Insights from the case studies on the Water-Energy-Food Nexus and its STI implications for the SDGs in Mekong region

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Abstract

The Water-Energy-Food (WEF) Nexus is a holistic framework addressing the interconnectedness of water, energy, and food sectors, essential for achieving Sustainable Development Goals (SDGs) and improving livelihoods amid environmental stresses like climate change. The Mekong Basin, facing floods, droughts, and developmental pressures, exemplifies where WEF Nexus policies and technologies can mitigate local challenges. This analysis reviews previous WEF Nexus projects in the region, identifying key lessons for success, including early risk management, clear role definitions, stakeholder involvement, and effective resource management. These insights support targeted SDGs and provide policy recommendations for future WEF Nexus initiatives.

Securing the supply of water, energy, and food lies at the heart of the Sustainable Development Goals (SDGs). Water, energy, and food security are essential elements for human well-being and poverty reduction as a solution to ensure livelihood. They are directly related to the SDG 2 (Zero Hunger), SDG 6 (Clean Water and Sanitation), SDG 7 (Affordable and Clean Energy), SDG 12 (Responsible Consumption and Production, and SDG 13 (Climate Action), among others. They are not isolated, but inextricably linked. The Water-Energy-Food (WEF) nexus is a holistic and integrated approach. It provides a foundation that can be considered essential in the implementation of the SDGs (Salam et al., 2017; Rasul & Sharma, 2016; Gallagher et al., 2016).

The Mekong River basin is one of the most significant river systems in the world, and its sustainable management is critical to the well-being of the region's inhabitants and ecosystems. This brief explores the WEF nexus approach as a strategy to address the grand challenges in the Mekong, including climate change, change in hydrology patterns, escalating environmental pressures, concerns of sustainable and inclusive growth across all water-related sectors, and multiple and acute risks such as reduced sediment replenishment and the increased salinity intrusion (Mekong Institute, 2023). As the role of Science, Technology and Innovation (STI) is considered as an effective means in the WEF nexus application (STEPI&MSIT&UNOSSC, 2023). This brief analyzes three significant project cases: 1) Water and Energy for Food (WE4F), 2) Integrated Resource Management in Asian Cities: The Urban Nexus, and 3) Case Study of Nexus in the Republic of Korea and Utilization for LAC Countries (STEPI et al., 2023).

The brief explores the overarching lessons from success factors and challenges that can be applied to WEF nexus projects that aim to identify innovative investments and technological solutions. Moreover, this provides the implications for practical solutions for planning WEF nexus projects. This could include the development of guidelines, frameworks, or best practices based on the insights gained from these cases. Recommendations should be tailored to address challenges commonly encountered in WEF nexus projects, fostering sustainable and integrated solutions for water, energy, and food security on a global scale.

Case Study 1: Water and Energy for Food

The Water and Energy for Food (WE4F) is a direct successor program of development programs, Powering Agriculture: An Energy Grand Challenge for Development (PAEGC) and Securing Water for Food (SWFF). The WE4F is operated through Regional Innovation Hubs (RIHs) in Africa, the Middle East, and Asia, with each hub serving as the local representation of WE4F in respective countries. The WE4F initiative is active for a five-year period, spanning from 2019 to 2024, with a total project budget of 4 million USD allocated for innovator grants. These grants are funded by the German Federal Ministry for Economic Cooperation and Development (BMZ), the U.S. Agency for International Development (USAID), and other contributors. The primary objective of the initiative is to offer innovative solutions from entrepreneurs to address challenges within the Water-Energy-Food (WEF) Nexus ("2024 Water and Energy for Food Grand Challenge").

Figure 1. Regional Innovation Hubs (RIHs)

Regional Innovation Hubs (RIHs)	**Objectives**	**Roles & Responsibilities**
	Ensuring that WE4F's regional needs and priorities are appropriately reflected and adapting the WE4F guidelines in accordance with specific situation and context of respective regions Understanding specific situations of innovators and facilitating the communication of the WE4F with them	Management of the identification of new innovators Report of regional issues to the Secretariat Technical assistance Financial brokering Capacity development of innovators in the region Advocacy for an enabling environment in the regions
Region	**Location**	**Responsible Entity**
Middle East and North Africa RIH	Lebanon	Berytech, Chemonics Egypt, cewas, International Water Management Institute (IWMI)
West Africa RIH	Ivory Coast	GFA Consulting Group, GIZ
Southern and Central Africa RIH	South Africa	Tetratech, Open Capital, IWMI
East Africa RIH	Kenya	NIRAS, Intellecap, GIZ
South and Southeast Asia RIH	Thailand	Tetratech, Crossboundary, DevWorks International

Data source: retrieved from WE4F website.

WE4F provides following support services for WE4F innovators: (1) milestone grants for innovative enterprises; (2) relevant support of technical assistance; (3) financial brokering and relevant investments facilitation services including the development of appropriate financial models; (4) guiding WE4F innovators by highlighting institutional barriers and compliance requirements with their business models; (5) communication and knowledge transfer and capacity development ("2024 Water and Energy for Food Grand Challenge").

Success Factors. Numerous success factors have emerged including: (1) adopting a decentralized approach with RIHs to customize services locally; (2) providing milestone-based funding with technology assistance to encourage active engagement from WE4F innovators; (3) incorporating a well-designed result framework and a systematic monitoring and evaluation structure with clear baseline; and (4) fostering support from innovation intermediaries and local expert groups to facilitate commercialization and private sector investment.

Challenges to Overcome. Certain considerations are necessary within the WE4F framework to better cater to the needs of WE4F innovators: (1) An open call for innovations has shown imbalances in applications due to issues like language barriers and the absence of a local coordinator; (2) The lack of a demand survey and limited connections with policy stakeholders at the local level could impede the creation of an enabling environment for innovative solutions and business models; (3) Administrative costs could pose challenges for small-scale innovators.

Case Study 2: Integrated Resource Management in Asian Cities: The Urban Nexus

"The Urban Nexus" is a project for integrated resource management implemented in Asian cities and funded by the Federal German Ministry for Economic Cooperation and Development (BMZ). This project supported up to twelve cities in China, India, Indonesia, Mongolia, the Philippines, Thailand, and Vietnam. UNESCAP played a role as a political partner, while Local Governments for Sustainability (ICLEI) in South Asia (SA) and Southeast Asia (SEA) implemented the "Urban Nexus" project in targeted regions. The project was implemented over six years, from 2013 to 2018 (Erlbeck, 2016).

It focused on creating sustainable urban development solutions and strengthening the capabilities of local and national governments in the Asia-Pacific region. UNESCAP, GIZ, ICLEI collaborated to foster the development of socially, economically, and ecologically resilient cities. For example, GIZ offered advisory services to local governments, focusing on enhancing resource management in energy, water, and food security/land use ("UNESCAP").

Success Factors. The success factors for the project are as follows: (1) the active engagement of national and local governmental officials, along with increased awareness and understanding of the NEXUS concept among relevant stakeholders; (2) sharing information and experiences at regular regional workshops

facilitated project implementation. GIZ's precise analysis of issues in target cities led to effective solutions; (3) this project also highlighted the importance of new thinking, leadership, and commitment to address resource management gaps; (4) facilitating collaboration, communication, and peer-learning activities proved crucial for the project's success.

Challenges to Overcome. The project encountered challenges such as language barriers and travel restrictions: (1) Limited English language skills among local governmental officials necessitated simultaneous interpretation, leading to additional costs not initially budgeted for; (2) the implementation of the project faced intermittent coordination and logistical challenges, such as difficulties in securing speakers and panellists for events; (3) travel restrictions posed additional obstacles such as challenges in obtaining travel permissions and visas; (4) scheduling events was also challenging due to holidays and election days, adding a barrier to effective project management.

Case Study 3: Case Study of Nexus in Korea and Utilization for LAC countries

The project, titled "Case Study of Nexus in Korea and Utilization for LAC Countries," aimed to enhance efficient planning and integrated management of water, energy, and food resources in Latin America and the Caribbean (LAC) countries, specifically targeting Colombia and Uruguay. Launched in July 2020 and concluded in November 2022, the project had a budget of USD 550,000, financed by the Korea Poverty Reduction Fund.[11] Drawing on Nexus cases from Korea, such as multipurpose dams, the project sought to ensure water and food security, as well as energy production. Due to the implementation coinciding with the COVID-19 pandemic, planned activities experienced delays in 2020 and 2021. This case, particularly noteworthy for its occurrence during the pandemic, provides valuable lessons on how to navigate unexpected challenges in the future (Lee, 2022).

Success Factors and Lessons Learned. To ensure the success of projects, it is crucial to engage in thorough discussions and negotiations with the governments of developing countries, ensuring their understanding of fundamental project concepts, particularly the NEXUS approach in this case, and establishing specific implementation plans. When the government ministry responsible for the project cannot cover all three resources, there is a risk of focusing solely on one or two of them. To address this, we propose that, despite potential differences in roles and responsibilities among countries, a unified approach should be maintained within the designated government ministries across different nations acting as project managers to ensure the project's smooth implementation (K-water, 2017).

Challenges to Overcome. Changes were necessitated in the project due to inadequate negotiation by the client (IDB) with the target countries during the planning phase, leading to modifications in the contract: (1) Insufficient understanding of the overall project direction among the concerned local governments contributed to the IDB's erroneous order. The scope of work was altered due to disparities between the business areas of the ministry and those proposed by participating institutions; (2) the project in Uruguay was cancelled due to a government ministries reorganization, leaving only Colombia to proceed; (3) the project's timeline had to be adjusted due to delays caused by the global spread of the Covid-19 pandemic (K-water, 2017).

Figure 2. Summary of Three Case Studies

Type	Project	Implementing institutions / Funders	Duration	Project Region
S-S & Triangular cooperation project	Water & Energy for Food(WE4F)	EU, BMZ-GIZ, Sweden, Netherland, USAID	2019 - 2024	Africa, Middle East, Asia
	Integrated Resource Management in Asian Cities: The Urban Nexus	UNESCAP, ICLEI, SA, SEA /GIZ	2013 - 2018	Asia
Local Level Project	Case Study of WEF Nexus in Korea and Utilization for LAC Countries	Inter American Development Bank / K-Water	2020 - 2022	Latin America and the Caribbean

Data source: author's compilation.

Policy recommendations / conclusions

We suggest four key lessons emerging from case studies: (1) unexpected challenges and risks within the beneficiary area need to be addressed at the beginning of the project; (2) clear roles and expectations need to be identified at the project's initial stage; (3) the involvement of stakeholders, community members, and beneficiaries at each stage of the project is crucial to

achieving project goals; (4) effective management of project resources and timelines stands out as a key factor for project success. This brief underscores that applying these lessons can contribute to achieving various SDGs, including relevant issues on food, water, energy, innovation, climate action and partnership. These issues are recognized as key factors for reaching sustainable development in the Mekong region and the implication from the case studies will be utilized as a foundation for the design, implementation, and monitoring of WEF Nexus approach in the region.

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