



## Innovation in Focus: Climate Resilience *Water Financing Partnership Facility*

### Business-as-Unusual in the Water Sector

Spotlight: Pakistan

#### Promoting Food Security through Responsive Canal Irrigation Management

High-level remote sensing and mathematical programming technology to advise canal irrigation controls in near real-time, developed for the first time in Pakistan, enables equitable water access to foster climate resilience and food security.

##### The Case for Innovation

Asia and the Pacific faces unprecedented challenges in water, with growing climate change impacts, increasing extreme water events, rising water scarcity, and rapid urban migration and growth—compounded by the ongoing economic and social recovery from the coronavirus disease (COVID-19) pandemic. Despite gradual improvements in water security, more than two billion people lack adequate water and sanitation services in the region.

These unprecedented challenges require unprecedented, innovative solutions.

The [Asian Development Bank](#) (ADB) is a leader in promoting water security and resilience in Asia and the Pacific through pioneering approaches that support inclusive, sustainable, and well-governed services delivery and

resource management; climate resilience; and adaptive capacity. ADB supports water entities by deepening gender mainstreaming, boosting private sector participation, increasing digitalization efforts, and building capacity to tackle climate change.

The [Water Financing Partnership Facility](#) (WFPP) is pivotal in enhancing ADB's operations and responding to the region's challenges by delivering “business-as-unusual.” Since 2006, WFPP has been changing lives by catalyzing innovative, resilient, inclusive, and sustainable water investments in Asia and the Pacific.

This series showcases this innovation in action in the water sector. Using case studies by topic from ADB's developing member countries, it highlights the efficacy and benefits of these solutions and explores their potential for replication and broad development impact.

## Climate Resilience and Water

Water is at the center of the climate crisis—inextricably linked to all areas of sustainable development, which are under threat from the growing impacts of climate change and natural hazards on local populations, the environment, and economies.

Asia and the Pacific is the most disaster-affected region in the world and is home to more than 40% of the globe's calamities and 84% of the people they affect. Climate-related disasters and water stresses are also having severe impacts on food production and supply chains across Asia and the Pacific. More than 300 million people in Asia alone remain food insecure.

Farming families in South Asia, Southeast Asia, and sub-Saharan Africa are disproportionately poor and vulnerable and, as such, most at risk from crop failures and hunger resulting from climate change. The 2022 devastating floods in Pakistan—affecting 33 million people and resulting in severe agricultural damages and losses—highlight the interrelated nature and impacts of climate change, water, and food security.

With irrigation systems expanding and water scarcity rising, there is an increasing gap between supply and demand. Water accounting—or data

on how much water is available, how much water is being utilized, and resulting shortfalls—is critical in addressing water insecurity in the region.

Building resilience by addressing and mitigating risks from climate change, water-related disasters, food insecurity, and related economic shocks is central to ADB's water program. ADB encourages the adoption of innovative, efficient, and sustainable water solutions—to improve water and food security and create climate and disaster-resilient water management systems.



**WFPF has enabled an opportunity to remove binding constraints, prepare alternative mechanisms in water service delivery, improve local capacities decision support system and take small but focused steps toward transformational engagement, evaluate alternative options for water service delivery.**

– **Asad Ali Zafar**

Senior Project Officer (Water Resources),  
Central and West Asia Department, ADB



## Climate Resilience in Action

### Context

Pakistan demonstrates not only the dramatic risks to agriculture through climate-related water impacts—as witnessed during the 2022 floods and the country’s vulnerability to future shocks—but also the significant opportunities for building water resilience by piloting and modeling innovative water solutions. WFPF investments to improve canal management in Pakistan through remote sensing-based decision support tool underline this potential.

The country’s Lower Bari Doab Canal irrigation system is a critical resource to about 295,000 farming households in Punjab, whose livelihoods depend primarily on the cultivation of rice, wheat, maize, cotton, and sugarcane. Given the variability of rainfall and groundwater, particularly as climate change impacts on the region increase, consistent cropping relies on an intricate network of secondary canals and distributaries branching from a primary canal that is opened and closed to rotate limited canal water supplies—a lifeline of support—to farms.

The canal systems have been explicitly developed to supplement precipitation and distribute water as equitably as possible. However, due to the size of the irrigation system and the scarcity of data on its precipitation and crop water needs, there is incomplete information for irrigation system managers to prepare reliable plans for volumes and timing and to quickly adapt to needs in different locations, resulting in inadequate or inequitable water distribution for farmers and end users.

The Lower Bari Doab Canal irrigation system serves **295,000** farm households, including **37,000** female-headed households.



### Solution

To support the Punjab irrigation department’s commitment to improve canal performance, ADB—through WFPF support—uses satellite imagery and soil moisture and flow sensors to estimate variations in crop water requirements and relative water deficits across farming land dependent on the canal’s far-reaching system. The combination of satellite-based technology and physical measurements enables the tracking of how canal water, rainfall, and groundwater are consumed through evapotranspiration—providing a comprehensive overview of water gaps.



**Canal yields.** Access to the Lower Bari Doab Canal has increased crop production and ensured more work for farmers and laborers in Punjab (photo by Sara Farid).

Using remote sensing earth observation data to track how water resources are being used and to assist farmers is a growing trend, given the rapid advances in technology, ease of access to information, and the declining costs for securing and processing this data. The approach is particularly promising for rapid water accounting over large geographic areas, as collecting comprehensive ground data can be impractical, time-intensive, and cost-prohibitive.

The activity has also quantified existing inequity in the canal commands. The goal is to reduce this inequity—demonstrated through the Gini coefficient—to less than 0.1, or as close to 0 as possible, by adjusting the distribution of irrigation water. While the math is complex, the aim is simple: allow farmers to build climate resiliency

by ensuring fair access to water for their crops. A decision support system uses these analyses to revise distributary rotations, or the opening and closing of secondary canals, in near real-time—with the goal that every farmer in the canal system receives the same amount of water per hectare of land to strengthen water security.

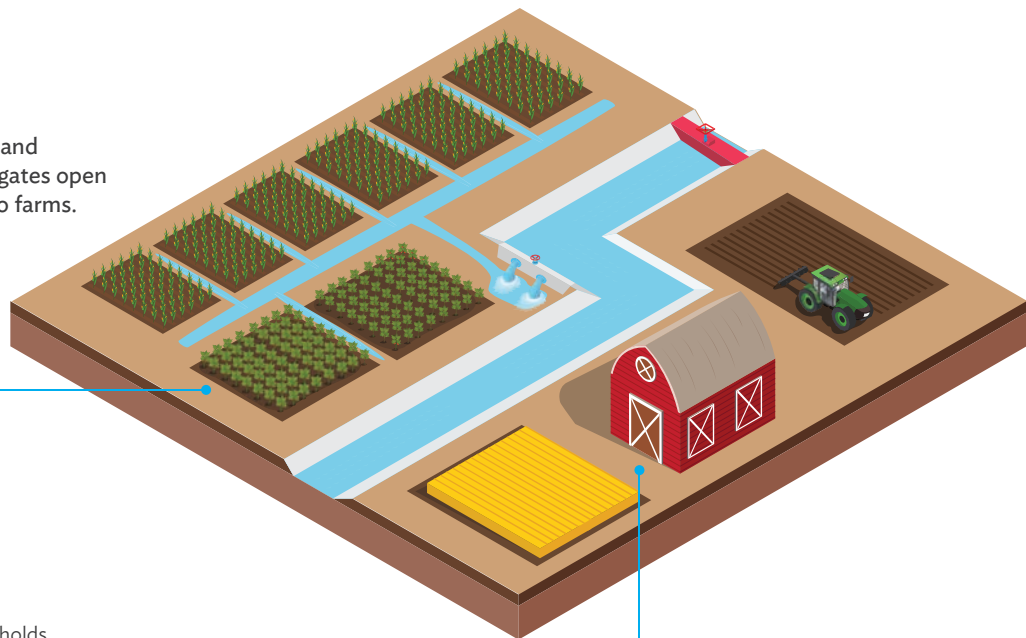
The canal allocation model has been developed and tested. The operational demonstration with additional results is expected in 2023. The project has assessed crop water requirements and provided recommendations for rotations by installing soil sensors to cross-check remote calculations, compiling flow data, and developing a framework for the web-based decision support system.

Graphic of canal and secondary canal gates open or closed down to farms.



## 2 million beneficiaries

Number of farming households or farm holdings with improved productivity and/or income, and number of hectares of farmland used more eco-efficiently.



## 750,000 hectares

## Impact

The WFPF-supported approach has resulted in innovation and the novel application of high-level technology combining satellite remote sensing and mathematical modeling. While remote sensing applications have been used elsewhere to inform farmers of irrigation requirements at the farm scale, the intervention represents the first time the technology is being used to estimate crop water deficits across a large canal command to inform the rotation of distributaries.

Satellite-based irrigation performance monitoring at the head, middle, and tail sections of the canal will allow near real-time control to change water rotations—based on complementary information on rainfall forecasts and groundwater—to maximize the use and equity of water supplies. It will improve water and land management for more than 750,000 hectares of Punjab.

The activity will benefit an estimated 2 million people, including farming households, with strengthened resilience to changing precipitation, temperature patterns, and extreme climatic events. Rotation corrections will improve social equity, with reliable water resulting in increased food production, enhanced farm profitability, and reduced income disparity in Punjab.



**Fostering equality.** Steady access to canal water improves social equity by increasing food production and reducing income disparity (photo by Sara Farid).



**WFPF is all about innovations and new technology. WFPF has done this here. It has triggered some novel, innovative ideas.**

**– S.A. Prathapar**

ADB Consultant  
Central and West Asia Department, ADB

## Advancing Innovation in Climate Resilience

Using high-level remote sensing technology and mathematical programming techniques for improved canal management has the potential for expansion and replication. The methodology offers a discreet intervention to improve management in contrast to the costly rehabilitation of irrigation infrastructure. Future irrigation modernization projects should consider existing and forthcoming learning from the approach used in the Lower Bari Doab Canal.

The Pakistan activity has brought together farmers, government agencies, leading universities, researchers, canal operators, and consultants to develop innovative technology. It installed sensors and has developed the decision support system to establish a responsive distributary rotation that promotes equity in access to water among farming families to increase their climate resilience. However, the approach is not without challenges. The project has faced difficulties in integrating the science, research, and operations aspects for implementation. To overcome these challenges, maximize the use of the technology and its benefits, and promote sustainability, ownership of the decision support system must be transferred to canal operators.

Investments in irrigation modernization are not adequate. Systems that provide real-time, easy-to-access data to irrigation managers, farmers, and communities about water shortages and



inform adjustments or preparations can positively impact broad economic and societal issues. As understanding derived from these technologies will be fundamental to sound water project planning, they should be considered critical interventions for improved irrigation management.

ADB is committed to promoting climate resilience across Asia and the Pacific, and innovative approaches to water management are pivotal in meeting this goal. ADB has used satellite remote sensing data in the design, monitoring, and evaluation of river basins and large irrigation

systems in [Tajikistan](#), and the bank has supported the development of modernized and climate-resilient irrigation systems to assist five drought-affected provinces in [Viet Nam](#). Both examples use improved data to empower farmers by enabling informed planning and resilience.

As the region's climate bank, ADB has elevated its ambition to deliver \$100 billion in climate financing from 2019 to 2030 and is committed to aligning its operations with the goals of the Paris Agreement and ensuring that by 2030, at least 75% of its operations support climate action.

Explore the [WFPF Annual Report 2022](#) to learn more about WFPF's business-as-unusual approaches, highlights, and successes in water and sanitation across Asia and the Pacific.

Join the [Asia and the Pacific Water Resilience Hub](#) to connect with sector specialists and discover innovative technologies, tools, and trainings to increase water resilience in the region.



## Asia and the Pacific Water Resilience Hub

**CONNECT. COLLABORATE. CAPACITATE.**

Stay posted for more Innovation in Focus issues



Climate  
Resilience



Food  
Security



Governance

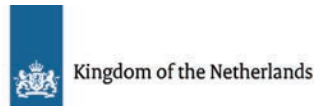


Technology

For more information, contact:

[wuds@adb.org](mailto:wuds@adb.org)

Follow ADB Water and Urban Development



Creative Commons Attribution 3.0 IGO license (CC BY 3.0 IGO)

© 2023 ADB. The CC license does not apply to non-ADB copyright materials in this publication.

<https://www.adb.org/terms-use#openaccess>  
Publication Stock No. ARM230577-2

<http://www.adb.org/publications/corrigenda>  
[pubsmarketing@adb.org](mailto:pubsmarketing@adb.org)