

CGIAR Initiative on NEXUS Gains at the 9th Asian Regional Conference on Irrigation and Drainage

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The International Water Management Institute (IWMI) supported by the CGIAR Initiative on NEXUS Gains co-organized two international workshops at the [9th Asian Regional Conference](#) in Sydney, Australia from 1-7 September, 2024. The conference, hosted by the International Commission on Irrigation and Drainage (ICID) and Irrigation Australia, saw the participation of researchers, professionals, policymakers, and exhibitors from across the globe. The theme of the conference was “Irrigation’s role in delivering economically viable food security and sustainable urban spaces in an increasingly unpredictable climate”.

International workshop on the importance of the water-energy-food-ecosystems nexus for the irrigation sector

On 1 September, 2024 IWMI co-organized an international workshop with ICID on “The Water-Energy-Food-Ecosystems Nexus: Trade-Offs and Foresight Analysis for Policy and Investment Decisions”. The session was co-chaired by Prof Ragab Ragab, Chair of the ICID Working Group on Water-Energy-Food, and Dr Narges Zohrabi, Head of ICID’s International Research Program for Irrigation & Drainage – Iran Regional Node. Prof Ragab highlighted the importance of the water-energy-food (WEF) nexus for the irrigation sector. He discussed how the thinking around the WEF nexus has moved forward and the need to have more research and engagement with policymakers to make it a central issue. Dr Yella Reddy, Vice President of ICID, presented the work of the ICID WEF nexus working group, including workshops and capacity development sessions. In the session, CGIAR Initiative on NEXUS Gains researchers presented the results from applied foresight and interactive modeling tools developed for the Ganges and Indus Basin to prioritize water-energy-food-ecosystems (WEFE) innovations for policy and investment decisions.

Dr Alok Sikka, Country Representative – India and Bangladesh, IWMI, welcomed the participants and set the context. Dr Mohsin Hafeez, Director of Water, Food, and Ecosystems, IWMI, presented the overview of the CGIAR Initiative on NEXUS Gains followed by a presentation on the WEFE modeling tools, including soil and water assessment tool (SWAT) and Python Water Resources (PyWR) models, developed for the Indus Basin. These models and tools are being developed for the Indus Basin Irrigation System to address water resource allocation and optimization. He also showcased the Groundwater Management Information System (GMIS) tool for database management, analysis, and reporting. The GMIS is enabling the Government to make informed decisions for implementing sustainable management practices and facilitating compliance with the Punjab Water Act by setting appropriate caps on resource extraction in vulnerable areas, thereby safeguarding groundwater resources for future generations.

Dr Dipaka Sena, Regional Researcher, IWMI, presented the integrated surface (SWAT+) – groundwater (Gwflow) model developed for the Ganges basin to enable the identification of losses and gains under business-as-usual and alternative development pathways (scenarios), across WEF sectors. The developed model has been integrated into an online toolbox that allows users to create and simulate WEFE policies and programs in the Ganges basin and visualize results.

Dr Sikka showcased the practical application of the National Water Productivity Atlas that has been developed for India under NEXUS Gains. The National Water Productivity Atlas is an online tool developed, based on the available open data, to assess spatial and temporal variation in water productivity and water footprint across various crops and regions. The tool provides these details for over 30 crops across 600 districts in India over the last 20 years. This tool offers spatial and temporal variation across different geographical scales and helps in running scenarios for future planning and investment decisions with a nexus lens. The groundwater footprints for the Ganges basin including scenarios analysis with crop diversification for the WEF nexus were presented. Faiz Alam, Regional Researcher, IWMI, presented the results from the integrated surface and groundwater storage management work, where NEXUS Gains is working on upscaling Underground Transfer of Floods for Irrigation

(UTFI). UTFI is a form of managed aquifer recharge that involves recharging aquifers at the basin or catchment scale with excess wet season flows to mitigate potential flood risks downstream, enhance groundwater storage and increase water availability during dry periods. NEXUS Gains is working on upscaling UTFI in the Ramganga Basin by assessing the Government's recharge programs to inform future investments.

Dr Santosh S Mali from the Indian Council of Agricultural Research, a NEXUS Gains partner, presented the case of solar energy and how it can play a pivotal role in the WEFE nexus. Potential solar energy can provide benefits across water (e.g., improved water access), food (e.g., improved productivity and resilience), energy (e.g., reduced fossil fuel use) and ecosystem (e.g., pollution reduction) sectors. He provided examples of different solar energy deployment approaches and highlighted the need for solar energy innovations and large-scale adoption that needs national and regional strategies, action plans, and programs.

The panel discussion, moderated by Dr Narges Zohrabi, focused on the challenges of translating WEFE nexus research into effective policy action and emphasised how NEXUS Gains results and tool is a step towards bridging science-policy gap. The panel included Dr Paul Pavelic, Senior Researcher, IWMI; Prof Sylvester Mandeli, Vice President, ICID, and Dr Sanjeeb Baral, Director General, Department of Irrigation and Water Resources, Nepal. The panelists emphasized that while the theoretical understanding and modeling of the WEFE nexus have advanced, implementation remains difficult. The panel highlighted key areas, including the need for quantification of the WEFE nexus, linking it to the Sustainable Development Goals, and addressing local contexts and political economies. They emphasized the importance of awareness, capacity-building, and interdisciplinary expertise, along with the necessity of breaking down silos across technical, social, and economic domains. Bridging the gap between research and policy implementation remains crucial, especially in integrating WEFE considerations into policy frameworks.

Workshop on irrigation modernization to build resilience and adapt to climate change



Irrigation has been instrumental in ensuring global food security by significantly boosting crop yields and reducing vulnerability to weather extremes. In the face of escalating climate change-induced vulnerabilities, irrigation is becoming critical for adaptation to climate change. The workshop on "Irrigation modernisation to build resilience and adapt to climate change" organised on 2nd September had speakers from the top irrigators in the world including India, China,

and Pakistan. The session was chaired by Dr Chandra Madramootoo, James McGill Professor, Department of Bioresource Engineering, McGill University and Director, McGill Water Innovation Lab. In his introductory remarks, he emphasized the importance of irrigation modernization for building climate resilience.

Dr Sikka opened the session and briefed about the workshops objectives. He highlighted that over the past years, significant investments have been made in developing canal irrigation systems, which have been instrumental in ensuring global food security and supporting the Green Revolution. However, the aging irrigation systems suffer from low overall efficiency in terms of conveyance, distribution, and field application, largely due to poor operation and maintenance, inefficient last-mile connectivity, and minimal focus on demand-side management. Additionally, ineffective institutions, governance, and limited capacities further contribute to these inefficiencies.

To build resilience, the modernization of irrigation systems through both technological and institutional interventions is crucial. He highlighted recent initiatives that have focused on enhancing efficiency with canal linings, pressurized piped networks, micro-irrigation, and the use of internet of things and sensor-based systems. However, modernization must extend beyond engineering solutions to include stronger governance, the empowerment of Water User Associations, and improved delivery mechanisms to ensure equitable resource distribution and the sustainability of irrigation systems.

Dr Ashwin B Pandya, Secretary General, ICID and Former Chair, Central Water Commission, Government of India, New Delhi, presented the lessons and opportunities from the modernization of irrigation systems in India. He highlighted that India has an ongoing process of modernization beginning at the inception of engineered irrigation in the second half of the nineteenth century. He highlighted India's work on canal modernization (e.g., automation, lining, piped irrigation), efficient irrigation systems and using data (e.g., satellites, sensors). He emphasized that climate change is seriously impacting irrigation thus making adaptation-related modernization important. He concluded by highlighting challenges related to modernization including issues with aging infrastructures, post-project implementation services, lack of adequate pricing and revenue models and capacity of people which may pose a challenge when absorbing new-age technologies and approaches.

Dr Wenyong Wu, Department of Irrigation and Drainage, China Institute of Water Resources and Hydropower Research, highlighted the role of smart irrigation in China along with the opportunities and challenges associated with it. He showed how irrigation has been instrumental in supporting national food security in China. It is estimated that by 2035, to ensure national food security, agriculture in China will face a water shortage of 60-80 billion cubic meters based on the current situation. He gave examples of new technologies such as the internet of things, big data, artificial intelligence and cloud computing which are being used to achieve water conservation, yield enhancements, and labor savings. This is leading to a transition from experience-driven traditional irrigation to data-driven smart irrigation.

Dr Hafeez presented the research leading to transformational pathways for climate-smart irrigation water management in the Indus Basin, Pakistan. He showcased how advances in monitoring and digitization are enabling better operations and distribution. However, efficient on-farm water management is still a challenge. IWMI in partnership with the Government is developing a remote-sensing-based evapotranspiration water management system which will be introducing the spatial irrigation demand management model to create water use flexibility and for irrigation demand forecasting. Alongside, IWMI is also carrying out capacity-building sessions with managers and farmers, including women and youth, on irrigation demand management and the use of instruments.

Dr Vikas Goyal, Asian Development Bank (ADB), Delhi shared ADB's experience in irrigation modernization in India for building resilience to climate change. He presented the ADB's Support for Irrigation Modernization Program led by the Ministry of Jal Shakti (Department of Water Resources, River Development and Ganga Rejuvenation) in India which selected four schemes for modernization with a total command area of 246,000 ha. Under this project, he gave the example of Madhya Pradesh Irrigation Efficiency Improvement Project which modernized the Kundalia command area. The project introduced an innovative irrigation system that involved designing and constructing a very large-scale pressurized and automated irrigation system allowing considerable gains in water use efficiency. The minimized losses led to large gains in the command area. This was done under the design-build-operate contract modality - where little experience exists in India.

All the speakers highlighted that climate change and increased competition for water resources make irrigation modernization critical. The Chair, in his concluding remarks, mentioned that while there is a range of successful examples, we need to see how to scale these up and make them financially viable. Also, the capacity of irrigation managers needs to be strengthened, both for intergarting new technologies and the changes needed to consider climate change.

In addition, Dr Sikka also presented on WEF nexus in the session organized by Irrigation Australia on 1 September and presented on "Irrigation and Drainage for Food Security in Asia", co-authored by Dr Alok Sikka, Faiz Alam, and Dr Mohsin Hafeez, in the Asian Regional Working Group session on 4 September.

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