

TRANSFORMING IRRIGATION THROUGH AUTOMATION - INSIGHTS FROM INDIA'S NLBC MODERNISATION AND GLOBAL LEARNINGS

TRANSFORMER L'IRRIGATION PAR L'AUTOMATISATION – ENSEIGNEMENTS TIRÉS DE LA MODERNISATION DU NLBC EN INDE ET DES EXPÉRIENCES MONDIALES

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ABSTRACT

The NLBC modernisation project in Karnataka showcases how canal automation can enhance water-use efficiency, equity, and crop productivity. Integrating advanced technologies with local capacity building, it sets a scalable model for sustainable irrigation in India and globally, aligning with national water goals and climate-resilient agricultural development.

Keywords: Canal Automation, Total Channel Control (TCC), Irrigation Efficiency, NLBC Modernisation, Water Use Efficiency, Gravity-fed Irrigation, Smart Irrigation, Digital Water Management, Agricultural Productivity, Climate-resilient Agriculture, Water Vision 2047, Sustainable Water Management, On-demand Irrigation, Rural Infrastructure, Farmer Equity.

RÉSUMÉ

Le projet de modernisation du NLBC au Karnataka montre comment l'automatisation des canaux peut améliorer l'efficacité d'utilisation de l'eau, l'équité et la productivité des cultures. En associant des technologies avancées au renforcement des capacités locales, il établit un modèle transposable pour une irrigation durable en Inde et dans le monde, en cohérence avec les objectifs nationaux relatifs à l'eau et le développement d'une agriculture résiliente au climat.

Mots-clés : Automatisation des canaux; Contrôle total des canaux (TCC); Efficacité de l'irrigation; Modernisation du NLBC, Efficacité de l'utilisation de l'eau; Irrigation gravitaire; Irrigation intelligente; Gestion numérique de l'eau; Productivité agricole, Agriculture résiliente au climat; Water Vision 2047; Gestion durable de l'eau; Irrigation à la demande; Infrastructure rurale; Équité des agriculteurs.

INTRODUCTION

India's water challenge and the case for efficiency

India is one of the world's most water-stressed countries, with increasing inter-sector demand driven by a growing population and economic development. More than 80% of available freshwater is allocated to agriculture (Dhawan, 2017), yet manually operated canal systems are resulting in losses of up to 40% before the water reaches the farm, with more than half of the country's agricultural land lacking sufficient water for half of the productive period (NABARD, 2018). Nearly 600 million people are at risk of surface water supply disruptions, with 54% of the country's land facing high to extremely high-water stress (WRI, 2014).

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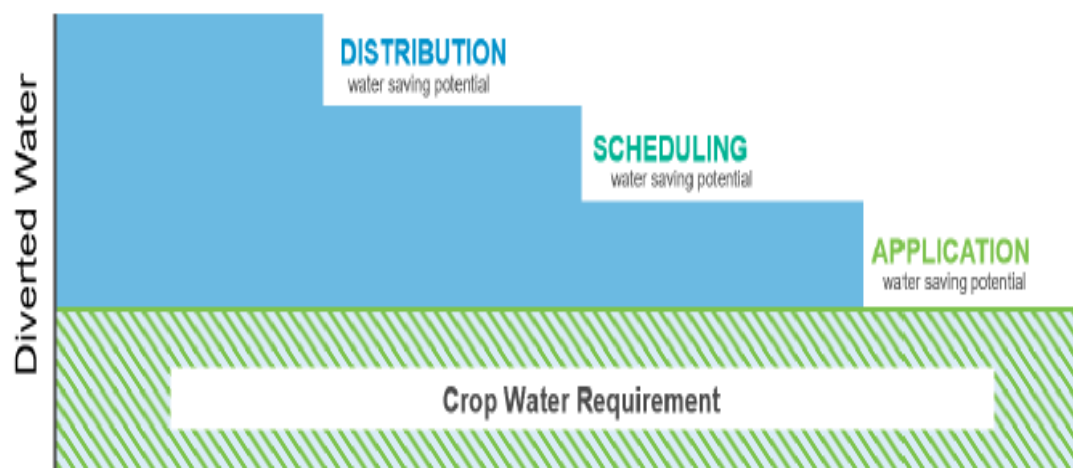


Figure 1: Water savings opportunities in irrigated agriculture.

NLBC MODERNISATION PROJECT OVERVIEW

The most scalable solution lies not in expanding supply, but in improving efficiency, particularly in agriculture. Irrigated agriculture remains the largest and most inefficient consumer of India's, and the world's, available freshwater resources. The Narayanpur Left Bank Canal (NLBC) modernisation project in Karnataka offers a compelling example of how targeted upgrades in canal control and distribution can deliver transformative outcomes in the context of India and more broadly, the globe.

The NLBC network spans over 3,000 kilometres and services more than four lakh hectares of farmland. Historically managed through manual gate operation, the system struggled with inconsistent supply, especially for tail-end farmers. These inefficiencies contributed to low crop productivity, poor service equity, and increasing pressure on already strained groundwater sources. The large-scale modernisation effort set out to address these challenges with the objective of improving water-use efficiency by up to 20%, ensuring equitable distribution across the system, and lifting agricultural productivity by enabling more timely and reliable supply.

OBJECTIVES AND TECHNOLOGY IMPLEMENTATION

To deliver on these goals, the project implemented Total Channel Control (TCC) technology. This included the installation of over 4,200 automated measurement and control gates, a network of 15 repeater towers to ensure communication across remote terrain, and 60 micro-climate weather stations and soil moisture probes. A centralised digital control room enables network-wide visibility to monitor water delivery, allowing operators to respond to changing needs in real time.

CHALLENGES

Despite the scope and complexity, the project was completed within 48 months, even with delays caused by the COVID-19 pandemic. Its success was made possible through close collaboration between KBJNL (a Government of Karnataka enterprise) and the private sector, as well as ongoing training for local operators and engagement with the farming community.



Figure 2: COVID period posed critical challenges for project progress.

IMPLEMENTATION STRATEGY AND COLLABORATIVE APPROACH

The outcomes of the NLBC project have been significant. Based on current system performance (partial system automation), the network has demonstrated a water conservation potential of 1.35 million megalitres annually. Crop yield improvements of approximately 30% have been reported by farmers in both the Rabi and Kharif seasons, with even greater improvements anticipated as the network approaches full autonomous operation.

Around one lakh hectares of previously unserviceable or waterlogged land is now being irrigated again. More than 80% of distributaries are delivering equitable flows to the tail end of the system, while end-of-system spills have reduced by 90%—an outcome that has historically eluded traditional management approaches. Over 1,000 skilled and semi-skilled jobs were created during implementation, and the automation of the system has improved safety by reducing hazards associated with manual gate operation.

From a community perspective, the NLBC project has shown that automation does not remove the role of people in water management. Rather, it transforms it by creating new opportunities for skilled, technical employment in rural areas—roles that support long-term operation and the digital integration of modern irrigation systems. By embedding these roles within local communities, the project is helping build regional capacity and retain talent outside urban centres. The NLBC experience offers a practical blueprint for integrating technology with local knowledge to deliver sustainable, people-centred outcomes.

While the NLBC project is situated in India, its design and outcomes are aligned with a broader international trend toward smart irrigation transformation. Similar deployments globally demonstrate both the scalability of these systems and their capacity to generate meaningful results across different climatic, economic, topographical, and institutional contexts.

GLOBAL COMPARISONS AND BENCHMARKS

In Northern Italy, for instance, automation of a pumped canal system led to a 29% reduction in electricity usage, saving 500 MWh and around €300,000 annually. In Australia's Murray-Darling Basin, canal modernisation enabled the recovery of over 430 gigalitres of water annually, surpassing initial targets and creating water savings that supported both environmental and agricultural needs (Premier of Victoria, 2022). At the farm scale, a maize grower in Victoria doubled productivity per mega-litre while reducing water use by 20%, attributed to the integrated surface irrigation automation and reliable on-demand delivery (Moller, 2024).

These examples—especially as witnessed in Karnataka—reinforce both the national and global applicability of canal automation. These projects carry the added advantage of being gravity-fed, meaning that when properly automated, they reduce dependence on pumped groundwater and avoid additional energy inputs. This aligns directly with India's goals to reduce pressure on aquifers, increase the productivity of existing infrastructure, and support national food security

POLICY ALIGNMENT AND REPLICATION PATHWAY

To replicate this success nationwide, canal automation must align with India's Water Vision 2047 (Ministry of Jal Shakti, 2023). A gravity-first strategy, as followed in Karnataka, prioritises upgrading existing networks before investing in pressurised systems. Automation facilitates demand-based irrigation and empowers farmers to adopt higher-value cropping systems. Government programs like AIBP, PMKSY, SIMP, and MCAD should standardise the inclusion of canal automation in Detailed Project Reports to ensure consistency. Water Tech demonstration clusters in each agro-climatic zone can serve as knowledge and training hubs, while public-private-producer partnerships involving Farmer Producer Organisations can help create shared ownership, strengthen education, and build long-term resilience.

A BLUEPRINT FOR SUSTAINABLE AND INCLUSIVE IRRIGATION

The NLBC modernisation project demonstrates that canal automation is not only technically feasible—it is economically sound, environmentally sustainable, and socially inclusive. It delivers tangible outcomes that support the future of rural communities and, at a macro scale, the agricultural output of the nation. India is not merely adopting international best practices but is actively contributing to a global benchmark for sustainable water management—securing the future prosperity of irrigated agriculture and the communities it sustains.

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