

Topic Concept Note Template

Thematic Process, 11th World Water Forum

- **Theme Number:** 6
- **Theme Title:** *Value of water*
- **Topic Number:** 6E
- **Topic Title:** *Water Resources as a National Natural Capital: Towards a Paradigm Shift*
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I. Topic Overview

Rationale and Context

The question arises why, notwithstanding the rich studies and research on the benefits of water investments, we witness a shortfall of intended outcomes in the field of investment to create new infrastructure. Such question leads us to collect the legacy of the Bali Forum and collect the exhortation to ensure equity, to identify financial mechanism to develop ability to obtain economic resources. Marginalized populations – including rural communities, urban informal settlements, women, and indigenous groups – continue to experience disproportionate exposure to water insecurity. The emerging paradigm explicitly embeds equity and inclusion as core evaluative criteria rather than ancillary considerations. Research and management frameworks must systematically address distributional outcomes related to access, affordability, legal entitlements, and participatory representation. Approaches such as gender-responsive water governance, community-managed groundwater systems, and decentralized infrastructure – including rainwater harvesting and managed aquifer recharge – demonstrate significant potential to enhance equity while strengthening local adaptive capacity.

Water resources constitute a foundational component of national wealth, social stability, and economic resilience. Yet, in many countries, water continues to be governed primarily as a sectoral input or engineering variable rather than as natural national capital that underpins human well-being, ecosystems, and long-term development.

Despite advances in hydrological science, modeling, infrastructure, and monitoring technologies, universal access to safe, affordable, and reliable freshwater remains unmet. This gap reflects structural limitations in prevailing water governance, finance, and knowledge systems, rather than a lack of technical capability.

Globally, increasing hydro-climatic variability, pollution, ecosystem degradation, and competing demands from agriculture, cities, energy, and industry are intensifying pressure on freshwater systems. Regionally and locally particularly in arid, semi-arid, fragile, and conflict-affected contexts these pressures translate into heightened vulnerability, inequality, and socio-economic instability.

This topic responds to these challenges by advancing a paradigm shift from control-oriented, fragmented, and expert-driven water management toward stewardship-based, adaptive, inclusive, and systems-oriented governance, recognizing water as natural national capital. This shift also requires strong coordination both at nationally and across borders level with the grounded in trust, data exchange, and a commitment to shared interests.

However, we need to pursue research in a way that ensures future developments are adapted to existing cultural differences and that the process of technical evolution is smoothly supported, making its outcomes both accessible and harmonized with local roots.

- The topic is strongly aligned with:
 - **SDG 6** (Clean Water and Sanitation)
 - **SDG 2** (Zero Hunger)
 - **SDG 3** (Good Health and Well-being)
 - **SDG 11** (Sustainable Cities and Communities)
 - **SDG 13** (Climate Action)
 - **SDG 14 & 15** (Life Below Water and Life on Land)
 - **SDG 17** (Partnerships for the Goals)
- Cross-cutting dimensions integrated in this topic include:
 - Climate resilience and adaptation
 - Gender, youth, and indigenous inclusion
 - Digital innovation and data-driven decision-making
 - Partnerships across public, private, and community actors
 - Innovative and equitable water financing

Objectives of the Topic

Water knows no boundaries. Freshwater ecosystems must be protected and connected from source to sea. At the same time, it's important to preserve the coastal waters to sustain under-water life and biodiversity. Fresh water must be considered alongside energy and food needs, as these resources are closely linked. In the MENA region (Middle East and North Africa), many countries face severe water stress. Yet, in this region, agriculture uses over 80% of their fresh water and in some places, more than 85% are reserved for Agriculture use. On top of this, several water-stressed countries grow high-water-demand crops, which requires large amounts of water to produce. At the same time, other countries in the region spend huge amounts of energy to desalinate seawater first, then use that water for farming, irrigation, or regreening efforts.

At the same time, floods, droughts, and pollution increasingly undermine economic stability and global welfare. These challenges are further intensified by climate change and increasing population.

A central pillar of the proposed paradigm shift is the transformation of knowledge production processes. Traditional expert-driven research models often generate technically optimal solutions that prove ineffective or unsustainable when deployed in real-world contexts due to limited stakeholder acceptance, institutional constraints, or misalignment with local socio-cultural conditions.

Transdisciplinary research frameworks explicitly incorporate non-academic actors—local communities, water utilities, basin authorities, policymakers, and civil society organizations—throughout the research cycle. Indigenous and local knowledge systems, particularly those related to groundwater governance, recharge practices, and water-use norms, represent conceptual resources.

The emerging paradigm embeds equity and inclusion. Research to secure fresh water call for advance methods for quantify ecosystem service, adaptive governance and coproduction of knowledge that is scientifically credible social legitimate and operationally actionable.

Scientific Introversion Groundwater is the main source of drinking water for many countries and supports agriculture, industry and ecosystems. It acts as a strategic “water savings account” that buffers droughts and climate variability when surface water becomes scarce. Overpumping and pollution can permanently damage aquifers, reduce river flows and degrade groundwaterdependent ecosystems. Groundwater is a hidden but critical water reserve that must be protected and better measured, and governments should use new technologies and managed aquifer recharge to secure it for the future. An explicit protection of groundwater must be part of any national water security strategy.

Governments need accurate estimates of how much water is stored in aquifers and how it changes over time. Key tools include:

- Monitoring networks: dense networks of observation wells with automatic sensors to measure groundwater levels, electrical conductivity and temperature.
- Remote sensing: satellitebased gravimetry and landsurface data to detect largescale groundwater storage trends and depletion hotspots.
- Numerical models: 3D groundwater models (for example, MODFLOWbased systems) to simulate recharge, pumping, flow and storage under different scenarios.
- Integrated assessments: combining field measurements, satellites and models to estimate recharge and sustainable yields with higher confidence.

Other than, countries need to work on the policy actions that require national groundwater monitoring networks, open data platforms, and regular “state of groundwater” assessments to guide the licensing and abstraction limits for the particular regions.

An other important aspect is to manage aquifer recharge (MAR) and aquifer storage and recovery (ASR) deliberately store water underground to increase supplies and stabilise water tables. Modern techniques include:

- Infiltration basins and recharge ponds to capture stormwater, treated wastewater or excess surface water and allow it to percolate into aquifers.
- Injection wells for ASR, where highquality water is injected during wet periods and recovered during dry periods.
- Using natural infrastructure such as restored floodplains, wadis and riverbeds to enhance recharge while also delivering ecological benefits.

Well-designed MAR projects can increase storage, improve drought resilience and in some cases improve water quality through natural filtration in the subsurface.

It is important to define groundwater protection zones, set clear quantitative and quality objectives for aquifers, and integrate hydrogeology into all freshwater planning. Government needs to set sustainable pumping limits based on assessed recharge and storage, enforce licensing, and use economic tools such as tiered water pricing. It is important to develop national guidelines for MAR and ASR (site selection, permitting, water quality criteria, monitoring and risk management). Last but not least, adopt decision support systems that combine monitoring, modelling and risk analyses to select and optimise recharge projects.

For countries and regions where surface water and groundwater are not available, seawater desalination is often required. Encouragingly, recent scientific and technological advances are making desalination and water reuse more sustainable and energy efficient. One key shift is the move from traditional thermal desalination processes to reverse osmosis (RO). New methods have been developed to improve membrane materials and to use advanced energy recovery devices in RO systems, which can substantially reduce specific energy consumption. Emerging low-energy approaches such as forward osmosis (FO), membrane-distillation hybrids, and solar-powered passive or photovoltaic-integrated desalination are also gaining traction, with some solar-driven systems achieving high efficiency while minimizing reliance on fossil fuels. In the MENA region, developments such as solar-powered desalination plants (for example, in Oman and the UAE), subsea desalination concepts that can cut energy use by around 40%, and regenerative, zero-emission pilot plants demonstrate practical pathways to lower environmental impact and costs.

Wastewater treatment can turn used water into a valuable resource and help reduce water shortages, especially in dry regions. By cleaning wastewater to different quality levels, we can safely use it again for farming, industry, city greenery, and even drinking in some cases, instead of taking more water from scarce natural sources. If water is properly treated, it can be reused instead of being discharged and wasted. This reduces the pressure on rivers, groundwater, and desalination plants, which are often expensive and energy-intensive. For example, treated wastewater is already used in many Gulf countries for irrigation of parks, crops, and roadside greenery, saving highquality drinking water for people.

However, traditional treatment plants can use a lot of electricity for pumping, aeration, and advanced cleaning steps. New lowenergy and efficient systems are therefore essential to meet growing freshwater demand in a sustainable way. These include improved biological treatment, smarter process control using data and artificial intelligence, energy recovery from sludge (biogas), and modular systems that treat water close to where it is produced to reduce pumping needs. Such technologies lower operating costs and greenhouse gas emissions while still producing water clean enough for its intended use, such as irrigation or industrial cooling.

In some cultures, people are uncomfortable with the idea of using treated wastewater, especially for drinking or anything directly linked to the body, because they associate it with dirt and disease. This is often more a psychological and cultural issue than a technical one, because modern treatment can make water as safe as, or even safer than, conventional sources. The “yuck factor” can be very strong and can lead to rejection of reuse projects, even when they are safe and well designed. There are several ways to respect cultural beliefs while still benefiting from wastewater reuse.

- Use stepbystep reuse: start with nondrinking uses such as irrigation of trees, industrial processes, or street cleaning, so people see the benefits without feeling that they must drink the water.
- Separate networks: build a clearly marked purplepipe or industrial network for reused water, while keeping a fully separate system for drinking water, which can reduce concern and confusion.
- Strong standards and transparency: apply strict treatment standards, continuous monitoring, and publish test results so communities can see that the water is safe for its intended use.
- Religious and community engagement: work with religious scholars, community leaders, and health experts to explain which uses are acceptable, clarify misconceptions, and show that protecting water resources aligns with ethical and religious values.
- Education and storytelling: use simple explanations, plant visits, and real examples from other countries where reuse has worked well to gradually build trust.

Many countries store water in man-made lakes behind dams. These lakes are very important for water supply, but they are affected by climate and weather. Because of climate change and higher temperatures, we are seeing more storms and more dust in the air. This dust, along with soil washed away by rain, can end up in these lakes. Sediment (dust and soil that settle at the bottom) comes from three main sources: dust falling from the air, soil erosion and runoff during storms, and small amounts that enter when extra water is added to replace water lost by evaporation.

When there is a big storm, a lot of sediment can enter the lake in a short time. After such events, we need special cleaning or treatment to reduce the impact on the lake. Over many years, dust from the air and small additions from “top-up” water can slowly build up sediment in the lake. **This build-up can cause problems for how the lake operates and can reduce water quality**, so long-term planning and regular treatment are needed. In the Middle East, dust is a natural part of the environment and has a strong effect on lakes and reservoirs. Saudi Arabia, for example, has around 20 major dust storms every year, in

addition to already high dust levels in the air. Dust in this region comes from nearby deserts and from far away, carried by the wind. **Fine dust can travel long distances high in the air before it falls. Coarser dust can be pushed along close to the ground by the wind.**

How much dust the wind can move (aeolian transport) depends on:

- Wind speed: stronger winds can pick up and move more particles.
 - Surface roughness: rougher ground, such as areas with plants or rocks, makes it harder for the wind to erode and move particles.
 - Particle size: smaller particles are easier for the wind to lift than larger sand grains.
 - Moisture: wet soil sticks together and is harder for the wind to blow away.
 - Vegetation: plants hold the soil in place and slow the wind at ground level, reducing erosion.
- All of this affects the quality of water in the lakes. Things like total dissolved solids (TDS), electrical conductivity (EC), and the amounts of different salts and minerals are influenced by dust and soil falling into the water, pollution washed in during storms, and the quality of any extra water added to make up for evaporation losses.

While technology is increasingly available, outcomes often depend on adoption and day-to-day practices. The paradigm shift should therefore include strategic communication and water-demand management, combining public awareness, farmer advisory services, incentives, and institutional change management to accelerate uptake and sustain efficiency gains across domestic, agricultural, and industrial uses.

This shows a clear need for a major change in thinking. We must shift from viewing water, food, and energy separately to seeing them as an interconnected nexus (the water-energy-food nexus). By addressing them together and leveraging these emerging technologies. With this approach water-stressed countries can make smarter, more sustainable decisions such as choosing less water-intensive crops, improving efficiency, scaling energy-efficient desalination and reuse, or balancing desalination costs with food imports. This integrated approach is essential for long-term resource security in water-scarce regions. Traditional expert-driven research models often generate technically optimal solutions that prove ineffective or unsustainable when deployed in real-world contexts due to limited stakeholder acceptance, institutional constraints, or misalignment with local socio-cultural conditions.

II. Key Issues, Opportunities, and Scope

Key Challenges

The Role of the Private Sector in Global Water Governance

- Investments in water infrastructure are crucial for water and food security and steady economic growth. The global landscape for the water sector is changing, with the private sector and philanthropies taking a more active role.
- Through their “**Corporate Social Responsibility mandate**”, the private sector has a key role to play in bridging the financing gap and helping to achieve the water-related Sustainable

Development Goals. Additionally, the private sector and philanthropies are piloting innovative technologies that can reach those most in need in a cost-effective manner.

Public-Private Partnerships (PPP) and Risk Management

- Public-Private Partnerships (PPP), in which government agencies can draw a contract with private partners to renovate, construct, operate, maintain, and/or manage a water facility or system that provides a public service. However, to allow such solution to produce effective outcome, we must envisage a fair distribution of risk among the partners, which implies a severe assessment of the local climate risk, cultural local conditions, and quantify the risking cost.
- In particular we can distinguish between :
 - Public-Private Partnership (PPP): The government does not directly finance the project; instead, it enables private-sector investment while committing to longterm service payments.
 - Project Finance: The private sector provides upfront capital (equity + debt), and the government commits to performance based and availability based payments.

Overall Objective: Reduce the financial burden on the public sector, enhance spending discipline, and ensure longterm financial sustainability.

Innovative Aspects :

1. Using PPP as a financing and governance tool from the early planning stages.
 2. Linking payments to performance rather than asset construction alone.
 3. Integrating the full asset lifecycle (design, construction, operation, maintenance) into decision making.
 4. Planning at the level of the entire water value chain rather than individual assets.
 5. Contracting for the service itself, not just the physical asset.
- Saudi Arabia experience with independent water transmission pipeline projects illustrates this system-based approach in practice. Projects such as the **Jubail-Buraidah Independent Water Transmission Pipeline** were designed to address strategic transmission bottlenecks between coastal production hubs and inland demand centers.
The benefits stem from combining innovative financing mechanisms with modern planning and operational approaches, resulting in improved financial and operational efficiency, fair risk allocation, stronger governance and transparency, and longterm service sustainability and water security, resulting in the following Benefits:
 - A. Financial**
 - Reduced reliance on direct government capital expenditure.
 - Shifting government spending from upfront capital investment to predictable longterm service commitments.
 - Improved efficiency in the use of public capital.
 - Enhanced project bankability.
 - B. Risk Management**
 - Transfer of construction, cost, and operational performance risks to the private sector.
 - Fair and balanced risk allocation among stakeholders.
 - C. Operational and Technical**

- Adoption of more efficient and reliable technologies (e.g., desalination, wastewater treatment).
- Reduced energy consumption.
- Improved design quality and ease of operation and maintenance.
- Lower longterm operational costs.

D. Governance and Regulation

- Clear roles and responsibilities between the public and private sectors.
- Enhanced transparency and financial discipline.
- Alignment of tariffs across the value chain.
- Protection of public interest and service sustainability.

E. Sustainability and LongTerm Impact

- Strengthened national water security.
- Improved sustainability of water resources and infrastructure.
- Capacity building for local operational teams through knowledge and expertise transfer.

Raising private capital out of the market

- The higher the risk, the higher return the private party will get. We must manage the risk so that the risk is low, because the amount of revenue can service, in much part, the investment.
- Private party has a choice to work alone or has partial ownership of the project, but it's culturally difficult to have foreign or private investment bank.
- The analysis of the risk of the revenue is really important to run the project.
- Private party has to look all of the sources of fund and see it is sufficient to develop the project. Full package must have sufficient funding in construction development monitor, so there is still enough money left to make the project done.
- They should closely monitor on insurance, local taxes, the cost of the workers; all have to be factored in and compared to the revenue, make sure there is enough revenue is being generated, whether it is through government subsidies to make the project works or something else.
- Government can lower the risk in partial for long guarantee.

Using Bonds for Water Infrastructure Financing

- Bonds, in the form of Government Bonds or Private Activity Bonds, may be used for projects which serve a public purpose as an essential government function, such as sewer infrastructure. Similarly, Private Activity Bonds can provide capital for projects that generally serve a public purpose but benefit private entities. However, bonds raise an issue of sustainability of the balance sheet of the concerned institution (public or private) issuing bonds, which can hamper issuance: for example in the **Tanga Water Bonds** in order to expand the source of financing the government has studied the possibility of issuing municipal revenue bonds as an alternative source for financing the project. The purpose is to reduce burden on the government budget.

Advantages of Perpetual Bonds for Water Projects

- In this context we draw the attention on the advantage of a perpetual bond: the perpetual bonds does not implies reimbursement of the capital (may be in 30 years) and it ensures higher yields to offset. That means that the issuer must find the money needed to pay only the annual interest and this implies that even the countries which are not rich may attract investors since the risk of default in reimbursing the capital is highly reduced. This means further that such bonds could lead the investor to limit their assessment of the risk of the investment only to the capacity of the State issuer to pay the annual interests and since the water investment recipient is meant to produce services, the default risk is unlikely. In addition investors are attracted by high yields and therefore are inclined to take higher risk. As a result the perpetual Bonds lead investors and issuers to stimulate innovative mechanism to fund water infrastructure water projects. In addition the perpetual bonds are liquid.

Underutilization of Carbon Credit Projects and the “Project Lele”

- Carbon credit projects remain underused due to weak implementation of the Paris Agreement. One promising example is **Project Lele**, a carbon credit program addressing social, environmental, and economic challenges in Timor Tengah Selatan (TTS), Nusa Tenggara Timur (NTT). Targeting some of the poorest districts in Indonesia’s NTT Province, the initiative empowers indigenous communities to adapt to climate change through alternative agricultural systems. Recognizing that smallholder farmers cannot access global carbon markets independently, the program collaborates with communities to grow forest trees and food crops on private lands, later consolidated into community forests. Farmers receive trees to plant and maintain, earning annual incentive payments for trees they own. Collectively, these efforts create new community forests that sequester CO₂ from the atmosphere. The LELE project provides a platform for local communities to contribute to Indonesia’s Nationally Determined Contribution (NDC, 2022) by supporting higher emission reduction targets. At the same time, it enhances livelihoods by generating additional income through carbon credits from both farming groups and afforested lands. By combining climate mitigation with economic benefits, the program strengthens community resilience and adaptability.

Value of Nature-Based Solutions and the Subak system

- Investments in NBS are cost-effective and can enhance overall water security. To justify their viability as bankable projects and attract private sector involvement, their monetary value should be quantified. Working with nature also helps address social challenges. NBS projects aim to promote organic farming practices such as composting, crop rotation, and natural pest control, improve soil health and water retention, reduce water pollution by avoiding synthetic fertilizers and pesticides, and educate and empower farmers through training programs and workshops.

The **Subak system** in Bali exemplifies traditional water management based on ecohydrology and Nature-Based Solutions. Beyond irrigation, it is a cultural heritage system linking water management, community cooperation, and spiritual values. Rooted in centuries of tradition, Subak maintains ecological balance and collective responsibility, but today faces threats from land-use change, tourism, upstream development, deforestation, pollution, and climate change, all of which disrupt water availability and natural cycles. Addressing these

challenges requires a **holistic and transdisciplinary approach**. Ecohydrology integrates hydrological, ecological, socio-economic, and cultural factors, promoting sustainable water management by working with natural processes. Restoring forests and wetlands improves water quality, stabilizes flows, and supports biodiversity, while combining scientific methods with traditional knowledge ensures culturally appropriate solutions. Nature-Based Solutions complement ecohydrology through watershed restoration, organic farming, and buffer zones, which reduce pollution, sustain water resources, and preserve cultural landscapes. Integrated farming, improved water-use efficiency, and community participation have already shown positive results, including higher rice yields. Overall, combining ecohydrology and Nature-Based Solutions provides a **viable pathway** to strengthen the Subak system, enhance resilience to environmental change, and protect Bali's water resources and cultural heritage.

Semi-Arid Regions of East Nusa Tenggara (NTT):

- **Water Scarcity and Socio-Economic Impacts:** Focus on challenges of groundwater depletion, drought vulnerability, and low water infrastructure in NTT.
- **Innovations in Groundwater Recharge and Rainwater Harvesting:** Present efforts in managed aquifer recharge (MAR), rainwater harvesting technologies, and community engagement to improve water availability.
- **Inclusive Governance and Indigenous Participation:** Discuss how governance reforms can empower indigenous groups and marginal communities, ensuring water as natural capital benefits are equitably shared.

Africa's Natural Resources: Conservation, Water, and Sustainable Development

- Africa's natural resources, which encompass water, forests, and biodiversity hotspots, are fundamental to its economies, providing livelihoods for millions through sectors such as agriculture, fisheries, and tourism. Nonetheless, conservation initiatives encounter obstacles including habitat destruction, excessive resource extraction, and the effects of climate change, all of which diminish natural capital and impede sustainable development. Recognizing water resources as natural national capital enhances conservation efforts by: Incorporating valuation into national policies, exemplified by initiatives like the African Union's Agenda 2063 and the African Water Vision 2025. Utilizing international frameworks like the Convention on Biological Diversity (CBD) and the Ramsar Convention on Wetlands to protect water-dependent ecosystems. Tackling inequalities, ensuring that conservation advantages marginalized groups, including indigenous populations in areas like East Africa. Successful conservation in Africa necessitates the integration of traditional knowledge with contemporary tools, guaranteeing that water resources are maintained as lasting assets for economic diversification and poverty.
- The proposed paradigm emphasizes adaptive management as a core governance principle. Adaptive water governance is characterized by iterative learning, continuous monitoring, scenario-based planning, and institutional flexibility. Recent advancements in real-time monitoring technologies, sensor networks, satellite-based observations, and artificial

intelligence offer unprecedented opportunities for dynamic assessment of water availability, quality, and demand.

Research priorities must therefore focus on the development of robust decision-support systems capable of translating complex, uncertain data streams into actionable strategies across basin, aquifer, and local governance scales.

Continued research into innovative technologies—including recycling, desalination, rainwater harvesting, watershed and wetland management, groundwater recharge, pollution control, and natural resource conservation—can further drive transformative change.

- With respect to reuse promotion, a social aspect of acceptance needs to be taken into account: consumers, agriculture first of all, do not easily accept reused water as a viable alternative to freshwater. There is still a social action to be carried out.

Technology Transfer for Water Management in Africa

- The Role of Technology Transfer in Advancing the Paradigm, with a Focus on the African Context: To effectively utilize water as a form of natural capital, nations—especially those in development—must gain access to cutting-edge technologies for monitoring, treatment, efficiency, and restoration (such as smart sensors, desalination, precision irrigation, and wastewater recycling). Technology transfer facilitates this process by:
 - Disseminating innovations from developed to developing regions, while adapting them to local needs. Lowering costs and enhancing efficiency (for example, leak detection systems that reduce non-revenue water).
 - Fostering capacity through training, collaborative research and development, and demonstration projects. In the context of Africa, technology transfer is vital in addressing water-related challenges such as arid climates, inadequate infrastructure, and funding shortages.

Initiatives like the African Development Bank's Africa Water Facility and collaborations under the African Union's Science, Technology, and Innovation Strategy for Africa (STISA-2024) promote these transfers. For example: North-South partnerships, such as EU-Africa collaborations for solar-powered desalination in the Sahel regions. South-South exchanges, including knowledge sharing between South Africa and Kenya regarding drip irrigation systems. Obstacles include intellectual property issues and the need for adaptation to local conditions (for instance, the rugged terrains in East Africa), which are being addressed through capacity-building initiatives like UNESCO's water technology hubs.

Effective transfer necessitates supportive environments: policy frameworks, flexibility in intellectual property, and partnerships (both public-private and North-South). It aids in the valuation of natural capital by supplying data for natural capital accounts (for example, remote sensing for water resources) and aligns with Africa's ambition for technological sovereignty.

Operations and Maintenance (O&M) Challenges and Solutions in Water Technology

- Operations and Maintenance (O&M) of Water Technology Equipment: Technology adoption proves ineffective without strong O&M; however, numerous challenges remain in various regions:

- A significant dependence on imported spare parts and expertise, which escalates costs and prolongs downtime.
- A lack of local skills, funding, and institutional capacity.
- Risk aversion among monopolistic utilities, resulting in a sluggish adoption of innovation.
- Tied aid conditions that favor foreign technologies, which undermine local repair capabilities.
- These challenges lead to infrastructure failures, water losses, and a diminished value of natural capital. In Africa, O&M frequently faces obstacles due to supply chain disruptions and skill shortages, particularly in rural water systems. Proposed solutions include:
 - Integrating O&M planning into technology transfer agreements (for instance, local training and localization of spare parts).
 - Enhancing domestic capacity through vocational training programs and knowledge-sharing networks, such as those facilitated by the African Water Association.
 - Implementing performance-based contracts or third-party O&M to utilize expertise while promoting sustainability.
 - Developing financing models that emphasize long-term maintenance over initial capital investment, such as green bonds for African infrastructure.
 - Effective O&M guarantees that technologies provide ongoing benefits, safeguarding water resources as a lasting national asset.

Opportunities and Strategic Importance

While technology is increasingly available, outcomes often depend on adoption and day-to-day practices. The paradigm shift should therefore include strategic communication and water-demand management, combining public awareness, farmer advisory services, incentives, and institutional change management to accelerate uptake and sustain efficiency gains across domestic, agricultural, and industrial uses.

Equally important is national cross-sector coordination (water–agriculture–energy–environment–urban development), since fragmented mandates and unaligned sectoral decisions can undermine efficiency, delay risk response, and weaken accountability.

Proposed Priorities of the Topic / Guiding Questions

- How can water be operationalized as the natural national capital in policy, finance, and governance?
- How can co-produced knowledge improve legitimacy, effectiveness, and sustainability of water decisions?
- What financial mechanisms can unlock equitable, bankable water investments, including NBS?

- How can new shared social metrics help to quantify non-financial returns to investments in water?
- How can adaptive governance be institutionalized across basin, aquifer, and local scales?
- How can hydro-diplomacy prevent conflict and promote shared benefits in transboundary waters? It is strongly advise to **underpin the creation of implementing committee** in cropping out multiple regions area thus developing mediation capacity to tackle transboundary issues.
- **What role can neutral international organizations play as trusted intermediaries in facilitating dispute prevention and resolution in transboundary water systems?**
- **Science Diplomacy . Action to prevent conflicts through transboundary institutional initiatives to share emerging technologies to manage natural resources.**
- **Major involvement of the Wolrd Meteorological Organization to ensure coordination to tackle drought, smart irrigation and allow assesement of Investments risks linked to climate changes**
- **Comparative study of native law.**

Proposed Sessions of the Topic

- 3A. Enhancing access to safe drinking water services for all
- 3D. Improving Water Quality in a one health and multi-sectoral approach
- 4A Adopting Policy, Regulatory Frameworks, and Institutional Mechanisms
- 5. Innovation for water management

III. Expected Outcomes and Deliverables

Policy and Strategic Outcomes

- Promotion of cooperative water management. A renewed vision for transboundary water agreements is also essential. Strengthening international cooperation can help prevent disputes and foster constructive negotiations. Where coordination and consensus are weak, transboundary water management often suffers from disrupted data exchange and fragmented decisions that increase shared risks and collective losses. In this context, raising awareness of existing international conventions and strengthening institutional platforms such as river basin organizations and opening them to non-sovereign entities would be indispensable. Hydro-diplomacy can play a decisive role in this process. Hydro-diplomacy can play a decisive role by building trust-based mechanisms for regular data sharing, joint monitoring, and coordinated operations—shifting from narrow self-interest toward shared interests and the common good, consistent with core principles of international water law.
- **However, we need to pursue research in a way that ensures future developments are adapted to existing cultural differences and that the process of technical evolution is smoothly supported, making its outcomes both accessible and harmonized with local roots.**

- Numerous water resources are transboundary in nature—over 263 international river basins and 300 aquifers traverse borders, encompassing nearly half of the world's land area and impacting 40% of the global populace. These shared systems operate as interconnected natural capital, delivering ecosystem services (such as flood mitigation, biodiversity, and water quality regulation) that extend beyond national borders. A paradigm shift necessitates collaborative governance to regard transboundary waters as shared capital:
 - Equitable and reasonable utilization in accordance with international law (for instance, the UN Watercourses Convention).
 - Joint monitoring, valuation, and benefit-sharing are essential to avert depletion.
 - Establishing mechanisms like basin commissions or funds (for example, the Okavango River Basin) is crucial for investing in shared infrastructure and restoration.
- In the absence of cooperation, degradation upstream diminishes capital downstream, heightening the risk of conflict and inefficiency. Transboundary strategies bolster collective resilience, particularly in the face of climate variability. In Africa, instances such as the Nile, Congo, and Zambezi basins underscore the necessity for regional agreements to manage shared waters as collective natural capital.
 - Policy recommendations on integrating water natural capital into national frameworks.
 - Guidance on adaptive and participatory water governance models.
 - Strategic messages for inclusion in the Forum Declaration.

Technical and Knowledge Deliverables

- Advocacy for the creation of regional basin authorities for sustainable and peaceful water governance.
- Synthesis notes on co-production of water knowledge
- Case studies on NBS, adaptive governance, and innovative finance including successful public-private water investments
- Conceptual framework for decision-support systems across scales

Partnerships and Financing Outcomes

- Promotion of blended finance, blue bonds, and results-based financing, giving value to non-revenue returns and social impacts of investments on water
- Engagement with development banks and climate finance institutions
- Public–private–community partnership models
- Strengthen Paris Agreement to foster **carbon credit project**

Actions and Initiatives for Implementation

- Identification of pilot basin or city-level initiatives
- MoUs between research institutions, utilities, and basin organizations Innovation challenges for youth-led water solutions
- Regular International Masterclass on Water Finance

Communication and Visibility

- Key messages framing water as a national and global asset
- Contributions to Forum communications and media outreach
- Visibility in thematic synthesis and legacy publications
- Promotion of seminar and joint initiative by involving business sector connected to water issues
- Prepare Impactful Advocacy Materials: Include policy briefs, infographics, and preliminary case study summaries (Subak and NTT) that visually and narratively show the link between water as natural capital, community resilience, and governance models.

IV. Monitoring and Post-Forum Action

This topic will contribute to:

- A lasting Forum legacy on water stewardship and natural capital, which would include participation and sponsoring to other territorial Forum on water and linked to specific industrial sector, first of all the fashion industry
- Follow-up initiatives toward the 12th World Water Forum
- Inputs to UN water, climate, and biodiversity processes
- Long-term partnerships, data platforms, and monitoring frameworks, valuing national and international Observatories that could favour a dialogue between industry and institutions
- **Is there a need to establish dedicated innovation platforms or think tanks to accelerate the development and application of advanced water management solutions?**

V. Proposed Cross-Process Dialogue Areas

Within Thematic Process

- Joint dialogue with Water Finance on valuing water and NBS, such as session 2B on Public-Private Engagement
- Joint dialogue with Climate Adaptation and Resilience themes

With Other Processes

- Ministerial Process: Water as natural capital in national development
- Basin Authorities & Local Authorities: Adaptive governance in practice

Priority Regions for Focus

- Middle East and North Africa (MENA)

- Sub-Saharan Africa
- Small Island Developing States (SIDS)
- Asian-Pacific Region
- The Asia-Pacific region faces increasing water scarcity, uneven access to sanitation, rapid urbanization, and accelerating climate impacts that directly threaten economic stability, public health, and biodiversity. Active work on this topic in the region is necessary due to the following factors:
 1. Demographic and economic pressures. High population density combined with growing industrial and agricultural demand intensifies pressure on freshwater resources and increases the cost of inaction.
 2. Transboundary water systems. Many Asia-Pacific basins cross national borders. Lack of coordinated management increases the risk of ecological degradation and political tensions.
 3. Climate vulnerability. The region is exposed to both droughts and floods, which destabilize supply chains, infrastructure, and food systems. Water resilience becomes a strategic requirement for sustainable growth.
 4. Biodiversity and ecosystem value. Freshwater ecosystems in the region provide critical ecosystem services. Their degradation carries long-term economic costs and undermines cultural heritage.

Example: Lake Baikal

Lake Baikal illustrates the relevance of these issues for the Asia-Pacific region. Baikal holds roughly 20 percent of the world's unfrozen freshwater reserves. It forms a unique ecosystem with high endemism and plays an essential role in regional water regulation, scientific research, and cultural identity. However, the lake is exposed to pollution, invasive species, and climate-induced hydrological changes. These pressures demonstrate the need for coordinated watershed management, stronger environmental governance, advanced monitoring technologies, and international cooperation. Baikal's significance to global biodiversity and water reserves reinforces the strategic importance of addressing water security, ecosystem protection, and sustainable use throughout the Asia-Pacific region.