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WATER QUALITY CHALLENGES AND SUPPORT NEEDS

Insights from a UNESCO IHP Survey of Member State Priorities

Introduction

In early 2025, UNESCO's Intergovernmental Hydrological Programme (IHP) conducted a Survey on Water Quality to better understand how Member States perceive emerging water-quality challenges. The survey comprised 12 thematic questions covering water-use categories, major pollutants, key pollution sources, institutional and technical capacities, financial and regulatory constraints, and priority areas for support. Results were obtained from 23 responses across 20 UNESCO Member States. Responses were submitted by individual experts and institutions, rather than by official national representatives, and some Member States are therefore represented by multiple responses.

Interregional participation provided insight into how water-quality pressures arise under diverse socio-economic conditions and highlighted common structural challenges towards improving water quality. The findings further identified priority domains where UNESCO IHP support is most urgently required—capacity development, dissemination of scientific tools and good practices, enhanced scientific and institutional cooperation, and strengthened multilateral collaboration—directly informing the implementation of the IHP-IX Strategic Plan.

Key Trends

The survey revealed a clear and consistent structural pattern in water-quality challenges across regions, despite differences in socio-economic contexts and sectoral priorities. In most regions, domestic was the water use category with the greatest water quality concern, followed by industry and irrigation (Figure 1a). Organic matter and pathogens emerged as the pollutants of greatest concern, with nutrients ranking second (Figure 1b). By contrast, metals and micropollutants, while relevant in specific regional contexts, were generally perceived as secondary challenges. For pollution sources, poorly managed urban wastewater was most frequently identified as the primary source of water pollution, while industrial activities were recognised as a more structural and persistent driver (Figure 1c). Taken together, these patterns indicated that water-quality challenges in many countries remain strongly concentrated in basic service delivery and day-to-day operational management, particularly in relation to household water use, sanitation, and wastewater systems.

The nature of these water-quality concerns constitute structural signals of vulnerability at the implementation stage of water-quality management systems. Issues related to domestic water use, pathogens, organic matter, and urban wastewater typically are controlled at an early stage of water pollution treatment[1] as long as institutional arrangements, technical systems, and operational practices function effectively. The persistent prioritisation of these "early phase" water quality challenges emphasizes the well-known global issues with implementing and enforcing existing water-quality regulations[2].

This interpretation was further supported by a priority ranking for institutional, technical, and financial constraints across Member States. Within each of these three domains, we assessed which stage of water quality management—monitoring, implementation, or assessment—was the greatest challenge. Across regions, the implementation stage emerged as the most frequently selected top-priority challenge across institutional, technical, and financial domains. Thus, water-quality challenges were greatest where existing frameworks had to be translated into operational action and enforcement, rather than at the stage of analytical design or diagnostic understanding. Monitoring showed a more heterogeneous pattern. In certain regions and constraint domains—particularly under financial constraints—monitoring was frequently identified as the highest priority, but substantial regional variation in monitoring needs and capacities existed. By contrast, the assessment stage was selected as the highest priority infrequently across domains, suggesting that concerns related to data assessment and analysis were generally less prominent than those associated with monitoring and implementation.

1 Hannah, D. M., Abbott, B. W., Khamis, K., Kelleher, C., Lynch, I., Krause, S., & Ward, A. S. (2022). Illuminating the 'invisible water crisis' to address global water pollution challenges. *Hydrological Processes, 36*(3).

2 Ménard, C., Jimenez, A., & Tropp, H. (2020). Addressing the policy-implementation gaps in water services: the key role of meso-institutions. OECD Principles on Water Governance, 13-33.

Together, these results demonstrated that the central water-quality challenge faced by many Member States is not a lack of diagnostic knowledge, but a gap between knowledge and action. Accordingly, efforts to improve water quality should prioritise support that directly strengthens implementation capacity, rather than focusing primarily on the expansion of analytical or diagnostic frameworks alone.

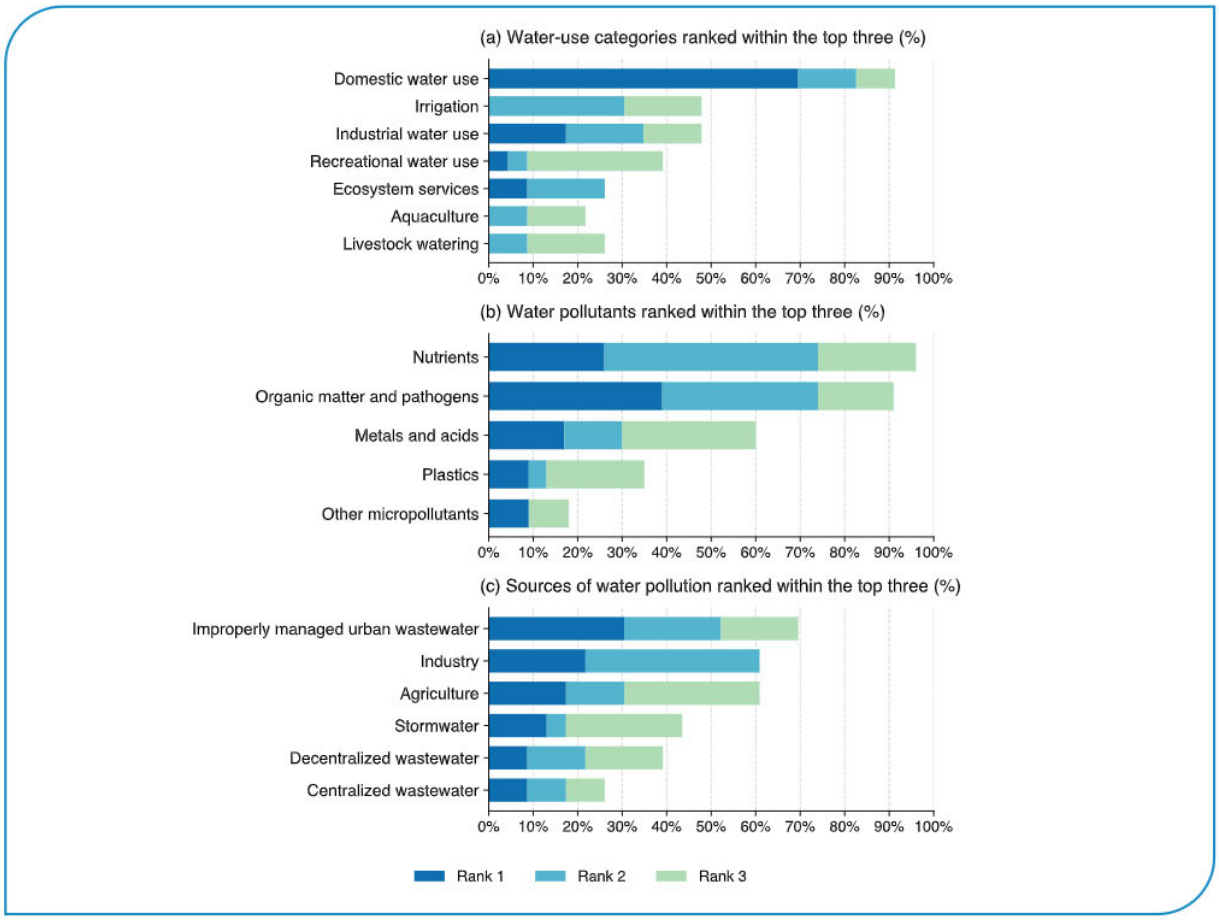

Figure 1 (a–c). Share of respondents (%) ranking items within the top three positions across three survey questions: water-use categories (a), water pollutants (b), and sources of water pollution (c). Ranking reflects respondent perceptions of severity, importance, or significance as specified in each question.

Regional Analysis – Water Quality Challenges

The following section presents a regional analysis based on UNESCO Electoral Groups I to V. Group I covers Western Europe and North America, Group II Central and Eastern Europe, Group III Latin America and the Caribbean, Group IV Asia and the Pacific, and Group V Africa and the Arab States. These Electoral Groups are used as analytical units to examine regional patterns and contrasts in water-quality concerns, pollution pressures, and perceived challenges, allowing for the identification of both region-specific characteristics and structural issues shared across different contexts. For Figures 2 and 3, Group I is excluded from the visualisation due to the very small number of responses, as proportional and average values would be highly sensitive to individual responses.

Water Use

Across regions, domestic water use was among the highest-concern categories, but the structure of prioritisation differed markedly between groups. Indeed, Group V (Africa and Arab States) overwhelmingly prioritised domestic as the water use category with the most water quality concerns. Likewise, Group IV (Asia and the Pacific) also

emphasised domestic water use, which received the largest number of highest-concern rankings within the region. Industrial water use emerged as a secondary concern, suggesting a concentrated set of priority sectors. Group III (Latin America and the Caribbean) presented the most consistent regional pattern: domestic ranked first, followed by ecosystem services and recreational. This indicates a relatively uniform perception of where water-quality pressures are most acute. In Group II (Central and Eastern Europe), rankings were more evenly distributed across domestic, ecosystem services, industrial, and recreational. Overall, the results highlight that domestic water use remains a central area of concern globally, yet the distribution of pressures across other water-use categories varied significantly by region pointing to distinct sectoral contexts and differing national priorities.

Pollutants

Member States identified a broad set of pollutants of concern, yet the priority structure differed substantially between regional Electoral Groups. Group I placed the highest emphasis on micropollutants, ranking them above nutrients, metals, and organic matter. Open responses confirmed this pattern, noting that the category effectively encompassed pharmaceuticals and other emerging contaminants. In Group II, nutrients and organic matter and pathogens formed the highest-priority group, yet open responses indicated concern for pesticides, pharmaceuticals, hormones and other emerging pollutants. This reflects a dual concern for traditional pollutants and new chemical contaminants. Group III showed no single dominant pollutant, as metals, organic matter, and nutrients all appeared in the top tier with similar rankings. Respondents also highlighted microplastics and pharmaceutical residues. Group IV displayed the most diverse pollutant profile among all regions. Nutrients and organic matter and pathogens were ranked most important, but open responses identified antibiotics, pharmaceutical residues, pesticides and herbicides, industrial chemicals such as PCBs and dioxins, arsenic and fluoride, salinity, sediments, and antimicrobial resistance. This diversity suggests complex and multi-source pollution contexts. In Group V, organic matter and pathogens are ranked as the most important pollutants, followed by nutrients. As with other regions, open responses highlighted pesticides, agricultural runoff, oil and gas contamination, antibiotics and hormones, nitrates, and solid waste challenges. Overall, while nutrients and organic matter emerge as common concerns across most regions, the prominence of micropollutants, pharmaceuticals, pesticides, hydrocarbons, and solid waste in open responses underscores the growing importance of emerging contaminants and the increasingly complex nature of water-quality pressures globally.

Pollution Sources

The survey revealed substantial regional differences in how Member States perceive the primary sources of water pollution, reflecting distinct economic structures, infrastructure gaps and environmental pressures. Group I identified industry as the most significant source of water pollution, followed by agriculture and stormwater runoff. Decentralized wastewater and urban wastewater were considered less critical. Open responses additionally mentioned concerns related to rising water temperatures linked to global warming. In Group II, agriculture and centralized wastewater treatment appeared most frequently as top-ranked sources, with industry also receiving several high rankings. Improperly managed urban wastewater and stormwater were generally rated lower. Open responses referenced solid-waste landfills, industrial accidents, diffuse sources, and the role of centralized wastewater systems in spreading emerging pollutants. Group III ranked industry and improperly managed urban wastewater as the most consistent pollution sources. Group IV presented the broadest diversity of pollution sources, with concern distributed across agriculture, industry, stormwater, decentralized wastewater, and improperly managed urban wastewater. Open responses expanded this list considerably, citing hospital wastewater, illegal mining runoff, urban runoff, plastic waste, deforestation-driven sedimentation, antimicrobial resistance pathways, and other emerging sources. The region's profile indicates complex, multi-sector pressures extending beyond the conventional pollution categories captured in the ranking exercise. In Group V, improperly managed urban wastewater was the most frequently identified top source, followed by industry and stormwater. Agriculture appears across second- and third-rank positions, while decentralized wastewater and centralized wastewater were of moderate concern. Open responses highlight poor solid-waste management, animal carcasses in waterways, herbicide leakage, oil and gas contamination, pesticides, and naturally occurring contaminants such as iron, revealing a layered mix of municipal, agricultural, and industrial pressures.

Regional Analysis – Capacity Gaps

Water-quality monitoring—arguably the first and most important step in water quality management—was a commonly noted capacity gap across regions, but the underlying reasons for this gap differed markedly across regions (Figure 2a). In Groups II and III, monitoring-related capacity gaps were frequently related to financial bottlenecks, though institutional constraints were also important. Broadly, Group IV reported less critical monitoring capacity gaps, but where relevant, financial and technical constraints were the biggest challenges. By contrast, in Group V, monitoring challenges were associated with technical constraints, with financial constraints playing a secondary role.

Implementation—the capacity to put existing water-quality regulations and management plans into practice—was consistently reported as the greatest capacity gap in water quality management all UNESCO Electoral Groups and across institutional, technical, and financial domains (Figure 2b). In Groups II and III, implementation was seen as the greatest challenge under institutional and technical domains, indicating difficulties in translating governance arrangements and technical standards into operational practice. In Group IV, implementation challenges were greatest in financial and technical domains, reflecting the combined effects of technical complexity and limited resources to implement management plans. In Group V, implementation challenges were most commonly seen at the institutional domain, indicating that limitations in governance structures constrained field-level implementation capacity. Taken together, these results indicated that while implementation failures constituted a shared priority across regions, the constraint pathways through which these failures arose differed markedly by regional context.

By contrast, capacity gaps in water quality assessment—the capacity to analyse and interpret water-quality data—were reported infrequently and with low priority (Figure 2c). In many group–domain combinations, assessment did not appear as a Rank 1 concern, and under financial constraints it was not selected as the top priority in any region. This pattern suggested that concerns related to data analysis and interpretation were generally less prominent than those associated with monitoring and implementation.

Regulatory capacity gaps exhibited clearly differentiated patterns across Groups III, IV, and V (Figure 2d). In Group III, enforcement authority was consistently identified as the highest-priority regulatory challenge, while regulatory effectiveness and stakeholder trust did not emerge as top concerns. Open-ended responses further indicated that outdated penalties and insufficiently updated drinking-water, effluent, and pollution standards limited the deterrent power of existing regulations, reinforcing the centrality of enforcement capacity in this context. In Groups IV and V, stakeholder trust was most frequently prioritised as the primary regulatory challenge, indicating that regulatory issues were perceived predominantly through the lens of social and institutional trust rather than a single technical or legal deficiency. Open-ended responses in both groups highlighted fragmented and overlapping regulatory responsibilities, misalignment between administrative jurisdictions and basin-scale water systems, insufficient monitoring and surveillance capacity, and weak coordination among regulatory actors. In Group V in particular, respondents emphasised the combined effects of weak enforcement, chronic underfinancing, limited monitoring and data systems, insufficiently deterrent penalties, and low public participation, pointing to a set of interlinked regulatory constraints rather than a single dominant failure.

Taken together, while the relative emphasis differed across regions, a shared structural pattern was evident: challenges in water-quality management were more likely to emerge as top priorities at the monitoring and, most notably, implementation stages than at the assessment stage**.** This finding reinforced the interpretation that many countries faced persistent difficulties not in understanding water-quality problems, but in translating existing knowledge, policies, and frameworks into sustained management action.

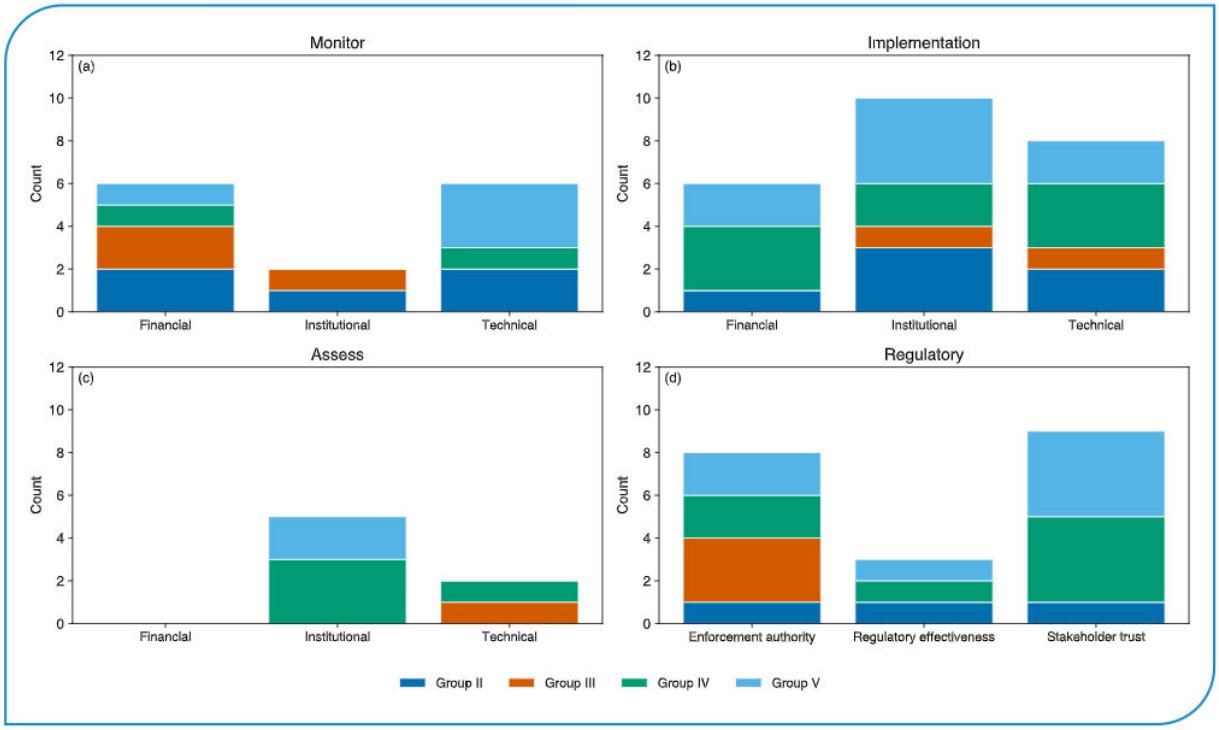

Figure 2. Prioritisation of stage-specific challenges across capacity domains. Bars show the number of times Monitoring, Assessment, and Implementation were ranked as the highest-priority challenge (Rank 1) within institutional, technical, and financial capacity domains, aggregated across UNESCO Electoral Groups II–V. Group I is excluded due to very small sample size.

How UNESCO IHP Can Support Member States

There was no clearly shared or dominant pattern in how Member States prioritised UNESCO IHP's support. Rather, importance scores across the five surveyed support domains were evenly distributed (Figure 3). This suggested that regional analyses might obscure important details and that more granular, country-level or context-specific analyses were required to identify concrete needs. For example, in Groups I and II, several respondents explicitly indicated that no additional support was required, reflecting a perception that existing institutional and technical capacities were sufficient. Although the survey did not identify a shared priority among support domains, responses pointed to region-specific patterns in the types of support considered most relevant. These patterns provided the basis for the domain-specific analysis presented below.

Technical capacity building was ranked relatively low in Groups II and III. In Group III, however, open-ended responses included references to specific advanced technical needs, particularly related to remote sensing and GIS, despite the overall low prioritisation of this support domain. By contrast, technical capacity building was ranked more highly in Groups IV and V, where it appeared among the top priorities. In these groups, open-ended responses more frequently pointed to unmet technical needs, including limitations in monitoring tools, laboratory capacity, equipment, and skilled personnel, as well as needs related to water-quality modelling and operational implementation. Together, these responses indicate that in Groups IV and V, technical capacity constraints were more closely associated with broader implementation challenges.

The need for improved dissemination of knowledge and operational tools followed closely behind, especially in Groups II and IV. Respondents emphasised that the availability of scientific methods, good practices and practical guidance was essential for informed decision-making—particularly in contexts where monitoring systems and analytical capacity remained limited. Even in regions with stronger institutional capacity, such as Groups I and II, continuous access to updated methodologies and technical tools was viewed as a core contribution of IHP.

Collaboration among scientists and institutions represented another cross-cutting need. Groups II and III, in particular, underlined the challenges posed by fragmented governance systems, insufficient inter-agency coordination and misalignment between administrative boundaries and basin-scale processes. Some countries explicitly requested structured platforms for dialogue, or national-level commitments to cooperation, suggesting that IHP's convening function could play a decisive role in bridging gaps between sectors and levels of government.

Multilateral cooperation also emerged as a relevant area of support, with Group V ranking it among its top three priorities and other groups assigning it intermediate importance. Respondents pointed to the difficulty of addressing water-quality pressures that span jurisdictions or require harmonised standards, and some called for high-level policy dialogues to strengthen legislative engagement or overcome inconsistencies in national surveillance systems. These perspectives highlighted the importance of basin-wide and transboundary approaches in regions where governance fragmentation and climate-related pressures were growing.

Financial brokerage was most strongly prioritised by Groups III and V, whose open responses emphasised chronic funding shortages that directly limited monitoring, enforcement and infrastructure development. Requests for investment in laboratory facilities, groundwater treatment, monitoring programmes and long-term capacity development reflected a structural financing gap that could not be addressed through technical assistance alone. In contrast, Groups I and II reported far lower dependence on financial brokerage, indicating more robust domestic funding environments.

Overall, the findings suggest that UNESCO IHP's support should focus on strengthening the implementation capacity of Member States—through technical and institutional development, improved knowledge transfer, facilitation of cooperative governance, and targeted financial brokerage where resource constraints are most severe. These priorities align directly with the objectives of IHP-IX and reaffirm IHP's role as a bridge between scientific knowledge, policy frameworks and practical action.

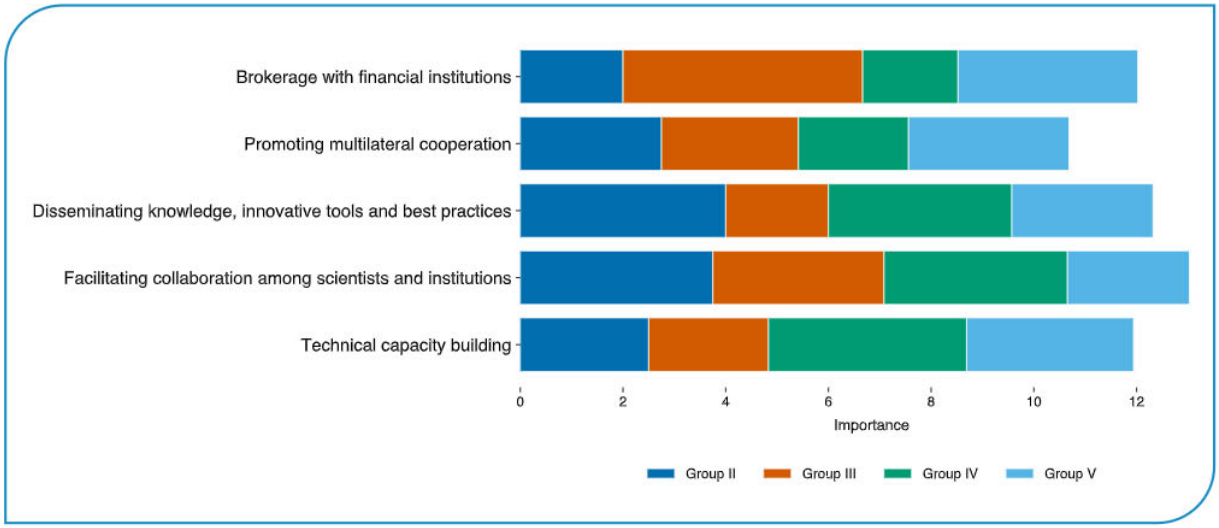

Figure 3. Relative need for IHP support in water quality management across five domains. For each UNESCO Electoral Group, average importance scores (1–5) were calculated based on survey responses and are visualised. Higher values indicate greater perceived importance of the corresponding support domain. Group I is not shown due to very small sample size, which would make group-average scores highly sensitive to individual responses.

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