

Topic Concept Note Template

Thematic Process, 11th World Water Forum

*This template should be completed through collaborative discussions among Topic Coordination Group Members under the leadership of each Topic Coordinator, and submitted to Theme Coordinators **by January 30th, 2026**, after which it will undergo final review by the Co-Chairs of the 11th Forum Thematic Process.*

- **Theme Number:** 3
- **Theme Title:** *Water for Human and Nature*
- **Topic Number:** 3E
- **Topic Title:** *Water-Energy-Food-Health-Ecosystem-Education (WEFHEE) Interlinkages*
- **Topic Coordinator:** *American University of Beirut – Texas A&M University (Rabi H. Mohtar, Professor)*

I. Topic Overview

Rationale and Context

The WEFHEE has emerged as a system of systems concept that recognizes the strong interconnectedness among the water, energy, food and ecosystem sectors towards impacting health and education sectors. It can help alleviate the competition among these vital sectors, bring about policy coherence, and shield communities from climate and other disasters that affect community resilience and sustainability. Issues related to governance, financing, coherence, and application of WEFHEE to sustainable development goals are emerging challenges surrounding these systems.

The topic will explore the multifaceted relationships within the Water, Energy, Food, Health, Ecosystem, and Education (WEFHEE) interconnected system of systems to manage resource interdependence, identify system-wide optimal solution options, and drive resilient, sustainable water management strategies in a One Health approach. Irrigation and agricultural water management are the primary interface between water and food systems within the WEFHEE Nexus. By leveraging systems thinking and promoting interconnectivity across sectors, we aim to build frameworks that best support both human and environmental health globally. The Education pillar of this system focuses on Literacy teaching to stakeholders on how to navigate and manage the complex trade-offs between water, energy, and food, rather than general water education.

Effective implementation of the WEFHEE framework requires a comprehensive understanding of how different components of the hydrological cycle support food systems, ecosystems, and human well-being. Beyond conventional focus on surface and groundwater, soil moisture and rainfall-driven water flows constitute a critical foundation for rainfed agriculture, ecosystem services, and biodiversity. These often-overlooked water pathways play a pivotal role in sustaining food

production, regulating microclimates, supporting ecological functions, and enhancing resilience to climate variability. Integrating these dimensions into water-related decision-making enables more balanced investments, improved food security outcomes, and stronger ecosystem protection, particularly in water-scarce and climate-vulnerable regions.

This is how WEFHEE is aligned and related to SDGs:

- SDG 2 (Zero Hunger): Water-use efficient and climate-smart food systems.
- SDG 6 (Clean Water and Sanitation): Promoting integrated water resources management, water quality protection, and sustainable and universal services.
- SDG 11 (Sustainable Cities): Resilient urban water, sanitation, and health systems.
- SDG 13 (Climate Action): Adaptation and mitigation through integrated system-wise planning.
- SDGs 14 & 15 (Life Below Water & Life on Land): Ecosystem protection and restoration.
- SDG 17 (Partnerships): Cross-sectoral, multi-stakeholder collaboration and knowledge exchange.

This topic is a natural, system of systems that includes multiple actors and sectors at various levels of scale. Achieving the goals of the WEFHEE topic integrates cross-cutting dimensions of climate resilience, gender and youth inclusion, digital innovation, partnerships, and financing. These aspects of integration will be described in the sections below.

The WEFHEE topic embeds cross-cutting dimensions as operational levers rather than thematic add-ons. Climate resilience is addressed through adaptive, multi-sector planning and risk-informed decision-making. Gender and youth inclusion are advanced by recognizing women and young professionals as agents of change in water, food, and health systems. Digital innovation—including AI, system dynamics modelling, and digital twins—enables evidence-based planning and optimization across sectors. Strategic partnerships and innovative financing mechanisms, such as blended finance and results-based financing, are positioned as critical enablers for scaling WEFHEE solutions.

Objectives of the Topic

▪ *Integrated Holistic Management in the WEFHEE System*

Delve into the interconnectedness of water, energy, food, ecosystems, and One Health. Emphasize their linkages to the health and education sectors; the necessity of integrated holistic management practices that balance synergies and trade-offs while fostering resilience and sustainability. Explore the WEFHEE system from a holistic One Health perspective that considers the interdependence of human, animal, and environmental health. In this context, AI-enabled decision-support tools can strengthen the assessment of WEFHEE Nexus performance by integrating multi-source data, modelling trade-offs, and generating actionable indicators to guide more adaptive and evidence-based interventions.

▪ *Cross-Sectoral Collaboration and Policy Coordination*

Advocate for comprehensive policy coordination and improved data sharing between sectors to enhance global water resource management. Highlight the role of system modeling and digital tools in improving resource efficiency and adaptability across the WEFHEE nexus. In transboundary river basins, AI-supported analytics can help assess policy coherence across jurisdictions by comparing regulatory frameworks, identifying gaps and contradictions, and informing more aligned and collaborative decision-making.

- ***Collaboration with a Broader Perspective on "Water, Competitiveness, and One Health***

Address the alignment with the initiative, focusing on holistic water management under the One Water (holistic strategy for managing all water) concept. Examine strategies for enhancing competitiveness in agriculture, energy, and industry through sustainable practices and innovation. Address the One Health approach to wastewater reuse, stressing the importance of global cooperation to tackle water and health challenges. Integrate irrigation and on-farm water management into WEFHEE system analysis to improve water productivity and food security.

- ***Health Integration into the Nexus***

Explore the roles of clean water access, sustainable energy, food security, and ecosystem services in promoting health and preventing disease. Implement integrated health strategies that leverage environmental determinants such as water-encoded knowledge through wastewater and environmental surveillance, for enhanced public health outcomes. Focus on building community resilience through education and policies that support healthier living environments.

- ***One Health***

Align with Forum thematic areas of Water Quality and One Health Opportunities, Water-Energy-Food-Ecosystems Nexus (WEFHEE System), and Water for Sustainable Development. It also contributes to Water Governance, Financing, and Planning During Uncertainty, particularly in relation to cross-sectoral coordination and integrated management. By bridging these themes, the panel will underscore the importance of interconnected solutions that address health, sustainability, and competitiveness simultaneously.

- ***Modeling, optimization, data, case studies***

Showcase successful WEFHEE case studies, data /modeling experiences, and tradeoffs analysis for various thematic and geographic areas highlighting synergies between sectors

- ***Stakeholders' engagement***

Showcasing the success of WEFHEE Nexus scenarios, projects, and applications depends on successful, inclusive engagement with stakeholders that solicits solution-ideas and facilitates adoption of these solutions. This objective highlights the importance of engagement and shares good examples. AI can also be used as a participatory tool—rather than a “black box”—to co-design human-centric, transparent, and accountable models with stakeholders. This enables communities, practitioners, and decision-makers to jointly define priorities, validate assumptions and data, interpret results, and iterate scenarios, ensuring the models reflect local knowledge, equity considerations, and real-world constraints while building trust, shared ownership, and more actionable decisions.

- ***Land, Water, and Ecosystem Interactions***

Promote methodologies and decision-support tools for assessing the availability, variability, and productivity of blue water, green water, and groundwater within the WEFHEE system, with particular emphasis on optimizing green water use to enhance food security, ecosystem services, and climate resilience.

- ***Energy and Food Systems***

Energy and Food systems impact water and other elements of the WEFHEE Nexus. Best practices in the energy and food sectors and their impact on the WEFHEE Nexus are

highlighted. The type of energy used, the irrigation practices employed, their impact on the sustainability of the WEFHEE system, the use of alternative water, and the impact on food security and soil health are to be addressed.

▪ ***Governance and Financing***

Issues related to governance, financing, coherence, and application of WEFHEE to the sustainable development goals are emerging topics that this topic will also address.

▪ ***Operationalizing the WEFHEE Framework***

Develop practical methodologies, indicators, and decision-support tools that enable policymakers and practitioners to operationalize WEFHEE interlinkages at basin, national, and city scales, including co-benefit identification across water, energy, food, health, ecosystems, and education. Mainstreaming systems thinking and sectoral interlinkages in policy dialogue and decision making.

The goal of the topic is that the WEFHEE interlinkages offer the World Water Forum a forward-looking, actionable framework which connects water with human health, ecosystems, and knowledge systems. This, we hope, will be one of the high impact outcomes of the 11th WWF.

Following the 19th World Water Congress in Morocco, we propose to introduce the WEFHEE framework and its assessment at the cross ministerial level to be adopted on national roadmaps.

Promote the integration of the WEFHEE framework into national water strategies, climate adaptation plans, food security policies, and health surveillance systems, with a focus on cross-ministerial coordination and institutional coherence.

▪ ***Education***

Capacity building and education regarding the system's view to water and WEFHEE Nexus are critical elements for mobilizing adoption of these systems. Most professionals managing the WEFHEE sectors are trained in disciplinary sectors and lack systems level training. Good practices in this area are needed. The goal is to strengthen education and training programs by integrating WEFHEE and One Health concepts into academic curricula and professional development.

▪ ***Gender and Youth***

Promote a youth and gender-transformative es in the creation of policies and decision-making processes at all levels and increase the recognition of women's contributions within the WEFE Nexus.

▪ ***Climate change***

The WEFHEE approach assess in developing plans for climate change mitigation and adaptation. The WEFHEE approach is a critical engine for climate adaptation.

II. Key Issues, Opportunities, and Scope

Key Challenges

- Fragmentation in water management
- Data gaps
- Lack of good examples to follow at scale

- Funding systems level solutions
- Governance of complex Systems
- Knowledge gaps and knowledge development
- Professional certificates for professionals
- Legal and regulatory silos
- Limited translation of nexus concepts into bankable projects
- Weak integration of health and education data into water planning
- Limited consideration of soil moisture–based and rainfall-dependent water use in planning and investment decisions

Opportunities and Strategic Importance

- Awareness of systems approaches to water management
- Future of business-as-usual approaches in terms of its impact on WEFH resources and the sustainability of these systems.
- Scaling efficient, low-energy irrigation technologies to improve agricultural water productivity within the WEFHEE framework.
- Financing opportunities including blended financing: private – public , loans etc.
- ML, AI, opportunities for data and modelling
- Link with IWRM community
- WEFHEE as a platform for climate finance and adaptation funding
- Regional knowledge hubs to scale successful WEFHEE applications
- Strengthening food security and ecosystem resilience by improving the productivity and retention of rainfall-derived water within landscapes

Proposed Priorities of the Topic / Guiding Questions

- How can we finance a systems' approach to water management and implement at scale?
- How do we operationalize WEFHEE system level approaches and solutions?
- How can academic and professional curricula be redesigned to produce 'Nexus-literate' professionals capable of managing these complex systems?
- How can WEFHEE approaches promote sustainable development?
- How do we advance Institutionalizing and governance of the WEFHEE approaches ?

Proposed Sessions of the Topic

These topics are:

- System approaches to Food Security, Agriculture, and Irrigation
- Energy, Ecosystem, and Optimization
- Water, Competitiveness, and One Health System
- Water of the Future
- Unconventional water tradeoffs on production: case studies and successful examples
- Sectoral collaboration and alliances, governance and coherence, financing and incentives
- Role of private sector
- Assessment and mapping of nexus vulnerabilities

- WEFHEE case studies at various thematic and geographic areas
- Modeling the WEFHEE at the local and regional scales
- Operationalizing WEFHEE: From Concept to Implementation
- Financing the Nexus: Making WEFHEE Bankable
- Capacity building and education of system approaches
- Case studies and success stories from national and climate financing organization adaptation funds and green climate funds and GEF.
- WEFHEE Interlinkages in Humanitarian and Fragile Contexts: From Emergency Response to Resilience

Proposed Sessions:

1. Food Security – Water - Agriculture – Energy and Ecosystem Nexus (FAO, TAMU, AUB, Kickstart, KAUST, SIF, NWRC)

Description:

- Irrigation technologies and practices: Scaling Smallholder Irrigation for WEFHEE Resilience at Basin and National Levels
- Data / Modeling and Tradeoff analysis
- Digital and AI / Smart / Precision farming
- Renewable energy (biogas, solar)
- Water allocation
- Water use efficiency
- Modeling the WEFHEE at the local scale
- **Interlinkages in Humanitarian and Fragile Contexts** focused on moving from emergency response to long-term resilience in fragile settings.

Expected Deliverables:

2. Water – Energy Nexus and Unconventional water sources: Successful technologies, Case Studies, and capacity building (NHRI(Nanjing Hydraulic Research Institute, Ministry of Water Resources), KAUST, TAMU, NWRC, SIO (TBC),

Description:

- Reuse technologies and practices
- Desalination, emissions and renewable energy integration
- Unconventional Water for irrigation, industry and environmental use
- applying the WFEN approach in the desalination for agricultural)
- Soil and Environmental Impact
- Monitoring, Efficient Utilization and Risk Management
- Hardness smart sensors, digital twins, and AI in leakage reductions and real-time monitoring and management of water systems

- Redesign regulatory guidelines for unconventional water sources towards fit-for-purpose regulatory standards

Expected Deliverables:

- Policy Briefs
- Inform Riyadh declaration
- Offer scalable examples of how health and environmental goals can be jointly advanced through integrated governance.
- Highlight digital and systems tools for improving cross-sectoral efficiency and adaptive water management.
- Case studies that represent the policy and governance for applying the WEFHEE approach
- WEFHEE indicators dashboard and decision-support toolkit
- Compendium of scalable WEFHEE case studies
- Consensus and regulatory framework on Efficient Utilization of Unconventional Water Sources among different sectors

3. Policy coherence, governance and financing (WWC, FAO)

Description:

- Benchmarking of water use efficiency across sectors
- Risk and resilience against shocks and disruptions
- Financing large scale nexus projects
- Policy coherence among WEFHEE sectors

Expected Deliverables:

Cross Cutting

4. ONE WATER ONE HEALTH (KAUST, SIF, TAMU,

Description:

- Water-health interdependences
- Systematic and integrated solutions towards disease prevention and water security
(This was this session of the same topic in 2022:
<https://www.unep.org/events/conference/one-water-one-health-session-9th-world-water-forum-2022>)

Expected Deliverables:

III. Expected Outcomes and Deliverables

This topic will contribute to:

- Policy Briefs
- Inform national and global water agendas
- Riyadh declaration
- Improved integration of irrigation and agricultural water management in WEFHEE-based policies and investments.
- Roadmaps for regional integration

Policy and Strategic Outcomes

- policy recommendations to support the uptake of One Health and WEFHEE approaches in water planning and management.
- A WEFHEE Policy Integration Framework for national adoption
- Recommendations for cross-ministerial coordination mechanisms

Technical and Knowledge Deliverables

- Offer scalable examples of how health and environmental goals can be jointly advanced through integrated governance.
- Highlight digital and systems tools for improving cross-sectoral efficiency and adaptive water management.
- Case studies that represent the policy and governance for applying the WEFHEE approach
- WEFHEE indicators dashboard and decision-support toolkit
- Compendium of scalable WEFHEE case studies

Partnerships and Financing Outcomes

This session will foster interactions between various WEFHEE sectors through partnerships with financing institutions, donors, private and public sectors, and academia: all working towards achieving the water challenges. Other outcomes includes:

- Engagement roadmap with development banks and climate funds
- Public-private partnership models for nexus investments

Actions and Initiatives for Implementation

- promote multi-stakeholder partnerships that drive innovation in water and wastewater reuse and surveillance.
- Using analytics and tradeoff analysis for water allocation among various users including agriculture, energy, ecosystem, and municipalities to promote holistic and sustainable water management without disruptions of any of these services at the basin level (following the Sao Paulo / EMBRAPA – TAMU Model).
- Facilitate the implementation of basin-level pilot projects for measuring / demonstrating measurable benefits of yield increase, ecosystem benefits, nutrition at the household, and bioeconomy (following the ongoing FAO assessment in Asia and Pacific).
- Expand on transboundary nexus assessment of river basin and aquifers, including stakeholder engagement: <https://www.iswel.org/>

Communication and Visibility

- Encourage community-level action through promotion of education, equity, and health resilience in water management.

IV. Monitoring and Post-Forum Action

- Inform global water agenda through dissemination of topic outcomes through knowledge products and webinars
- Special session to follow up on outcomes of this topic and link to Post 2030 agenda
- Link to UNEA-8 (United Nations Environment Assembly 8) - scheduled for December 6-10, 2027.

V. Proposed Cross-Process Dialogue Areas

Create cross-cutting sessions across all themes and topics with system thinking in mind.

Particularly:

- One Health in partnership with Topic 3D and 3C, including Improving Water Quality in a One Health approach.
- Integrated water resources management with Topic 1C.
- Sponsor ministerial dialogue in this cross-cutting topic.
- Valuing water Topic 6
- ML, AI, opportunities for data and modelling interlinkages in the water system