Topic Concept Note (Semi-Final)

- **Theme Number**: 1
- **Theme Title**: Water Security
- **Topic Number**: 1.E
- **Topic Title**: Securing Water for Food Security
- **Topic Coordinator**: International Commission on Irrigation and Drainage (ICID), Alireza Salamat

Executive Summary: Topic 1.E – Securing Water for Food Security

As the global population approaches an estimated 9.7 billion by 2050, the intersection of water scarcity and food systems has emerged as a critical geopolitical and socio-economic frontier. Topic 1.E, "Securing Water for Food Security," addresses this challenge by redefining water not merely as an agricultural input, but as a strategic lever for climate resilience, poverty reduction, and global stability. Led by the International Commission on Irrigation and Drainage (ICID), this topic provides a comprehensive roadmap for transforming how water is managed across the global food value chain.

The strategic framework of Topic 1.E is built upon four thematic pillars and a concluding synthesis, designed to move from technical evidence to political action:
1. Innovation & Technology: Scaling digital irrigation, AI-driven management, and climate-smart farming systems to increase "crop per drop."
2. Circular Water Economies: Integrating unconventional resources—including desalination, treated wastewater reuse, and rainwater harvesting—into national water budgets.
3. Governance & Finance: Pioneering blended finance models and inclusive regulatory reforms that bridge the investment gap for smallholder farmers, women, and youth.
4. Transformative Partnerships: Fostering multi-stakeholder and transboundary collaborations to dismantle "silo-based" management and accelerate knowledge transfer.

Central to this topic is the Water-Energy-Food-Ecosystem (WEFE) Nexus and the promotion of Circular Bio-economy models, such as the valorization of agricultural waste to recover water, energy, and nutrients.

The ultimate objective of Topic 1.E is to deliver the "Riyadh Roadmap"—a unified set of policy recommendations and technical guidelines that ensure water security for food systems remains a cross-cutting priority in the 2030 Agenda. By bridging the gap between field-level realities and ministerial-level decisions, Topic 1.E catalyzes progress toward a resilient, equitable, and water-secure future for all.

1. Topic Overview

The challenge of securing water for food security has become one of the most pressing global concerns of the twenty first century. The relationship between water and food security on a global scale is not limited to production capacity alone, but is also a strategic issue that encompasses geopolitical stability, economic resilience, and social justice. As the world's population moves toward an estimated 9.7 billion people by 2050, demand for food will rise substantially, placing unprecedented pressure on already stressed freshwater resources, energy and food securities. Agriculture currently accounts for nearly 70 percent of global freshwater withdrawals, and in many regions, water scarcity is increasingly undermining the ability of communities, particularly vulnerable rural populations, to sustain food production and agricultural livelihoods. These pressures are compounded by the rapid intensification of climate change, which has altered hydrological cycles, increased the frequency and severity of droughts and floods, and threatened ecosystem services that support sustainable food production systems. The intensity and frequency caused by high climatic variability and change is not only affecting climate sensitive sectors, it also threatens various economies of several countries across the globe. A large share of global food production depends on smallholder and family farmers, who manage a significant proportion of irrigated and rainfed land and are among the most exposed to water scarcity and climate shocks. In many low- and middle-income countries, smallholder farmers produce the majority of fruits and vegetables and a substantial share of staple crops, yet they often lack reliable access to affordable irrigation, finance, and appropriate technologies. Strengthening water security for food security therefore requires solutions that are not only technically sound at system level, but also economically accessible and operationally viable at the farm level. In this context, water is increasingly recognized globally as more than just a strategic input for food systems; it is a critical lever for climate adaptation, poverty reduction, and peaceful cooperation.

At the regional level, water scarcity manifests differently across continents. In arid and semi-arid regions, chronic shortages and inefficiencies have become an impediment to achieving food security and poverty reduction. Whereas in water abundant regions, inefficiencies, pollution, and governance challenges hinder the sustainable use of water for agriculture. Local challenges often include fragmented institutional responsibilities, limited access to technology, insufficient data for planning, and lack of financing mechanisms to support resilience building in agricultural communities, limited financial resources in order to counteract any natural vagaries, for example, outbreaks of diseases and pests, fires etc. These dynamics demonstrate the need for integrated holistic approaches including the Water-Energy-Food-Ecosystem (WEFE) Nexus that address water availability, efficiency, quality, governance, socio-economic inclusion, and environmental considerations.

The topic is intrinsically aligned with the 2030 Agenda, particularly Sustainable Development Goals 2 (zero hunger) and 6 (Clean Water and Sanitation), which call for ending hunger, achieving food security, improving nutrition, promoting

sustainable agriculture and the sustainable management of water resources as a foundation for human well-being, socio-economic development, and ecosystem health. Ensuring reliable water availability for agriculture, by far the largest global water user, is central to achieving Target 6.4, which focuses on increasing water use efficiency and addressing water scarcity, as well as Target 6.5 on integrated water resources management and SDG 5 on Gender Equality by recognizing the pivotal role of women in water resources governance and agricultural water management. Strengthening water security for food systems supports SDG 2 (Zero Hunger) by enhancing agricultural productivity, improving resilience of farming communities, and safeguarding the stability of food supply chains amid climate and hydrological uncertainties. This includes a shift towards Nutrition-Sensitive Water Management to ensure the production of high-value, nutritious foods. Evidence from multiple regions shows that access to reliable irrigation enables smallholder farmers to increase cropping intensity, diversify into higher-value and more nutritious crops, and stabilize incomes across seasons.

Beyond these core linkages, the theme also contributes to a broader set of interdependent SDGs. It reinforces SDG 11 (Sustainable Cities and Communities) by mitigating water related vulnerabilities in urban–rural interfaces and strengthening the reliability of water for peri-urban agriculture. It supports SDG 13 (Climate Action) through adaptive water management strategies that reduce climate induced risks such as droughts, floods, and extreme weather impacts on food production. Protecting water resources, essential for agriculture, simultaneously advances SDG 14 (Life Below Water) and SDG 15 (Life on Land) by reducing pollution, preventing over extraction, and promoting watershed and ecosystem restoration. Finally, achieving water and food security at larger scales requires robust cooperation, knowledge exchange, and governance partnerships, directly contributing to SDG 17 (Partnerships for the Goals).

Overall, securing water for food security is a cross-cutting priority that catalyzes progress across the SDGs, ensuring that water, food, ecosystems, and communities advance together in a sustainable and resilient manner.

Cross cutting dimensions are central to the discussion. Climate resilience forms a core element, as adaptive and nature-based solutions are essential for sustaining water availability and supporting stable agricultural production. Gender and youth inclusion are equally important, addressing the gender gap in access to land, water, and resources recognizing that women and young people constitute a significant portion of the agricultural workforce, but often face barriers in accessing water resources, financing, and technology. Women and youth are among the most vulnerable groups in agricultural water systems, yet also represent a major opportunity for impact. Targeted access to irrigation technologies, finance, training, and market linkages can enable women and youth-led farms to become productive, resilient, and commercially viable, strengthening both food security and social equity. The integration of digital innovation offers transformative potential, enabling data driven irrigation, remote sensing, and improved forecasting capabilities. Partnerships and financing frameworks are also critical, particularly blended finance, public–private cooperation, and regional investment platforms, all of which play a decisive role in scaling solutions for food and water

security. The overall objective of this topic is to foster both technical and institutional pathways that will ensure water is managed efficiently, equitably, sustainably, and in an environmentally sound manner, in order to support resilient food systems and eco-systems now and in the future.

2. Key Issues, Opportunities, and Scope

A number of key challenges shape the landscape of securing water for food production. Global reports reveal that problems in agricultural water management now stem not only from technical deficiencies, but also from governance gaps, financial vulnerabilities, and information inequalities. Significant data gaps and restricted sharing limit the ability of governments and stakeholders to forecast water availability, manage allocations, monitor consumption, or evaluate the impacts of droughts, floods, and land degradation. In many countries, agricultural water governance remains fragmented across institutions, (Silo-based management), leading to inefficiencies, overlapping responsibilities, and weak enforcement of regulations. Financing constraints further limit the spread and adoption of modern irrigation systems, water-efficient technologies, and climate-resilient agricultural practices, particularly because many existing solutions remain unaffordable or poorly aligned with the cash-flow realities of smallholder farmers and rural enterprises. Furthermore, reliance solely on internal production without considering Virtual Water trade potentials in arid regions exacerbates water stress.

Technology and innovation, while advancing rapidly, remain unevenly accessible. Many smallholder farmers lack access to digital tools, precise irrigation systems, or climate smart technologies that could significantly improve water efficiency. On the other hand, these technologies are positioned not only as tools that increase productivity at the farmer level, but also as strategic infrastructures that strengthen national water accounting, watershed planning, and early warning systems. Adoption is further constrained by affordability, risk aversion, limited access to credit, and the need for solutions that fit farmers' labor, gender, and seasonal cash-flow realities. Moreover, in some regions, the institutional environment does not support the uptake of innovation due to bureaucratic hurdles, inadequate incentives, or limited capacity building, poor awareness raising regarding the new technology or innovation that has been developed. These barriers underscore the need for targeted interventions that enable farmers and water managers to adopt innovations that reduce losses, increase productivity, and support sustainable water use.

Despite these challenges, numerous opportunities exist. Alongside advanced digital and data-driven tools, scalable progress also depends on the widespread deployment of simple, low-cost, and energy-efficient irrigation and water management technologies that can be adopted rapidly by smallholder farmers and producer groups. Advances in digital water management such as remote sensing, geographic information system, artificial intelligence and machine learning (AI & ML), soil moisture monitoring, and hydrological modeling offer new possibilities for optimizing water use. Nature-based solutions, including wetland restoration,

watershed management, and regenerative agriculture, provide low cost and high impact options for sustaining water resources and enhancing resilience. Improving governance through integrated water resources management, stakeholder engagement, and river basin cooperation and strict Groundwater Governance to protect aquifers can lead to more coherent and effective water allocation systems. Strengthening partnerships among governments, research institutions, academia, and NGOs, private companies, and farmers' organizations can also unlock new sources of finance and accelerate innovation.

Within this context, the scope of the topic includes exploring policy and technical pathways for enhancing water use efficiency in agriculture, developing sustainable irrigation strategies, low environment footprint agrifood systems, improving data systems, and strengthening institutions that govern agricultural water use. The topic will further examine the role of climate adaptation strategies, inclusive participatory, and emerging technologies. The scope of the topic also includes water as a productive input for income generation, nutrition, and rural livelihoods, recognizing that reliable irrigation enables farmers to shift to higher-value crops, stabilize incomes, and strengthen household and community resilience.

In this ration, four thematic sessions as well as synthesis session are envisioned to run under topic 1.E. as follows:

Session 1: Innovations in Agricultural Water Management; Technology, Climate Adaptation, and Sustainable Farming Systems

Scope:

The session examines comprehensive approaches to improving agricultural water productivity and resilience through technological innovation, climate-smart practices, and sustainable farming systems. It covers: (i) digital and data-driven solutions including precise irrigation, remote sensing, IoT platforms, smart irrigation management that enable farmers to optimize water use and respond to scarcity in real time; (ii) climate-resilient agricultural water management strategies such as water-saving irrigation methods, soil moisture management, and nature-based solutions that stabilize agricultural yields under changing climatic conditions; and (iii) integrated approaches that promote producing more food with less water while enhancing the sustainability and productivity of farming systems.

Structure: (Total Duration: 90 Minutes):

The session showcases practical applications across diverse agricultural contexts, emphasizing scalable solutions that strengthen food security through improved agricultural water management.

Tentative schedule:

- Opening Remarks & Context Setting (5 mins): The Moderator outlines the session's objectives and the critical role of the selected papers in the global water-food agenda.
- The Research & Case Study Showcase (75 mins):

Format: Five papers on the following themes, each allocated 15 minutes (approx. 12 minutes for presentation + 3 minutes for direct technical Q&A).

- Theme 1: Digital/AI-driven solutions for real-time irrigation.
- Theme 2: IoT and remote sensing applications in water-scarce regions.
- Theme 3: Climate-resilient soil moisture and nature-based management.
- Theme 4: Scalable water-saving irrigation technologies for smallholders.
- Theme 5: Integrated systems for enhancing crop productivity per drop.

- Synthesis & Closing (10 mins): A facilitated "Cross-Paper Synthesis" where the moderator identifies common threads across the five presentations.

Intended Outcomes:
- Policy recommendations to accelerate the adoption of digital water tools in arid regions.
- Proposal of a "Lighthouse Network": A commitment to establish a trans-regional network of "Smart-Agri Hubs" that will share data and best practices between the 11th and 12th WWF.

Session 2: Use of alternative sources of freshwater for irrigation: desalination, harvesting and reuse

Scope:
This session explores the integration of unconventional water sources to bridge the irrigation gap in water-scarce regions. It covers large-scale desalination of seawater and brackish groundwater, emphasizing energy efficiency (WEFE Nexus) and sustainable brine management. Simultaneously, it addresses decentralized, low-energy solutions such as rainwater harvesting, managed aquifer recharge (MAR), and small-scale pumping systems tailored for smallholder resilience. A significant focus is placed on the safe reuse of treated wastewater (TWW) as a reliable, nutrient-rich, and drought-proof resource. By examining policy frameworks, safety protocols, and circular business models, the session identifies pathways to scale these alternative sources into national water budgets.

Structure: (Total Duration: 90 Minutes):
This session follows a Technical Evidence-to-Policy format, featuring peer-reviewed papers that bridge the gap between industrial-scale technology and localized water security.

Tentative Schedule:
- Opening Remarks & The Circularity Vision (5 mins): The Moderator introduces the concept of the "Circular Water Economy" and sets the stage for the technical presentations.
- The Research & Case Study Showcase (75 mins):

Format: Five papers on the following themes, each allocated 15 minutes (approx. 12 minutes for presentation + 3 minutes for direct technical Q&A).

- Theme 1: Innovations in low-energy or solar-powered desalination for agricultural use.
- Theme 2: Sustainable brine management: Moving toward Zero Liquid Discharge (ZLD) in inland and coastal farming.
- Theme 3: Policy and safety protocols for scaling treated wastewater (TWW) reuse in high-value food chains.
- Theme 4: Decentralized rainwater harvesting and small-scale pumping for smallholder resilience.
- Theme 5: Managed Aquifer Recharge (MAR) as a strategic tool for groundwater stabilization.

- Synthesis & The "Circular Action" Wrap-up (10 mins): The moderator facilitates a discussion on how these five distinct sources can be integrated into a single national water budget, followed by a concluding summary of technical takeaways.

Intended Outcomes:

- A proposal on the pathways to integrate desalination and reuse into National Determined Contributions (NDCs) for food security.
- A proposal on Safe TWW for High-Value Crops: A policy template for to harmonize safety standards and monitoring protocols for wastewater-irrigated produce.

Session 3: Governance and financing frameworks

Scope:

This session addresses the institutional, regulatory, and financial mechanisms needed to strengthen water security for agriculture. While technological and agronomic solutions are essential, their effectiveness and scalability depend fundamentally on robust governance structures, enabling policy frameworks, and adequate financing mechanisms. It covers policy reforms, sustainable water allocation frameworks, incentive structures, and innovative financing models such as blended finance and climate funding that enable the scaling of efficient irrigation, watershed management, and water-smart agriculture across regions. It will specifically address the inclusion of women and marginalized groups in decision-making processes and resource access.

In addition, particular emphasis will be placed on partnerships that connect national and global institutions with last-mile delivery organizations, farmer organizations, and local enterprises that bring water and irrigation solutions directly to smallholder farmers.

Structure: (Total Duration: 90 Minutes):

This session is designed as a Policy & Finance Dive, featuring papers that provide evidence-based solutions to the "software" challenges of water security.

Tentative Schedule:

- Opening Remarks: The Governance-Finance Nexus (5 mins): The Moderator frames the discussion: Why technology alone is insufficient without robust institutions and sustainable funding.

- The Research & Case Study Showcase (75 mins):

Format: Five papers on the following themes, each allocated 15 minutes (approx. 12 minutes for presentation + 3 minutes for direct technical Q&A).

- Theme 1: Impact of Policy Reforms on Sustainable Water Allocation (Case studies on successful regulatory shifts).
- Theme 2: Blended Finance Models for Irrigation.
- Theme 3: Climate Funding for Agriculture.
- Theme 4: Strengthening Water User Associations.
- Theme 5: Gender Equity in Resource Access.

- Synthesis & closing (10 mins): The moderator synthesizes the findings to identify the top three "Policy Accelerators" and "Financial Instruments" recommended by the presenters

Intended Outcomes:

- A proposal for a regional or global digital platform that connects bankable water projects with ESG-focused investors and climate funds.
- The "Blended Finance Framework for Irrigation": A set of principles outlining how public subsidies can be strategically used to de-risk private investment in water-saving technologies.

Session 4: Transformative partnerships for securing water and food security

Scope:

This session highlights the critical role of multi stakeholder collaboration and strategic partnerships in accelerating progress toward agricultural water security and food production systems. No single actor - government, private sector, farmer organization, research institution, or development agency - can address the complex challenges of water and food security alone. Transformative change requires partnerships that bridge sectors, link actors, mobilize diverse resources, share knowledge and innovation, and build collective actions. The session showcases successful partnership models, explores mechanisms for effective collaboration, such as water mediation initiatives, and identifies opportunities to scale impact through strategic alliances.

Structure: (Total Duration: 90 Minutes):

The session will be designed as to show how collaboration solves complex water challenges.

Tentative Schedule:

- Opening Remarks: (5 mins): The Moderator explains how the 11th WWF goal of "Real Action" depends entirely on moving from individual projects to integrated partnerships.
- The Partnership & Cooperation Showcase (75 mins):

Format: Five papers on the following themes, each allocated *12 minutes (9 mins presentation + 3 mins direct technical Q&A).

- Paper 1: Success Factors in Public-Private Partnerships (PPP) for large-scale water infrastructure.

- Paper 2: Data-Sharing Protocols: Technical models for regional/transboundary water cooperation.
- Paper 3: Scaling Community-Led Projects: How NGOs and local governments can co-manage water resources.
- Paper 4: The Role of Youth & Academia: Bridging the gap between university research and field application.
- Paper 5: Case studies on sharing water-saving.

- Synthesis & closing (10 mins): The moderator identifies the "Success DNA" shared by these five papers.

Intended Outcomes:
- Collaboration Architecture Models: A summary of the different organizational structures (PPP, NGO-Public, Transboundary) used in the papers and their specific impact on project longevity.
- Multi-Stakeholder Synergy Report: A technical brief on how data-sharing and joint monitoring can reduce conflict and improve water distribution between different sectors.
- Capacity Building Strategies: A synthesis of effective methods for transferring technical knowledge from research and industry to local field operators and communities.

Synthesis Topic Session: Integrated Framing & Strategic Roadmap

Rationale & Function:
The Synthesis Session serves as the executive capstone for Topic 1.E. Its primary purpose is to move beyond the technical and institutional specifics of individual sessions to provide a holistic "integrated framing" of Water Security for Food Security. It acts as the mechanism to harmonize the 20+ technical papers and case studies from the four thematic sessions into a unified strategic message for the 11th World Water Forum's High-Level Process.

Objectives:
- Vertical Integration: To distill the "Main Messages" from Sessions 1–4 into a set of high-level policy recommendations for the Ministerial processes.
- Horizontal Synergy: To bridge the gaps between technology (S1), alternative sources (S2), finance (S3), and partnerships (S4), demonstrating how they must function as a single ecosystem (WEFE Nexus).
- Cross-Cutting Synthesis: To re-center the discussion on the circular bio-economy and social equity (women and youth), ensuring these dimensions are the "golden thread" through all thematic outcomes.

Scope and Process:
The session focuses on the "So What?" for global decision-makers. It extracts the "Success DNA" from the various field-level models discussed across the topic and

translates them into a" Riyadh Roadmap" for global implementation. This session will not feature new technical papers, but rather a" Facilitated Synthesis Dialogue" among the chairs/moderators of the four thematic sessions, led by the Topic Coordinator. The goal is to identify common barriers and shared opportunities that only appear when the topic is viewed in its entirety.

Integrated Deliverable:
The Topic1.E Policy Brief: A unified document synthesizing the outcomes of all four sessions into a coherent strategic guide.

3. Overall Expected Outcomes and Deliverables

The expected outcomes of this topic span policy, technical, institutional, and strategic dimensions in securing water for food security. At the policy level, the topic aims to support governments in developing coherent, integrated, and inclusive policy frameworks that strengthen the link between water and food security. This includes recommendations for improving regulatory structures, aligning national water strategies with climate and agricultural priorities, and promoting equitable allocation of water resources across sectors and user groups. Expected outcomes include measurable improvements in smallholder irrigation coverage, water productivity per hectare, farmer incomes, and the resilience of food production systems in climate-vulnerable regions.

From a technical and knowledge perspective, the topic will include practical tools, analytical insights, and guidelines that can support improved irrigation efficiency, water productivity, and climate resilient agricultural practices. This may include mapping tools, case studies, technical briefs, and capacity building modules focusing on individual, organizational, and institutional levels (Systemic Capacity Development) that address both traditional and modern water management approaches. Knowledge outputs will also aim to highlight best practices in digital innovation, nature-based solutions, and participatory governance models.

In terms of partnerships and financing outcomes, the topic expects to encourage the creation of new collaborative initiatives, including regional platforms for investment in agricultural water management, partnerships with the private sector, and innovative financing schemes such as blended finance, climate funds, and performance-based grants. Strengthening partnerships is critical not only for resource mobilization but also for scaling pilot projects and ensuring long-term sustainability.

Finally, the topic will propose a set of actions and initiatives that support implementation at global, regional, and national levels. These may include demonstration projects, knowledge exchange programs, support for local water user associations, and engagement with youth, women, and community groups. Communication and visibility efforts will ensure that the results and lessons learned are widely disseminated across stakeholders and processes relating to the global water and food security agenda.

4. Monitoring and Post-Forum Action

Monitoring mechanism will be designed to ensure accountability, continuity, and the long-term impact of the topic's initiatives. A clear monitoring mechanism will track progress against agreed upon indicators, including the implementation of policy recommendations, the uptake of technological and institutional solutions, and the strengthening of partnerships and financing mechanisms. The resulting framework will contribute to the broader legacy of the World Water Forum by establishing long-term structures for follow up and by supporting the transition toward the 12th World Water Forum.

Post-forum actions will focus on maintaining momentum, encouraging further collaboration, and promoting continuous learning and knowledge exchange. Contributions to global processes, including UN agencies, international river basin organizations, and regional development banks, will ensure that the outcomes of the topic inform major international frameworks and dialogues. Continued partnerships will be supported through multi stakeholder platforms, technical cooperation programs, and joint research efforts. Knowledge sharing tools and regular monitoring reports will keep stakeholders informed and engaged.

5. Proposed Cross-Process Dialogue Areas

To strengthen integration across themes and processes, the topic proposes the development of two dialogue areas in collaboration with other topics within Theme 1 or across other themes. These dialogues may focus on the relationship between water security and resilient cities, or the role of ecosystems and nature-based solutions in sustaining agricultural water supplies. Additional dialogue areas may be developed with ministerial processes, local and regional authorities, and basin organizations to ensure coherence between policy, territorial management, and water governance.

Finally, the topic proposes engagement with at least two regions that face acute challenges related to water and food security. Regions such as the Middle East and North Africa, South Asia, or Sub-Saharan Africa may be prioritized due to their vulnerability to climate change and their high dependency on climate sensitive sectors such as agriculture, energy and biodiversity for livelihoods. Regional consultations will help tailor solutions, capture localized knowledge, and reinforce the global commitment to securing water for food security.

In alignment with the objectives of Topic 1.E and the Water–Energy–Food–Ecosystem (WEFE) Nexus, this topic further proposes the integration of circular economy approaches through the valorization of fruit and vegetable waste as a strategic pathway to enhance water security, food production, renewable energy generation, and ecosystem restoration. In many regions, post-harvest and market losses of fruits and vegetables can reach up to 70–80 percent, representing a critical inefficiency within food and water systems, particularly in water-scarce environments.

The topic will take advantage of synergies with topic 4D session 3 Navigating Trade-offs and Rebuilding Trust - Facilitating Dialogue on Contested Water Issues in

Agriculture, exploring how to better foster dialogue, participation, and consensus in contexts of competing water demands in agriculture and low institutional trust.

By adopting circular bio-economy models, organic agricultural and food waste can be transformed into multiple co-benefits, including organic soil enhancers, renewable bioenergy, and recoverable water for irrigation. Technologies such as anaerobic digestion, composting, and integrated bio-processing systems enable the conversion of organic residues into biogas for clean energy production, nutrient-rich biofertilizers that improve soil structure and water retention, and treated process water that can be reused in agricultural irrigation, thereby reducing pressure on conventional freshwater resources and groundwater abstraction. This approach directly operationalizes the WEFE Nexus by closing resource loops, reducing environmental pollution, and enhancing agricultural water productivity while supporting climate adaptation and mitigation objectives. The reuse of recovered water and nutrients contributes to more resilient farming systems, improved soil health, and reduced dependency on chemical fertilizers and energy-intensive water supplies.

The proposed innovation is strongly aligned with environmental protection, emissions reduction, sustainable land management, and the transition toward green and circular economies at both national and regional levels. Integrating organic waste valorization into agricultural water management supports these initiatives by reducing greenhouse gas emissions from organic waste disposal, enhancing land restoration, and promoting sustainable resource efficiency across the region. From a socio-economic perspective, circular economy-based water and food systems generate new green value chains, stimulate rural and peri-urban employment, and create opportunities for youth- and women-led enterprises in waste management, renewable energy, and sustainable agriculture. The application of digital technologies, smart monitoring systems, and data-driven decision-making further enhances efficiency, transparency, and scalability of these solutions.