ICMM Global Water Dataset Highlights Escalating Water Risks Threatening Mining Operations and the Global Clean Energy Transition

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Recent Developments:

- The **International Council on Mining and Metals (ICMM)** has released the **Global Mining and Metals Water Dataset**, the first global assessment mapping physical water risks across mining and metals facilities.
- The report finds that **nearly two-thirds of mining and metals processing facilities** worldwide are exposed to at least one major physical water hazard, raising concerns over the long-term sustainability of **critical mineral supply chains** essential for the global clean energy transition.

About the Global Mining and Metals Water Dataset Report:

Overview:

- The **Global Mining and Metals Water Dataset** is the **first comprehensive cross-commodity assessment** examining the exposure of mining and metals operations to physical water risks worldwide.
- The assessment was prepared by the **International Council on Mining and Metals (ICMM)** in collaboration with research partners using geospatial analysis.
- The study overlays the locations of nearly **12,000 mining and metals facilities** across **148 countries and regions** with globally recognised water-risk indicators.
- The report evaluates five major physical water hazards, namely **baseline water stress, water depletion, drought, flood risk and interannual water variability**, enabling facility-level risk assessment.

About the International Council on Mining and Metals (ICMM):

- **ICMM** is a global industry organisation established in **2001** to promote **responsible mining, environmental sustainability and social performance**.
- It brings together leading mining companies and regional mining associations to develop common standards for sustainable mineral extraction.
- The Council promotes responsible management of **water resources, biodiversity, mine waste, climate change and community engagement**, aligning mining practices with the **Sustainable Development Goals (SDGs)**.

Major Findings of the Report:

Water Stress as the Dominant Risk:

- **38% of global facilities** are located in river basins experiencing **high or extremely high baseline water stress** or arid climatic conditions.
- More than **70% of these facilities** simultaneously experience high groundwater depletion, indicating severe pressure on freshwater availability.

- Competition between mining operations, agriculture, industries and domestic users has emerged as the most widespread physical water challenge.

Growing Drought Vulnerability:

- Around **27% of mining facilities** are exposed to severe drought risk globally.
- The risk reaches **81%** across **Africa and the Middle East**, while countries such as **Zambia, Ghana and Uzbekistan** show almost universal drought exposure.
- Persistent drought reduces operational efficiency, increases production costs and threatens long-term mine viability.

Flood Risks in Mineral Processing:

- Although global flood exposure averages **14%**, several mineral processing activities face substantially higher flood vulnerability.
- **Steel production, alumina refining, molybdenum processing and aluminium smelting** exhibit elevated exposure because of their dependence on water-intensive infrastructure.
- Extreme flooding can damage processing plants, disrupt logistics and contaminate surrounding ecosystems through tailings failures.

Interannual Water Variability:

- About **16% of global facilities** experience large year-to-year fluctuations in water availability.
- **Oceania**, particularly **Australia**, records exceptionally high variability, making long-term operational planning increasingly difficult.
- Climate change is expected to intensify hydrological uncertainty and increase operational risks.

Compound Water Risk Hotspots:

- Nearly **5% of mining facilities** face simultaneous exposure to **three or more major water hazards**.
- Major hotspots include **Chile, Peru, the western United States, southern Africa, northern China, central India and western Australia**.
- Compound risks significantly reduce resilience because multiple hazards occur together rather than independently.

Risks to Critical Energy Transition Minerals:

- Minerals essential for renewable energy technologies exhibit above-average exposure to physical water risks.
- **Platinum Group Elements, manganese, copper and lithium** are increasingly produced in water-stressed regions.
- Water scarcity could become a major constraint on manufacturing **electric vehicles, solar panels, wind turbines and battery storage systems**.

<u>Mining–Water Nexus: How Mining Affects Water Resources:</u>

High Freshwater Consumption:

- Mining requires substantial quantities of water for **ore processing, dust suppression, slurry transportation, drilling and equipment cooling**.
- Large-scale withdrawals often increase competition with agriculture, industries and local communities, particularly in semi-arid regions.

Groundwater Depletion:

- Continuous groundwater pumping for mine dewatering lowers regional water tables and reduces groundwater recharge.
- Excessive extraction may permanently alter aquifer systems, affecting drinking water security and agricultural productivity.

Water Pollution:

- **Tailings storage facilities**, acid mine drainage and untreated industrial effluents may release **heavy metals, toxic chemicals and suspended sediments** into nearby rivers and groundwater.
- Such contamination threatens aquatic biodiversity, drinking water quality and ecosystem health.
- Recent mining-related tailings failures have reinforced the need for stronger environmental safeguards and monitoring.

Alteration of Natural Hydrology:

- Open-pit excavation, waste dumps and land clearance modify natural drainage patterns and watershed hydrology.
- These changes increase **soil erosion, sediment transport, flash floods and habitat degradation**, reducing ecosystem resilience.

Significance of the Findings:

Energy Transition Challenge:

- Critical minerals such as **copper, lithium, nickel and rare earth elements** form the backbone of the global low-carbon economy.
- Water scarcity may become a major bottleneck for expanding renewable energy infrastructure despite growing mineral demand.
- Sustainable mineral production is therefore inseparable from sustainable water management.

Supply Chain Risks:

- Climate-induced droughts and floods can interrupt mining operations, reduce global mineral supply and increase commodity price volatility.
- Supply disruptions may delay renewable energy projects and increase manufacturing costs for clean technologies.

Socio-Economic Consequences:

- Water competition often intensifies conflicts among mining companies, farmers, indigenous communities and local governments.
- Social unrest, litigation and environmental protests can delay mining projects and reduce investor confidence.

Financial and Regulatory Risks:

- Companies failing to manage water sustainably may face **regulatory penalties, higher operational costs, insurance liabilities and stranded assets**.
- Investors increasingly evaluate **Environmental, Social and Governance (ESG)** performance before financing mining projects.

Way Forward:

Integrated Catchment-Based Water Management:

- Water governance should move beyond individual mining sites towards **river basin and catchment-level planning** involving governments, industries, communities and environmental agencies.
- Integrated Water Resources Management (**IWRM**) principles should guide water allocation and ecosystem conservation.

Strengthening Water Efficiency:

- Mining companies should expand **closed-loop water recycling, wastewater reuse, desalination technologies and alternative water sources** to reduce freshwater dependence.
- Circular water management can improve both operational resilience and environmental sustainability.

Improving Transparency and Monitoring:

- Public disclosure of **facility-level water withdrawal, consumption, recycling and discharge data** should become standard industry practice.
- Greater transparency supports informed regulation, investor confidence and scientific risk assessment.

Integrating Water into Critical Mineral Policies:

- Governments should incorporate **water availability, climate resilience and watershed carrying capacity** into critical mineral strategies and mining approvals.
- Environmental impact assessments should explicitly evaluate cumulative water risks before granting new mining leases.

Value Addition for UPSC:

Prelims Facts:

- **ICMM** was established in **2001** and promotes responsible mining practices globally.
- The report analysed **12,000 facilities** across **148 countries and regions**.
- The five assessed indicators are **baseline water stress, water depletion, drought, flood risk and interannual variability**.
- **Critical minerals** such as **copper, lithium, nickel, manganese and platinum group elements** are indispensable for renewable energy technologies and advanced manufacturing.

Integrated Water Resources Management (IWRM) promotes coordinated management of water, land and related resources to maximise economic and social welfare without compromising ecosystem sustainability