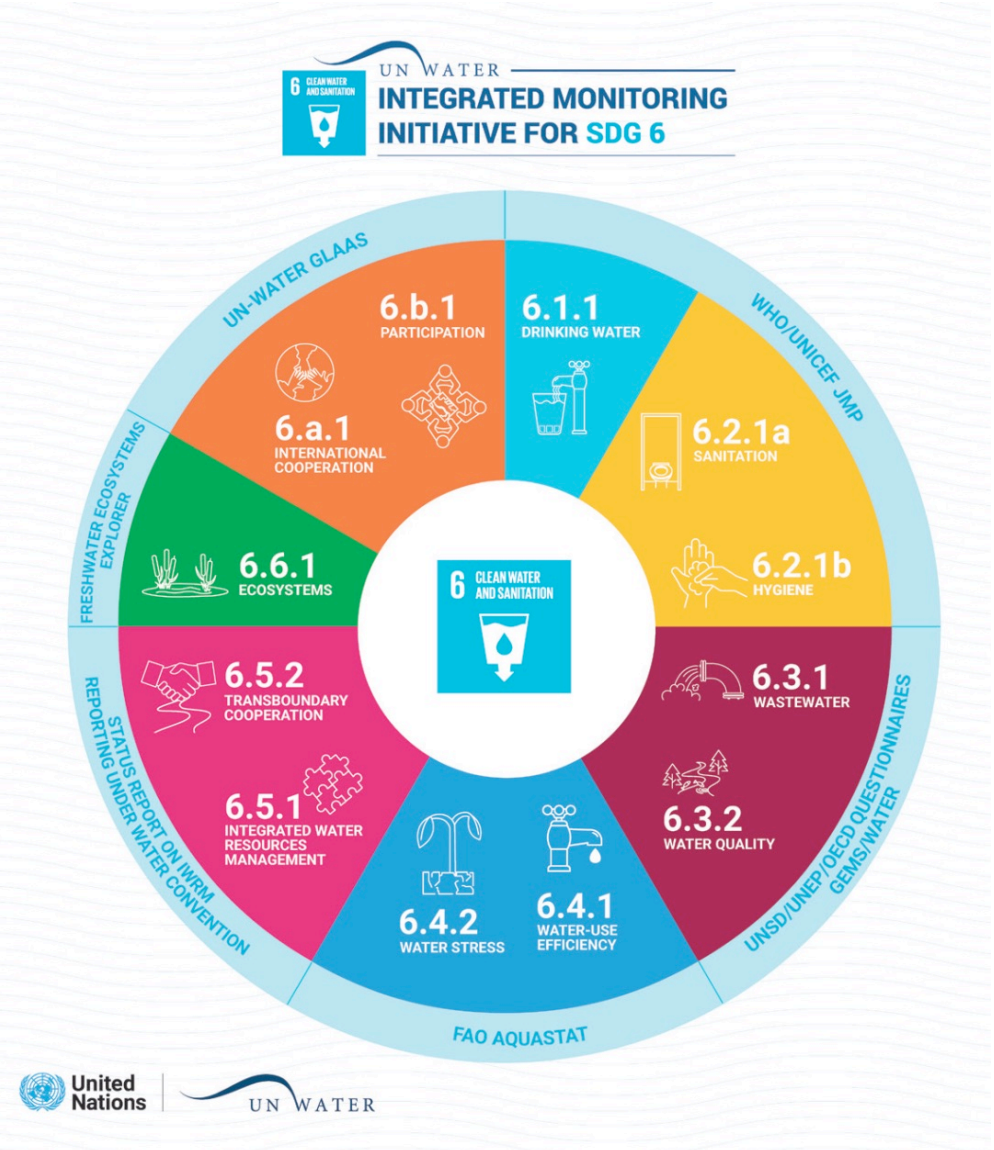
Ensure availability and sustainable management of water and sanitation for all

SDG 6 – Targets on eight different aspects of freshwater resources

Eight targets and 11 indicators covering:

- Water use – quantity and quality
- Water pollution
- Management and co-operation
- The freshwater ecosystem

Target 6.3: "**By 2030, improve water quality** by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally"



SDG Indicator 6.3.2: Proportion of bodies of water with good ambient water quality

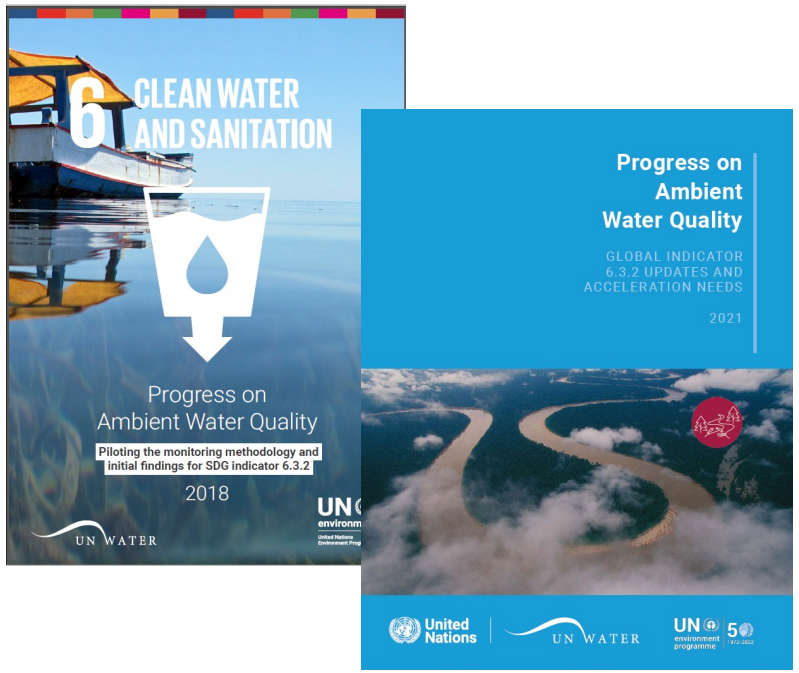
Good ambient water quality does not damage ecosystem function or present a risk to human health:

- It should not be severely impacted by human activities
- It should support a balanced ecosystem, including fisheries
- It should be safe for recreational activities, such as water contact activities

UNEP GEMS/Water - Global implementation of SDG Indicator 6.3.2

- Development of indicator methodology
- Baseline data drive in 2017
- Providing support to countries globally
- Reviewing implementation and improving the methodology
- Assisting countries with indicator calculation
- Analysing implementation and data submissions and preparation of the Indicator reports
- Exploring additional methods for data generation

Over 100 Countries engaged



SDG Indicator 6.3.2: Monitoring parameters and target values

Suggested water quality monitoring parameters in bold for Level 1

Parameter group	Parameter	River	Lake	Groundwater	Reason for inclusion
Oxygen	**Dissolved oxygen**	•	•		Measures oxygen depletion
	Biological oxygen demand, chemical oxygen demand	•			Measures organic pollution
Salinity	**Electrical conductivity** Salinity, total dissolved solids	•	•	•	Measures salinization and helps characterize the water body
Nitrogen*	**Total oxidized nitrogen** Total nitrogen, nitrite, ammoniacal nitrogen	•	•		Measures nutrient pollution
	Nitrate**			•	Consumption threatens human health
Phosphorus*	**Orthophosphate** Total phosphorus	•	•		Measures nutrient pollution
Acidification	**pH**	•	•	•	Measures acidification and helps characterizes the water body

* Countries should include the fractions of nitrogen and phosphorus which are most relevant in the national context.

** Nitrate is suggested for groundwater due to the associated human health risks.

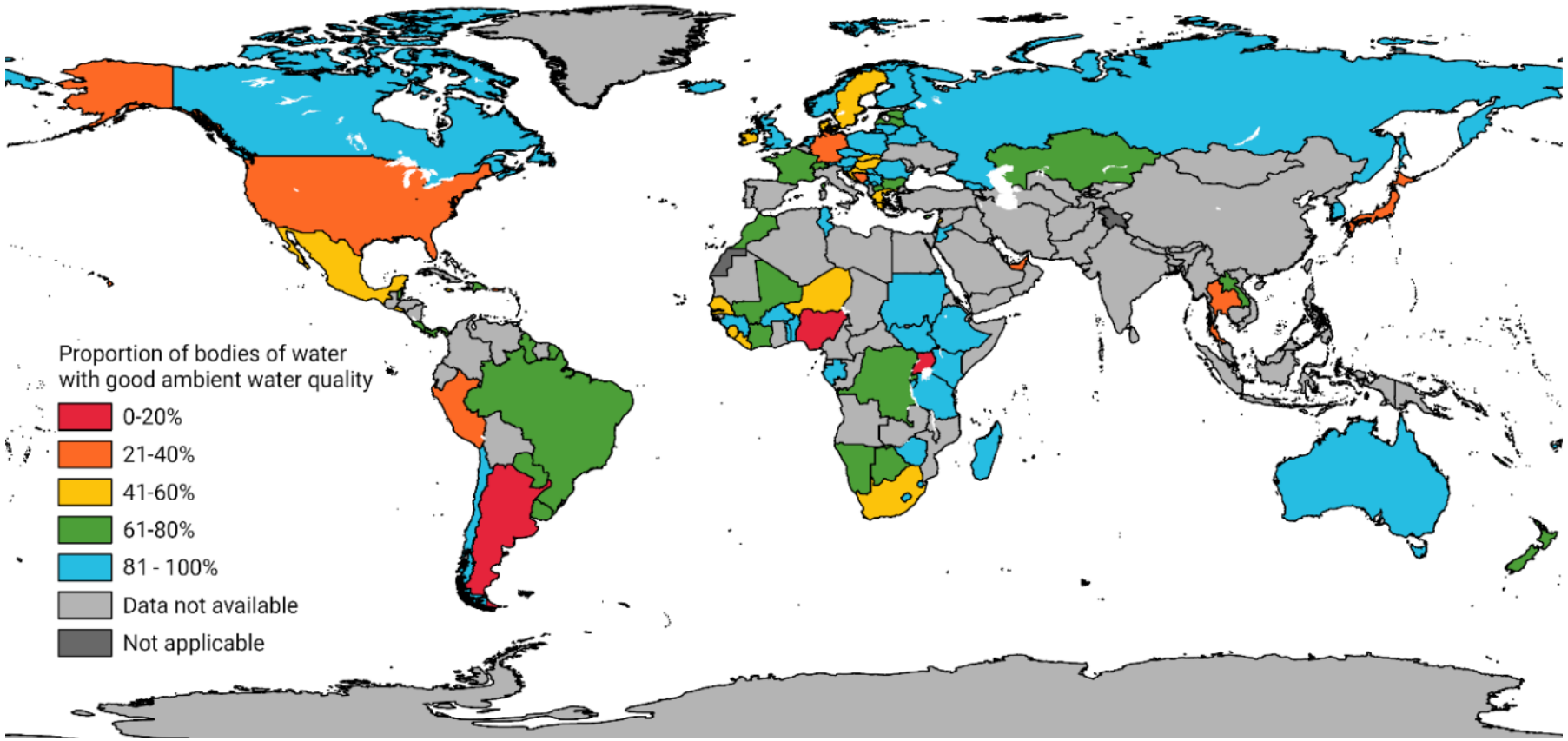
Examples of target values

Parameter Name	Target Value	Unit
Dissolved Oxygen	**6**	mg/l
Electrical Conductivity	**300 - 500**	µS/cm
pH	**6 - 8**	-
Orthophosphate	**0.035**	mg P/l
Total Oxidised Nitrogen (Nitrate + Nitrite)	**1.8**	mg N/l

The national indicator value is the proportion of water bodies assessed which achieve 80% compliance with the target values over the period of assessment (every three years).

SDG Indicator 6.3.2: Results from 2017 and 2020 data drives

Data submissions from 2017 and 2020 from 96 countries



3 billion people could be at risk because the health status of their freshwater ecosystems is unknown

Source: **Adapted from UN-Water (2021).**

Of the 89 countries with data available, only 50 have information about groundwater

Monitoring and reporting capacity in countries

- *Lack of technical and institutional capacity in many countries* to monitor water quality, manage the data and report an indicator value leading to large gaps at global scale
- *Lack of knowledge and appreciation amongst policy makers* about the importance of monitoring and managing ambient water quality
- *Perceived lack of need for targeted in situ water quality data collection at national scale*
- Differences between SDG indicator 6.3.2 and existing monitoring and reporting frameworks leading to additional burden on national level agencies and organisations

Methodology

- Many countries do not have *target values for ambient water quality*
- Many countries do not already measure all of the core parameters, therefore there is *additional resource requirements*
- Integration of alternative monitoring approaches into a global index is challenging, i.e. *how to combine traditional with novel data sources* (remote sensing, *in situ* sensors, citizen science, models)

Summary: Why global water quality monitoring is needed

Pressure from human activities is causing a deterioration in freshwater quality worldwide

In order to know where these pressures need to be managed, it is necessary to determine the locations and extent of degradation in freshwater quality

Information on status and changes in water quality is obtained from monitoring activities

Measuring progress towards sustainable management of freshwater requires an integrated approach to monitoring at global scale based on water catchments

At the global scale there is a big demand for capacity development in freshwater monitoring and management

Thank you for your attention
Any questions?

For further information:
Contact me: d.chapman@ucc.ie
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