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Prof. Dr. Dietrich Borchardt
Helmholtz-Centre for Environmental Research – UFZ
TU Dresden
dietrich.borchardt@ufz.de

The world's water quality:
A pre-study for a worldwide assessment

HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

CESR Center for Environmental Systems Research

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UN WATER

Background and motivation

- Wastewater production at least doubling by 2050 → Sewerage connections increasing
- But not wastewater treatment → More untreated wastewater to rivers and lakes

Nexus with human health:

Health risk of contaminated rivers & lakes → contact with surface waters → washing, cleaning, drinking

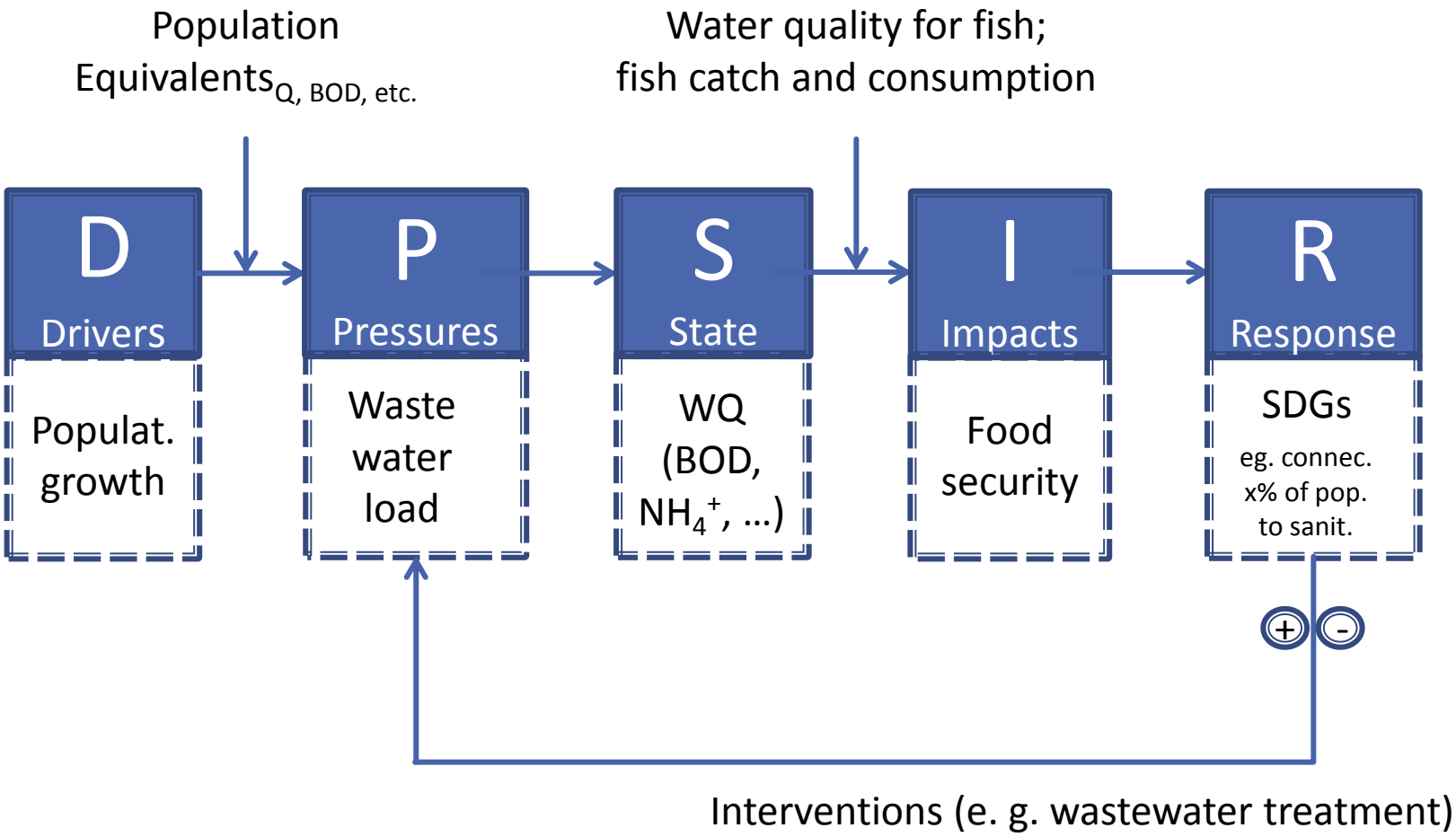
Nexus with food security:

95% inland fishery production from developing world

200 million Africans consume fish regularly

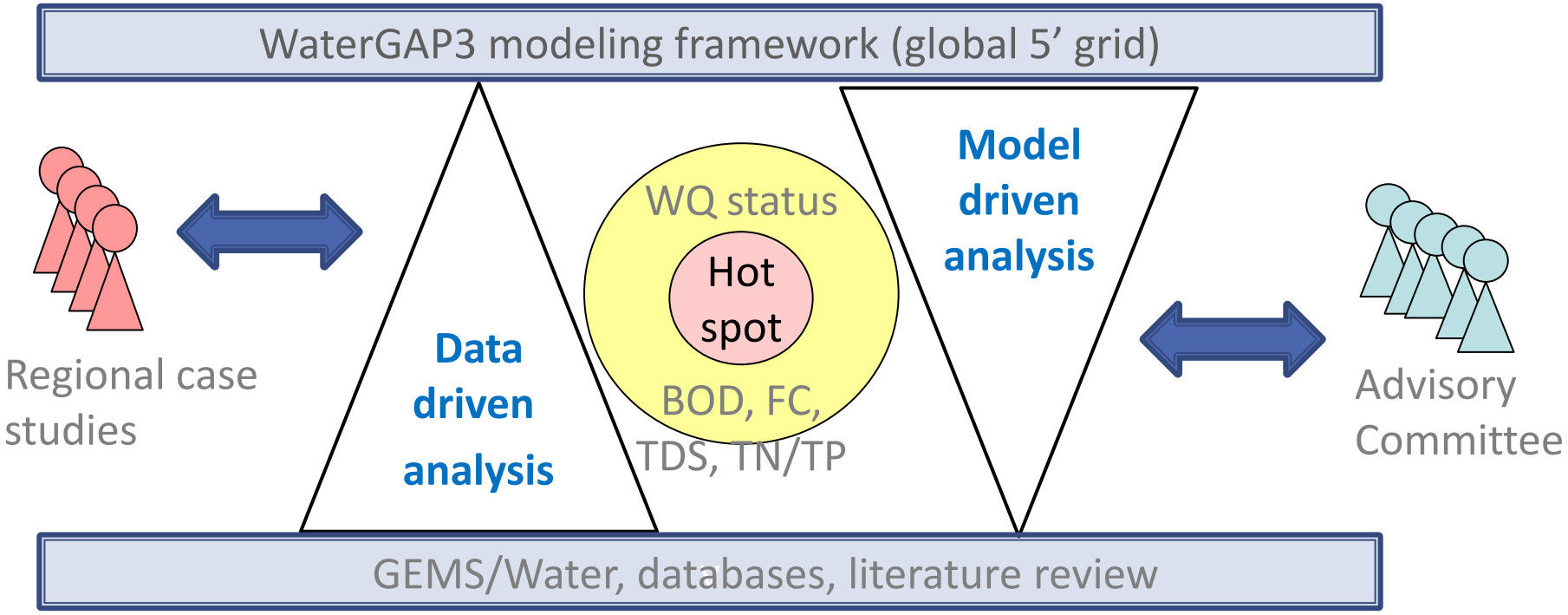
Rapidly growing demand for irrigation from surface and groundwaters

The generic concept behind the assessment



Which methods do we have at hand?

Global perspective – Top down



Local/Regional perspective – Bottom up

How can we classify the status of water quality?

WQI and Nexus

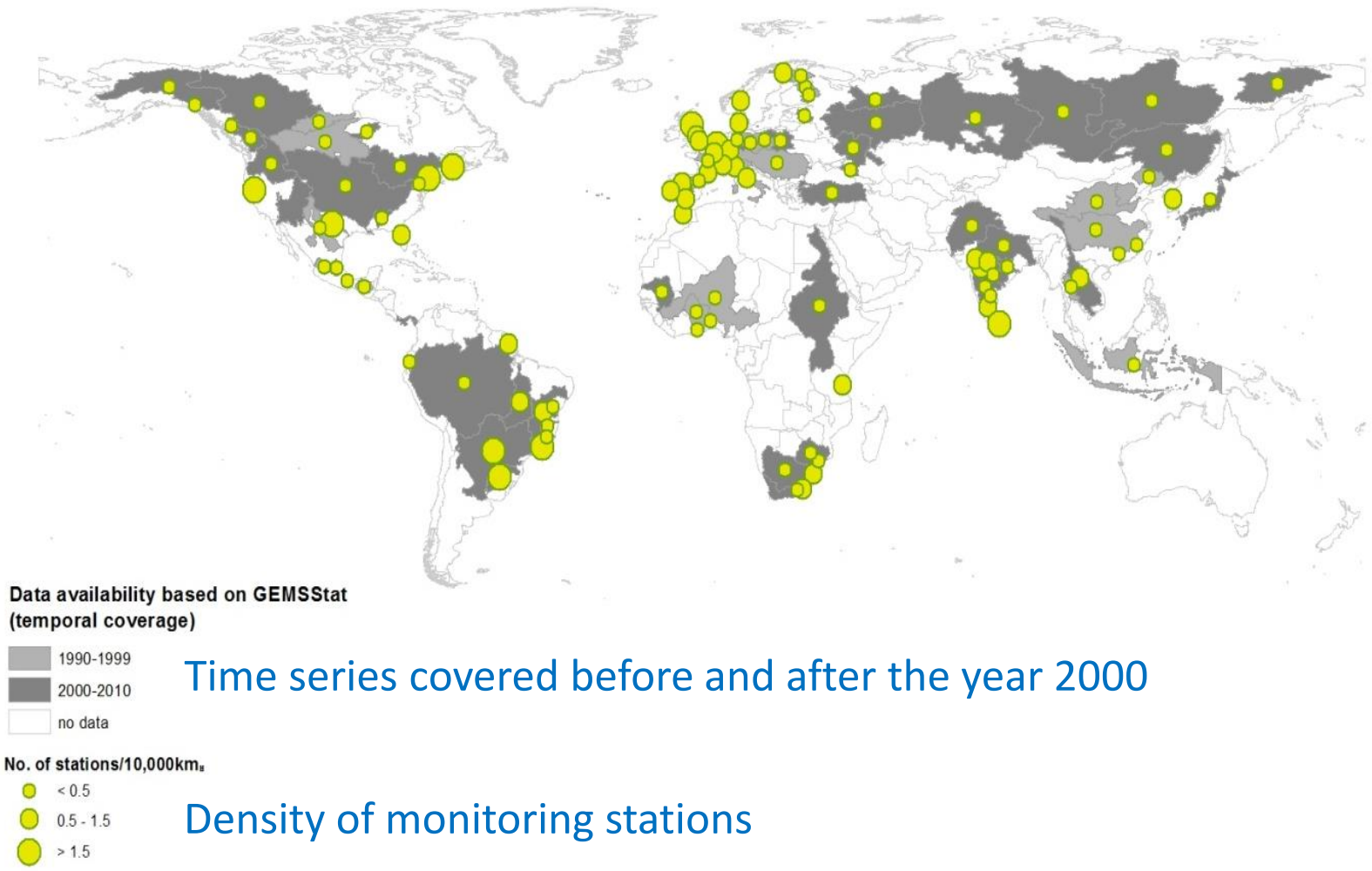
Parameter / Indicator	Food security	Human health
BOD => DO	**X**	X
TDS	X	
FC		X
N	X	
P	X	

- **Plus trends over time**

Classification

Water Quality Criteria	Dissolved Oxygen		Biological Oxygen Demand		Total Phosphorus		Total Nitrogen		TDS / Chloride
No adverse effects. Ecosystem functioning and natural processes within normal range	>6 mg/L	>7 mg/L	≤6 mg O_2 L^{-1}	≤3 mg O_2 L^{-1}	Mesotrophic to Meso - eutrophic (0.01 – 0.025 mg/L)	Oligotrophic (<0.004 – 0.01 mg/L)	<7.5 mg/L	≤ 3.0 mg/L	<100 mg/L
Aquatic life may experience some detrimental effects from current water quality	6-4 mg/L	6-5 mg/L	7 - 9 mg O_2 L^{-1}	4 - 6 mg O_2 L^{-1}	Eutrophic (0.025 – 0.05 mg/L)	Mesotrophic to Meso - eutrophic (0.01 - 0.025 mg/L)	7.5 – 15.0 mg/L	3.0 – 7.5 mg/L	<300 mg/L
Water quality impacting most aquatic organisms, mortality may occur.	<3 mg/L	<4 mg/L	>10 mg O_2 L^{-1}	>7 mg O_2 L^{-1}	Hyper-eutrophic (>0.050 mg/L)	Eutrophic (0.025 – 0.050 mg/L)	>15.0 mg/L	7.5 – 15.0 mg/L	>120 mg/L

What is the available information ?

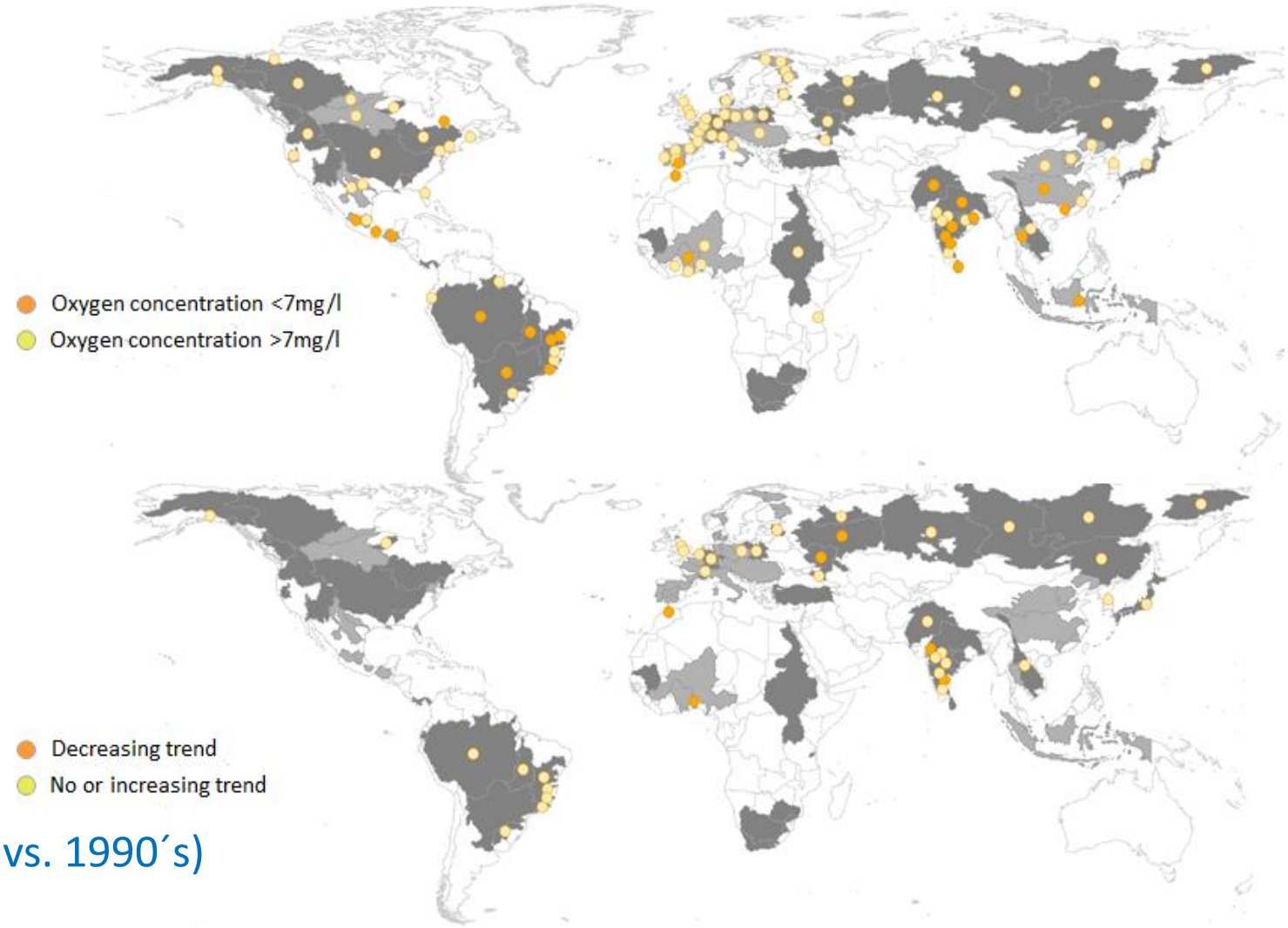


Time series covered before and after the year 2000

Density of monitoring stations

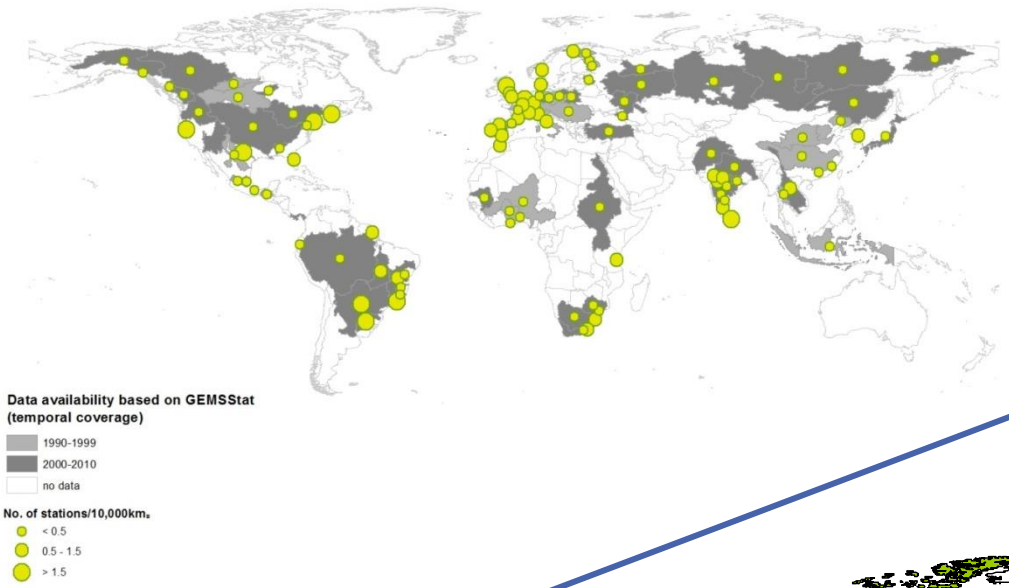
Results: water quality status and trend (example oxygen)

Actual status

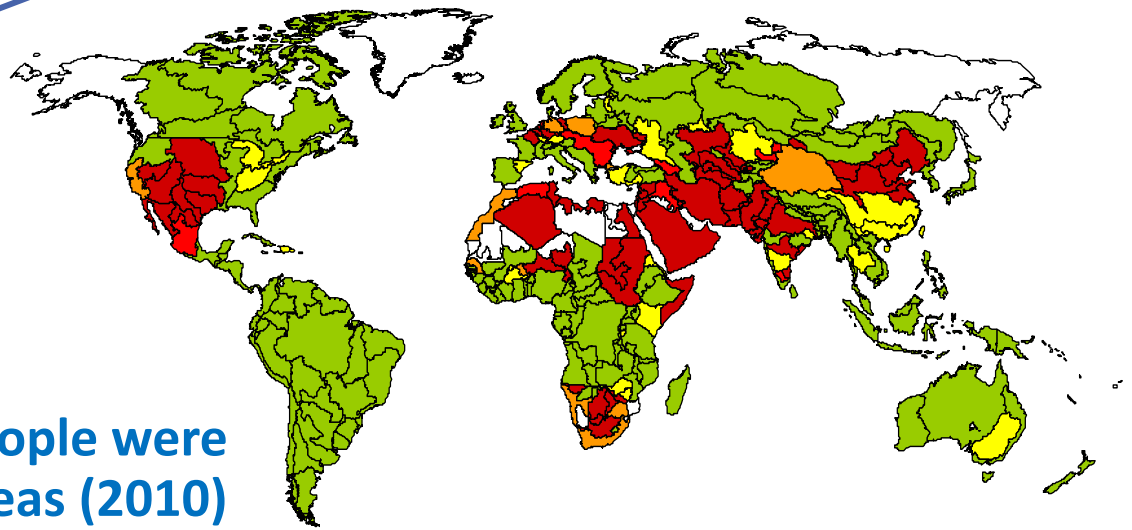


Trend (2000´s vs. 1990´s)

Water scarcity ≈ data scarcity



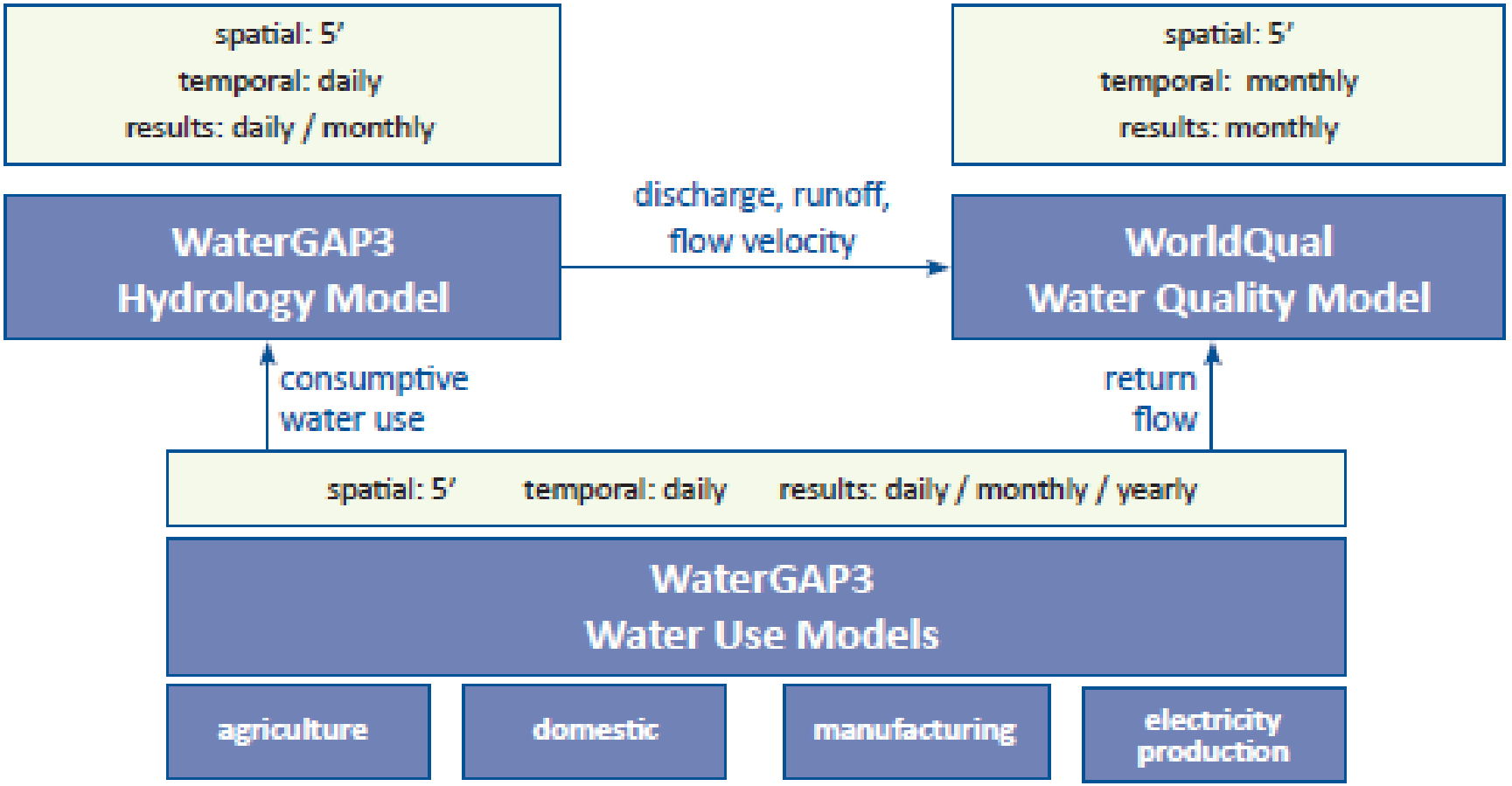
Density of WQ monitoring stations and time series covered before and after 2000



In 2010 ≈ 2.5 Bill. people were living in water short areas (2010)

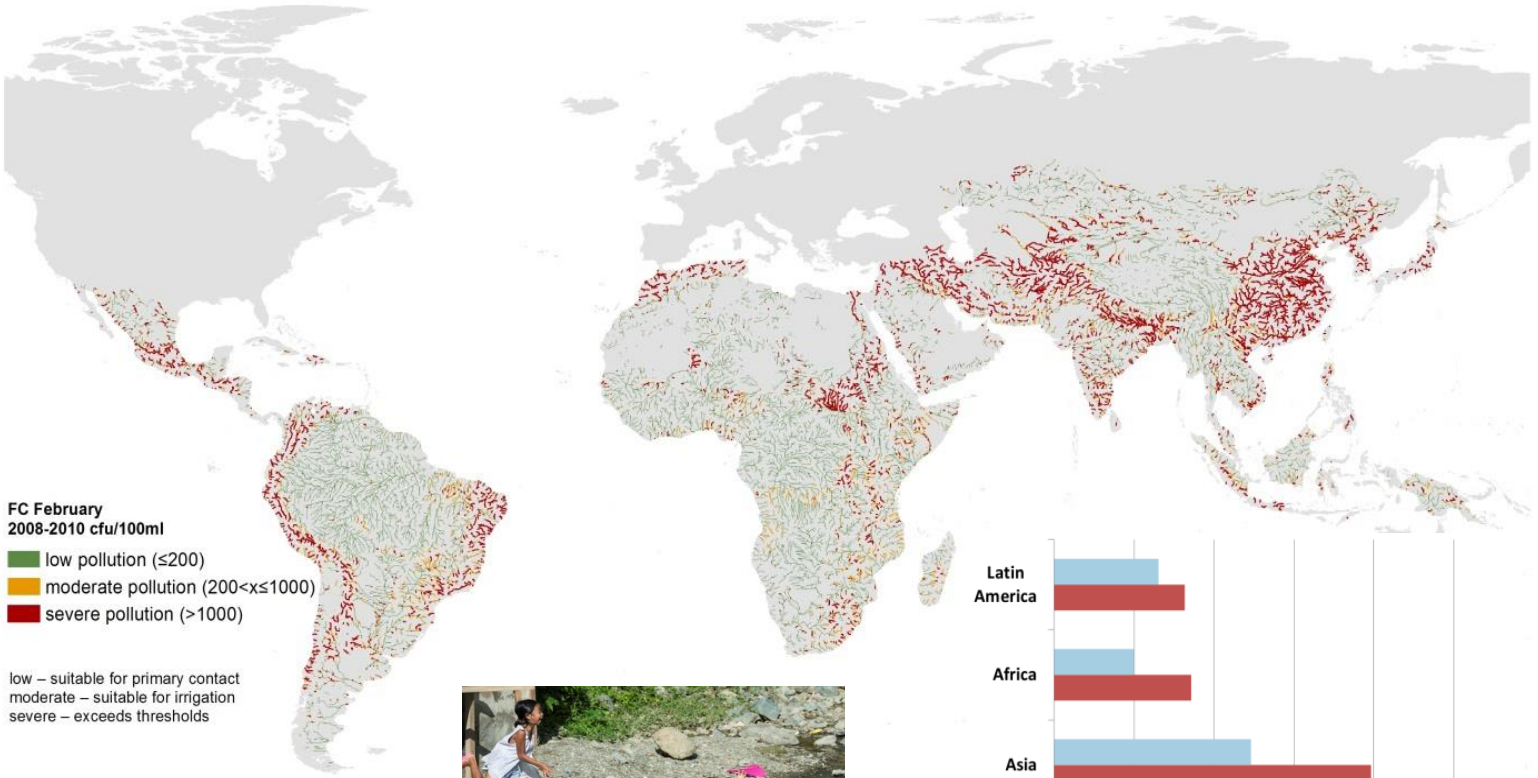
(IFRI 2011)

Overview of the modelling framework (WorldQual)



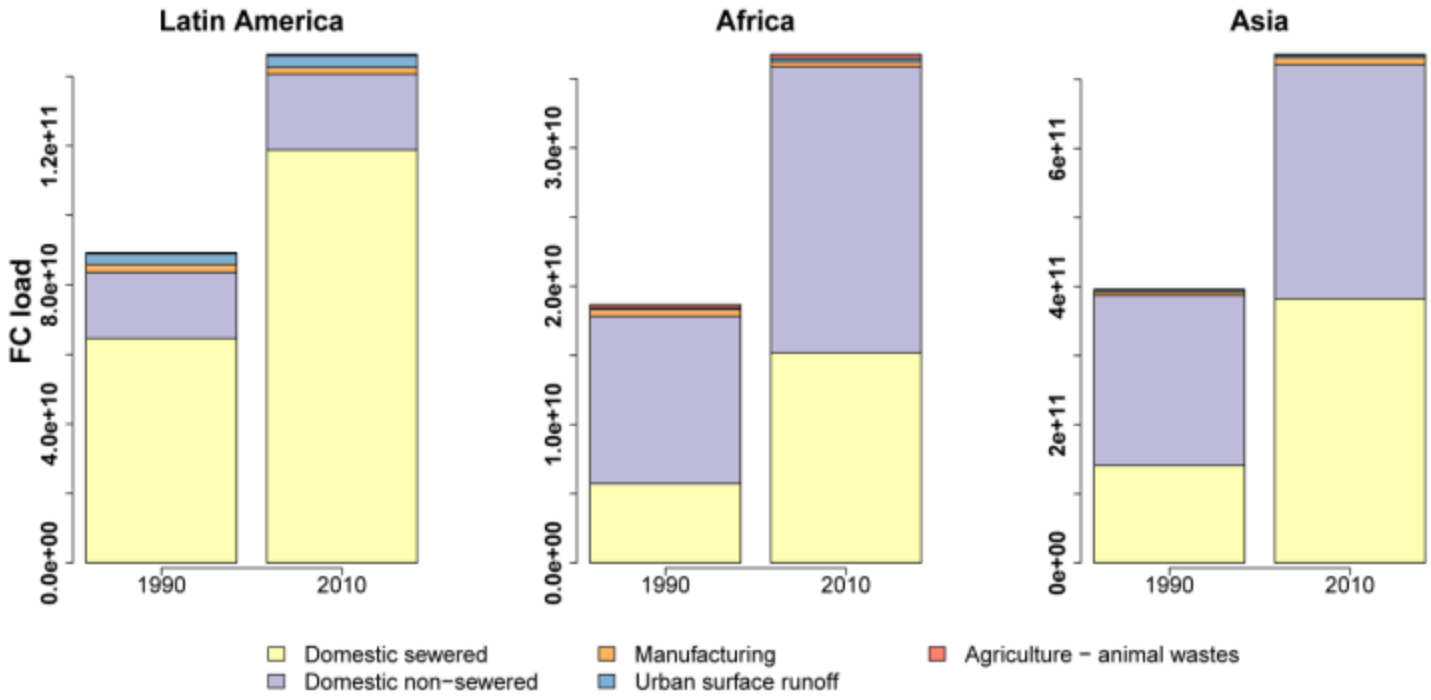
Results: nexus with human health (example pathogens)

Description :- Estimated in-stream concentrations of faecal coliform bacteria (FC) for Latin America, Africa and Asia for February 2008-2010. Bar charts show minimum and maximum monthly estimates of river stretches in the severe pollution class per continent in the 36-month period from 2008-2010.



Results: Where does the pollution come from?

Description : Faecal coliform bacteria loadings ("FC load") for Latin America, Africa, and Asia for 1990 and 2010. Units: 10^{10} cfu/year..

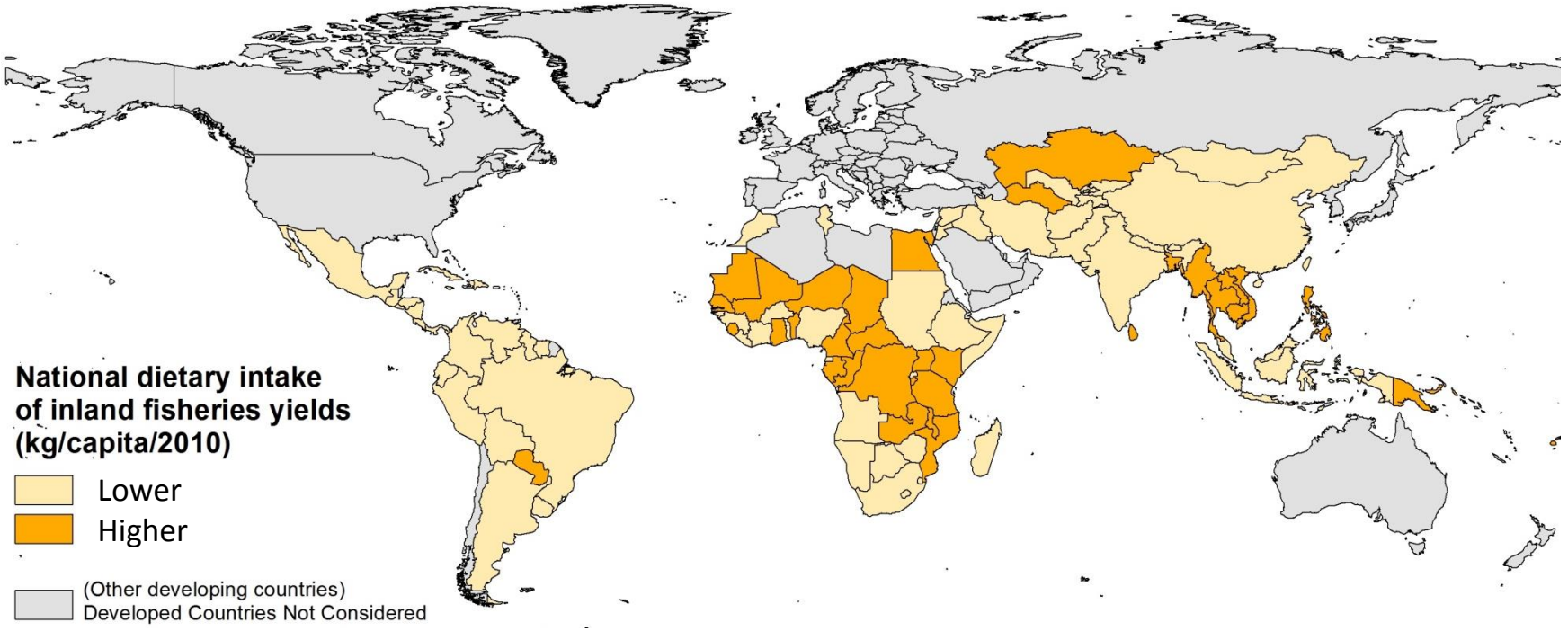


Results: nexus with food security (example inland fisheries)

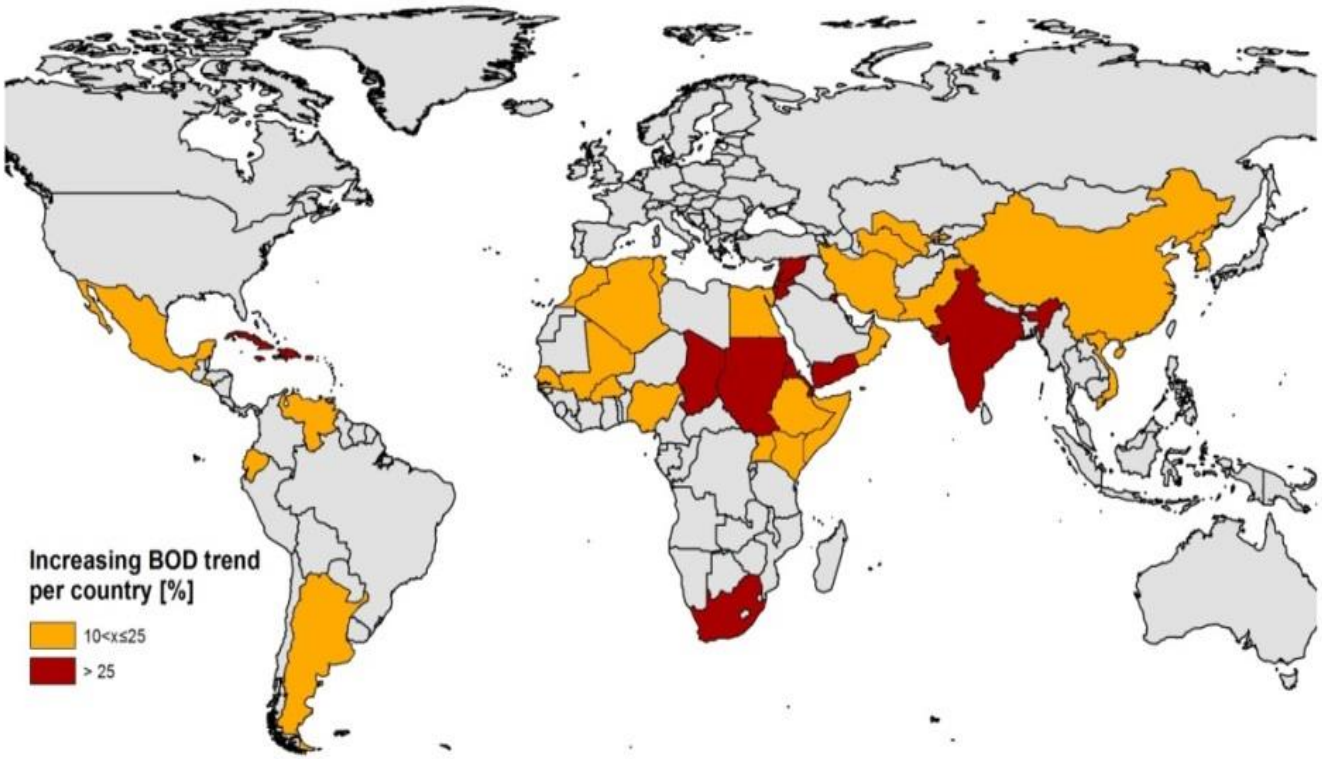
Description :- Estimation of the level of consumption of inland fisheries per person per country.

Method :- Reported inland fisheries catch (t) divided by the official national population.

Categorisation :- Higher consumption: ≥ 1,86 kg/capita/2010 and Lower consumption: < 1,86 kg/capita/2010
(75th percentile of countries reporting inland fisheries yields)



Results: nexus WQ with food security (example inland fisheries)



Description :- Percentage of river stretches in each country with "increasing trend of BOD of particular concern" meaning that in these stretches the pollution level increased into the severe pollution category in 2008-10, or that they were already in the severe pollution category in 1990-1992 and further increased in concentration by 2008-2010

Solutions to the water quality challenge

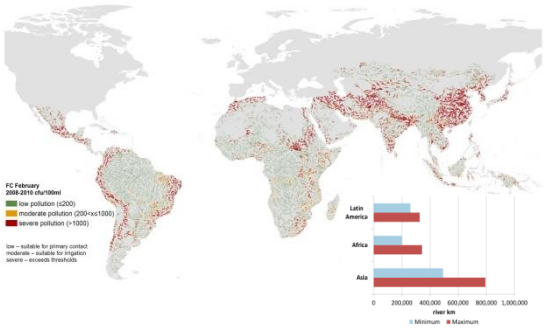
Sources of pollution →

Technical and management options ↓

Technical option	Source of pollution: Domestic sewered	Domestic non-sewered	Urban surface runoff	Industry	Agriculture and sediment pollution
1. Pollution prevention					
Increasing water use efficiency	+	+		+	+
Reduction of wastes produced	+	+		+	+
Urban green infrastructures			+		+
2. Treatment of wastewater					
Mechanical/primary treatment	+		+		
Biological/secondary treatment	+			+	
Chemical/tertiary treatment	+			+	
Advanced treatment	+			+	
Constructed wetlands & natural treatment systems	+		+		+
3. Safe reuse of wastewater					
Use of stormwater			+		
Reuse of domestic wastewater and sludge	+				
Household greywater recycling systems	+				
Reuse of wastewater in industries				+	
4. Protection and restoration of ecosystems					
Forest conservation / reforestation of river basins			+		+
Using natural wetlands for treatment of wastes	+		+		+
River dilution	+	+	+	+	+
Flow regime restoration	+	+	+	+	+
Targeted environmental dredging				+	+

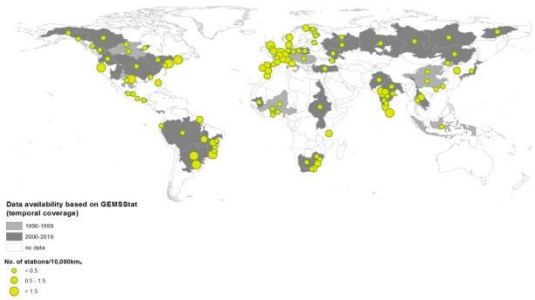
- Pollution prevention
- Treatment of wastewater
- Safe re-use
- Protection and restoration of ecosystems
- Governance instruments

Key findings on water quality



- **Water pollution has worsened** since the 1990s in almost all rivers in Latin America, Africa and Asia.
- **Severe pathogen pollution** already affects around one-third of all river stretches in Latin America, Africa and Asia.
- The number of **people at risk to health** by coming into contact with polluted surface waters may range into the tens of millions on these continents.
- **Severe organic pollution** already affects around one-seventh of all river stretches in Latin America, Africa and Asia.
- The **food security from inland fisheries is threatened** in a number of countries in Africa and Asia

Key findings on information and data



- There is a **substantial** data and information **gap**
- **Very low density of monitoring stations** in the only global data bank (GEMStat)
  - typical minimum density of around 1.5 to 4 stations per 10,000 km^2 of river basin area in the USA and Europe.
  - The average density for the Latin American continent is 0.3 stations per 10,000 km^2, for Africa 0.02 stations per 10,000 km^2, and for Asia, 0.08 stations per 10,000 km^2
- **Significant inconsistencies** between global assessment and regional knowledge/information needs
- **Efforts and priorities** on data-deficient rivers/catchment **needed** => crucial for management

What can be done?

- Although water pollution is serious and getting worse, the **majority of rivers in Latin America, Africa, and Asia are still in good condition**
- **Great opportunities for short-cutting** further pollution and restoring the polluted rivers
- **Priority fields of action needed under the SDG-Agenda**
  - **Monitoring** → more understanding needed
  - **Assessment** → comprehensive national/international
  - **Management and technology**→ Nexus; old./.new
  - **Effective institutions** → promote action, overcome barriers



How could it be done?

Building blocks for a full WWQA assessment

1. Baseline assessment
State of water quality

2. Scenario analysis
Prospects & policy options

3. Mitigation options
Technical, management

4. Governance options
All levels

http://www.wwqa-documentation.info

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