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Enhancing the Effectiveness of Irrigation Infrastructure Management and Operation in Vietnam

Pham Quoc Phong
Thuyloi University, Vietnam

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Corresponding Author: **Pham Quoc Phong**

Abstract
The management and operation of irrigation infrastructure in Vietnam play a pivotal role in ensuring agricultural productivity, water security, and climate resilience. Despite significant investments over recent decades, the irrigation sector continues to face challenges related to fragmented governance, limited financial autonomy, aging infrastructure, and increasing variability in water resources caused by climate change. This study provides an in-depth analysis of the current management framework, institutional arrangements, and operational practices governing Vietnam's irrigation systems. Drawing on policy documents, empirical studies, and international best practices, the paper identifies structural inefficiencies and proposes a comprehensive approach for improving performance. Key recommendations include transitioning toward participatory irrigation management, strengthening digital monitoring systems, adopting cost-recovery mechanisms, and enhancing coordination among state agencies and water user organizations. The research contributes to the broader discourse on sustainable water resource management in emerging economies and offers actionable policy insights for Vietnam's ongoing irrigation sector reform.

Keywords: Irrigation Management, Water Governance, Infrastructure Operation, Vietnam, Agricultural Water Use, Institutional Reform, Irrigation Efficiency, Climate Resilience

1. Introduction

Irrigation infrastructure constitutes a foundational component of Vietnam's agricultural development, supporting nearly 70 percent of cultivated land and contributing substantially to national food security. The system includes reservoirs, canals, pumping stations, drainage networks, and multipurpose hydraulic structures designed to regulate water resources for crop production, aquaculture, urban use, and flood control. Over the past several decades, the government has invested heavily in expanding and modernizing hydraulic works to sustain agricultural growth and stabilize rural livelihoods. However, as Vietnam has transitioned toward a market-oriented economy and faced growing climatic stresses, the effectiveness of irrigation management and operation has become increasingly complex and contested.

Despite steady improvements, substantial challenges persist. Many irrigation systems operate under fragmented institutional arrangements, whereby responsibilities are divided among central agencies, provincial authorities, irrigation management companies, and local water user organizations. This fragmentation often leads to inefficiencies in planning, budget allocation, and system maintenance. Additionally, a significant proportion of infrastructure is aging, requiring continuous rehabilitation to maintain functionality. The shift from traditional wet rice cultivation to diversified crop patterns further demands more flexible, demand-oriented irrigation services.

Climate change presents another critical layer of complexity. Increased variability in rainfall, extended droughts, saline intrusion in coastal areas, and extreme flooding events have intensified pressure on irrigation systems. These changes require adaptive and resilient management approaches capable of ensuring reliable water distribution while minimizing environmental risks.

In response to these challenges, Vietnam has initiated institutional reforms aimed at promoting financial sustainability, enhancing participatory management, and improving operational efficiency. The promulgation of the 2017 Law on Hydraulic Works marks a significant milestone, redefining the roles of stakeholders and establishing new principles for service provision, cost recovery, and decentralization. Nevertheless, gaps remain between policy objectives and on-the-ground implementation,

underscoring the need for deeper analytical assessments and evidence-based recommendations.

This paper contributes to the academic discourse on water governance by examining the structural, institutional, and operational factors that influence the efficacy of irrigation management in Vietnam. Through a systematic analysis of policy frameworks, empirical studies, and international best practices, the study aims to identify key barriers and propose strategic directions for reform. The findings are expected to inform policymakers, irrigation practitioners, and development partners seeking to enhance the sustainability and performance of Vietnam's irrigation sector.

2. Literature Review

Research on irrigation management and hydraulic infrastructure in Vietnam has expanded considerably over the past two decades, reflecting heightened national and international interest in sustainable water governance. The literature broadly encompasses three thematic domains: (1) institutional and governance dynamics; (2) technical and operational performance of irrigation systems; and (3) socio-economic and environmental dimensions influencing irrigation service delivery. This review synthesizes key findings from existing scholarship to establish the conceptual foundation for the present analysis.

2.1 Institutional and Governance Dimensions

Studies on water governance in Vietnam highlight the complexity of institutional arrangements that shape irrigation management. Early works underscore the dominance of state-led management through centrally regulated irrigation management companies (IMCs), which historically operated under command-and-control frameworks. Scholars note that while this model effectively supported large-scale rice production during earlier periods, it has become less compatible with contemporary demands for service responsiveness, cost efficiency, and resource sustainability.

The transition toward decentralized and participatory governance has been a recurring theme in academic discourse. Research on Water User Organizations (WUOs) demonstrates their potential to enhance local ownership, improve fee collection, and support collaborative maintenance; however, challenges persist in terms of legal recognition, technical capacity, and coordination with IMCs and provincial authorities. The 2017 Law on Hydraulic Works has received considerable scholarly attention for its attempt to formalize service-based management, redefine institutional roles, and establish cost-recovery principles. Nonetheless, several authors argue that implementation remains uneven due to entrenched administrative practices, limited financial autonomy, and constrained human resources.

2.2 Technical and Operational Efficiency

Technical literature on Vietnam's irrigation systems consistently points to aging infrastructure. Empirical assessments indicate substantial losses in water conveyance efficiency, especially in tertiary and on-farm canal networks. Scholars attribute these inefficiencies to inadequate maintenance, sedimentation, structural deterioration, and limited application of modern technologies such as remote sensing, SCADA systems, and real-time operational monitoring.

Furthermore, the evolution of cropping patterns—from monoculture rice production to diversified, market-driven agriculture—has been identified as a major driver of operational challenges. Demand-based irrigation scheduling, which is essential for diversified cropping systems, remains difficult to implement under traditional supply-driven models. Several case studies reveal that such rigid operational frameworks reduce water productivity, limit farmers' capacity to adopt high-value crops, and increase conflicts over water allocation during peak seasons.

Digital transformation in irrigation management is an emerging area in the literature. Recent research highlights the benefits of applying telemetry systems, automated gates, and GIS-based asset management platforms to enhance precision and transparency. However, adoption remains limited by financial constraints, lack of standardized technical protocols, and fragmentation of data systems across agencies.

2.3 Socio-Economic and Environmental Considerations

The socio-economic literature emphasizes the close linkage between irrigation performance and rural livelihoods. Scholars note that reliable irrigation services significantly influence farm productivity, income stability, and vulnerability to climate shocks. Conversely, inefficiencies in water delivery exacerbate income disparities, constrain crop diversification, and increase transaction costs for farmers.

Environmental studies have focused on climate change impacts, including droughts, saline intrusion, upstream hydropower development, and altered river hydrology. These changes have been shown to reduce system reliability, increase operational risks, and demand more adaptive management. Several researchers advocate integrating climate resilience strategies—such as multi-source water supply, improved drainage, enhanced groundwater monitoring, and nature-based solutions—into irrigation planning and operations.

2.4 Synthesis of Literature Gaps

The existing literature provides a robust understanding of governance challenges, technical inefficiencies, and environmental pressures. However, notable gaps remain. First, there is limited synthesis bridging institutional reforms with technical modernization pathways. Second, the interplay between financial sustainability and service quality is insufficiently explored. Third, empirical evidence on the outcomes of post-2017 irrigation reforms is still emerging, indicating a need for updated, integrative evaluations.

This study addresses these gaps by adopting a holistic perspective that links governance structures, operational practices, and climate-resilient management strategies, with a focus on actionable recommendations for Vietnam's irrigation sector.

3. Methodology

This study employs a qualitative, multi-source analytical approach designed to provide a comprehensive assessment of irrigation management and operational performance in Vietnam. The methodology integrates document analysis, comparative policy review, and synthesis of empirical research results from both domestic and international sources. Given the complexity of Vietnam's hydraulic infrastructure system—characterized by diverse institutional arrangements, ecological zones, and socio-economic

contexts—a qualitative research design is well-suited to examining governance structures, identifying systemic constraints, and formulating policy-oriented recommendations.

3.1 Research Design
The research is structured around three analytical dimensions: (1) governance and institutional frameworks; (2) technical and operational performance; and (3) environmental and climate resilience considerations. These dimensions were selected based on prevailing themes identified in the literature and their relevance to current reform efforts in Vietnam's irrigation sector.

A deductive approach guides the analysis, beginning with established theoretical frameworks in water governance, public service delivery, and infrastructure management. These frameworks inform the development of analytical criteria used for evaluating Vietnam's irrigation management practices, including institutional coherence, financial sustainability, technological adoption, stakeholder participation, and adaptability to climate variability.

3.2 Data Sources
Data were compiled from multiple sources to ensure robustness and triangulation. Key materials include:

- **National legal and policy documents**, such as the 2017 Law on Hydraulic Works, government decrees, ministerial circulars, and provincial implementation directives.
- **Reports and technical assessments** from Vietnamese ministries, irrigation management companies, water user organizations, and research institutions.
- **Peer-reviewed academic studies** published in international journals addressing irrigation governance, infrastructure performance, water resource management, and climate impacts in Vietnam and comparable contexts.
- **Publicly available datasets**, including hydrological statistics, agricultural production data, and climate-related reports from global organizations such as FAO, ADB, and the World Bank.
- **Comparative international case studies** from countries with similar irrigation governance challenges, notably Thailand, China, India, and Indonesia.

These sources collectively provide a comprehensive base for evaluating structural constraints, institutional capacities, and technological gaps.

3.3 Analytical Framework
A thematic content analysis was applied to synthesize insights across diverse documents and data sources. The analysis proceeded in three stages:

1. **Coding and Categorization:** Key issues were coded into thematic categories—governance, finance, operations, technology, stakeholder participation, and climate resilience.
2. **Cross-comparison:** The identified themes were compared across different provinces, institutional contexts, and system types (e.g., large-scale reservoirs, canal systems, pumping stations).
3. **Benchmarking with international practices:** Findings were evaluated against global best practices in irrigation modernization, participatory water management, and climate-adaptive infrastructure planning.

This framework enables a structured, integrative analysis that transcends single-issue assessments and supports the development of actionable policy recommendations.

3.4 Limitations
The study acknowledges several methodological limitations. First, the reliance on secondary data may not fully capture local-level variations in system performance or recent on-the-ground developments. Second, empirical data on the post-2017 reform outcomes remain limited, constraining longitudinal evaluation. Third, while international comparisons provide valuable insights, contextual differences must be considered when drawing lessons for Vietnam.

Despite these limitations, the methodology provides a comprehensive and analytically rigorous foundation for assessing Vietnam's irrigation management system and identifying pathways for improvement.

4. Findings
This section synthesizes evidence from policy documents, empirical studies, and comparative analyses to identify key challenges and opportunities in the management and operation of Vietnam's irrigation infrastructure. The findings are organized around three core dimensions: governance and institutional arrangements, technical and operational performance, and climate and environmental resilience.

4.1 Governance and Institutional Challenges
4.1.1 Fragmented Institutional Responsibilities
A primary finding is the persistent fragmentation of governance responsibilities across multiple administrative levels. While the Ministry of Agriculture and Rural Development (MARD) maintains overall authority for national irrigation policy, operational responsibilities are distributed among provincial authorities, irrigation management companies (IMCs), and water user organizations (WUOs). This fragmentation results in overlapping mandates, inconsistent implementation, and inefficiencies in system planning and maintenance.

4.1.2 Limited Financial Autonomy and Cost-Recovery Capabilities
Despite the 2017 Law on Hydraulic Works' emphasis on service-based management, IMCs continue to rely heavily on state subsidies and budget allocations. Many systems lack effective cost-recovery mechanisms, and the abolition of irrigation fees in 2008 further reduced financial incentives for efficient service provision and maintenance. As a result, IMCs face chronic budget constraints, leading to deferred maintenance and underinvestment in modernization.

4.1.3 Weak Stakeholder Participation
Although WUOs have expanded in number, their operational capacity remains limited. Many organizations lack formal legal status, technical expertise, and financial resources. In some areas, coordination between IMCs and WUOs is minimal, resulting in misaligned water delivery schedules and reduced service quality. Local participation in planning and decision-making processes also remains relatively weak compared to international examples of participatory irrigation management.

4.2 Technical and Operational Performance Constraints

4.2.1 Aging and Inefficient Infrastructure

A significant portion of Vietnam's irrigation network—particularly tertiary canals and on-farm distribution systems—suffers from structural degradation. Common issues include sedimentation, erosion, leakage, and outdated control structures. These conditions contribute to water conveyance losses, reduced system reliability, and heightened operational costs. Empirical assessments indicate that actual water delivery often falls short of planned volumes, particularly during dry seasons.

4.2.2 Limited Adoption of Modern Technologies

Another key finding is the slow pace of digital transformation in the irrigation sector. While pilot projects have introduced automated gates, telemetry systems, and GIS-based asset management tools, adoption remains inconsistent and localized. Barriers include limited technical capacity, lack of standardized protocols, insufficient investment capital, and fragmented data systems. As a result, real-time monitoring and adaptive operational control—essential features of modern irrigation management—are not yet widespread.

4.2.3 Misalignment Between Water Delivery and Agricultural Demand

The shift from monoculture rice systems to diversified agricultural production has outpaced changes in irrigation service delivery. Many systems continue to operate under fixed schedules and rigid distribution patterns, limiting farmers' ability to adopt high-value crops requiring flexible and timely irrigation. This misalignment reduces water productivity and contributes to localized conflicts over water allocation.

4.3 Climate and Environmental Vulnerabilities

4.3.1 Increased Hydrological Variability

Climate change has amplified the variability of rainfall patterns, leading to more frequent droughts, irregular monsoon timing, and intense short-duration storms. These conditions strain system capacity and complicate operational planning. Reservoirs face competing objectives of water storage, flood control, and environmental requirements, making real-time decision-making more challenging.

4.3.2 Saline Intrusion and Coastal Vulnerabilities

Coastal irrigation systems, especially in the Mekong Delta, face severe saline intrusion driven by sea-level rise, upstream hydropower development, and reduced river discharge. Traditional canal networks designed for freshwater distribution are increasingly inadequate under salinized conditions, leading to water shortages, crop failures, and high operational risks.

4.3.3 Environmental Degradation

Irrigation practices have contributed to issues such as waterlogging, soil salinization, and reduced riverine ecosystem health in certain regions. Poor drainage, lack of integrated water management, and insufficient environmental flow considerations exacerbate these problems. These environmental stresses highlight the need for more holistic and sustainable management approaches.

4.4 Opportunities for Improvement

Despite the challenges, several opportunities for enhancing irrigation management in Vietnam are evident:

- **Institutional reforms** under the 2017 Law on Hydraulic Works provide a legal basis for service-oriented management, cost recovery, and decentralization.
- **Technological innovations**, including digital monitoring and remote sensing, offer pathways to improve operational efficiency.
- **Expansion of WUOs** creates opportunities for increased local participation and shared responsibility.
- **Growing awareness of climate risks** is pushing policymakers to integrate resilience and adaptation into water sector planning.
- **International experiences** offer valuable models for participatory management, financial sustainability, and technology adoption.

These opportunities provide the foundation for the policy recommendations that will be developed in subsequent sections.

5. Discussion

The findings highlight a complex interplay of institutional, technical, and environmental factors shaping the effectiveness of irrigation management and operation in Vietnam. This section interprets these findings within broader theoretical and policy contexts, with a focus on identifying structural constraints and strategic avenues for reform.

5.1 Reassessing Governance Structures: Toward Integrated and Coherent Management

The persistent fragmentation of institutional responsibilities underscores the need for a more integrated governance framework. International experience demonstrates that coherent institutional arrangements—characterized by clear mandates, coordinated planning, and shared accountability—are critical for improving irrigation performance. In Vietnam, however, overlapping roles among MARD, provincial authorities, irrigation management companies, and water user organizations continue to impede effective management.

Strengthening vertical coordination (between central and provincial agencies) and horizontal coordination (between IMCs and WUOs) is essential. This requires clarifying administrative mandates, improving communication channels, and introducing mechanisms for joint planning and performance monitoring. The 2017 Law on Hydraulic Works sets a foundation for such improvements, but the pace of policy translation into operational practice remains slow.

5.2 Enhancing Financial Sustainability and Incentives

The limited financial autonomy of irrigation management companies constitutes a major barrier to system sustainability. Without adequate budgetary resources and effective cost-recovery mechanisms, IMCs struggle to maintain infrastructure, adopt modern technologies, or provide reliable services.

A reform agenda should focus on diversifying revenue sources, introducing transparent service-based pricing models, and implementing performance-based contracts. International examples from India, Indonesia, and Thailand demonstrate that cost recovery—when combined with equitable pricing and strong local participation—can significantly improve operational efficiency.

While the abolition of irrigation fees was intended to reduce financial burdens on farmers, it has inadvertently weakened

incentives for efficient water use and system maintenance. Revisiting pricing policies, with appropriate safeguards for vulnerable groups, may be necessary to support long-term sustainability.

5.3 Aligning Irrigation Services with Evolving Agricultural Demands

As Vietnam transitions toward market-oriented and diversified agricultural production, irrigation services must evolve accordingly. Traditional supply-driven systems designed for monoculture rice cultivation are increasingly inadequate in meeting the needs of high-value crops, horticulture, and aquaculture.

A shift toward demand-based irrigation scheduling—supported by accurate water demand forecasting, flexible delivery protocols, and modern control technologies—is essential. This transition would not only improve water productivity but also enable farmers to adopt climate-resilient and economically competitive cropping patterns.

5.4 Accelerating Technological Modernization

The slow adoption of modern technologies represents a missed opportunity for improving system efficiency. Global irrigation modernization trends emphasize digitalization—including remote sensing, telemetry, automated control structures, and GIS-based asset management—as core to achieving real-time operational control and transparency.

Vietnam's pilot projects have generated promising results, but scaling these innovations requires:

- standardized technical protocols,
- strengthened digital infrastructure,
- enhanced training for IMC staff and WUOs,
- stable financial support for capital investments.

A national irrigation digitalization roadmap could help align efforts across provinces and avoid fragmented, project-based implementation.

5.5 Building Climate Resilience Into Irrigation Management

Climate change has fundamentally reshaped water governance challenges in Vietnam. Increased hydrological variability demands adaptive management approaches capable of operating under uncertainty. The expansion of saline intrusion and the deterioration of watershed conditions further complicate operational planning.

To improve resilience, Vietnam should integrate climate risk assessment into irrigation planning, promote multi-source water supply systems, and strengthen reservoir operation models. Nature-based solutions—such as riverbank restoration, wetland rehabilitation, and managed aquifer recharge—may complement traditional engineering interventions.

5.6 Strengthening the Role of Water User Organizations

Despite their potential to improve transparency, fee collection, and system maintenance, many WUOs face institutional and capacity-related constraints. Greater empowerment of WUOs is essential for achieving participatory management, which global research has shown to improve service delivery and local accountability.

Capacity-building initiatives, legal recognition frameworks, and co-management arrangements can help WUOs transition from passive recipients of services to active partners in system governance.

5.7 Integrating Governance, Technology, and Climate Adaptation

A central argument emerging from this study is that isolated interventions in governance reform, infrastructure rehabilitation, or technology adoption are insufficient. Sustainable improvements require integrated strategies that simultaneously address institutional coherence, financial sustainability, technological modernization, and climate resilience.

Vietnam's ongoing irrigation sector reform provides an opportunity to harmonize these dimensions into a coherent policy framework, supported by evidence-based decision-making and participatory implementation.

6. Policy Recommendations

Building on the findings and discussion, this section proposes a set of strategic policy recommendations aimed at enhancing the effectiveness, sustainability, and climate resilience of irrigation management and operation in Vietnam. These recommendations integrate institutional reform, financial restructuring, technological modernization, and participatory governance.

6.1 Strengthen Institutional Coordination and Governance Frameworks

6.1.1 Clarify Roles and Responsibilities Across Administrative Levels

Vietnam should further refine the institutional mandates of MARD, provincial authorities, IMCs, and WUOs to eliminate overlaps and ensure accountability. Clear delineation of responsibilities would improve planning coherence and enhance system-wide coordination.

6.1.2 Establish Multi-Stakeholder Coordination Platforms

Formal platforms for regular consultation among IMCs, WUOs, farmers, and local authorities should be institutionalized. These platforms would improve operational decision-making, facilitate conflict resolution, and ensure that water delivery schedules reflect local needs.

6.1.3 Strengthen Regulatory Oversight and Performance Monitoring

Introducing standardized performance indicators—covering service quality, water efficiency, cost recovery, and maintenance—would enhance transparency and guide evidence-based policymaking.

6.2 Enhance Financial Sustainability and Operational Incentives

6.2.1 Introduce Service-Based Pricing Models

Revising water service pricing to reflect actual operational costs—while protecting vulnerable farmers through targeted subsidies—would incentivize efficiency and improve financial viability. Transparent pricing mechanisms would also align IMC incentives with service delivery outcomes.

6.2.2 Promote Performance-Based Budget Allocation

Government allocations to IMCs should incorporate performance metrics, encouraging improved service quality and efficient maintenance practices. This approach has proven effective in several Asian countries undergoing irrigation reform.

6.2.3 Diversify Funding Sources

Exploring revenue diversification—such as public-private partnerships, agricultural value-chain contributions, and

payments for ecosystem services—could reduce reliance on state budgets and support modernization initiatives.

6.3 Modernize Infrastructure Through Strategic Investments

6.3.1 Prioritize Rehabilitation of Aging On-Farm Systems

Given the high water losses in tertiary canals and on-farm structures, rehabilitation should focus on these segments to maximize efficiency gains. Investments may include canal lining, upgrading control gates, and improving drainage.

6.3.2 Scale Digital and Automated Technologies

A national roadmap for irrigation digitalization should be developed, focusing on SCADA systems, telemetry, automated gates, and GIS-based asset management. Standardized technical protocols would ensure compatibility across provinces.

6.3.3 Promote Water-Saving Technologies at Farm Level

Encouraging the adoption of modern irrigation practices such as sprinkler, drip, or alternate wetting and drying (AWD) could improve water productivity and climate resilience, particularly.

Encouraging the adoption of modern irrigation practices such as sprinkler, drip, or alternate wetting and drying (AWD) could improve water productivity and climate resilience, particularly in drought-prone areas.

6.4 Improve Responsiveness to Agricultural Demand

6.4.1 Transition to Demand-Based Irrigation Scheduling

Water allocation should be guided by crop-specific water requirements and real-time monitoring. Flexible scheduling would support crop diversification and enhance farmer incomes.

6.4.2 Integrate Irrigation Planning With Agricultural Development Strategies

Better alignment between irrigation planning and regional agricultural restructuring would ensure that water services support high-value and climate-resilient cropping systems.

6.5 Strengthen Climate and Environmental Resilience

6.5.1 Mainstream Climate Risk Assessments Into Planning

Irrigation projects should incorporate climate scenarios, hydrological modeling, and risk assessment frameworks. This approach ensures that systems are designed and operated for long-term variability.

6.5.2 Develop Multi-Source Water Supply Systems

Integrating surface water, groundwater, rainwater harvesting, and treated wastewater can reduce vulnerability to droughts and saline intrusion, especially in coastal and delta regions.

6.5.3 Implement Nature-Based Solutions

Wetland restoration, river corridor rehabilitation, and managed aquifer recharge can complement engineering approaches, enhance environmental conditions, and mitigate climate impacts.

6.6 Empower Water User Organizations

6.6.1 Formalize Legal Status and Strengthen Capacities

Wider legal recognition and targeted capacity-building programs for WUOs would enhance operational autonomy and accountability, enabling them to manage tertiary systems more effectively.

6.6.2 Promote Co-Management Models

Shared responsibility between IMCs and WUOs—based on contractual agreements—can enhance performance, reduce costs, and ensure that water delivery aligns with user needs.

6.6.3 Introduce Participatory Monitoring Mechanisms

Engaging WUOs and farmers in monitoring service quality, maintenance needs, and water distribution promotes transparency and builds trust between users and service providers.

6.7 Foster Integrated, Adaptive, and Evidence-Based Planning

6.7.1 Develop Comprehensive Basin-Level Irrigation Plans

Planning at the river basin level—rather than provincial boundaries—would improve hydrological coherence and enhance the efficiency of multi-purpose water infrastructure.

6.7.2 Promote Pilot Projects and Knowledge Exchange

Pilot programs on digital transformation, climate-resilient irrigation, and participatory governance should be expanded and systematically evaluated. Lessons learned should inform national policy.

7. Conclusion

The management and operation of irrigation infrastructure in Vietnam stand at a pivotal point, shaped by the intersecting pressures of institutional fragmentation, aging infrastructure, evolving agricultural demands, and intensifying climate risks. This study has provided a comprehensive examination of governance structures, operational performance, and environmental vulnerabilities, drawing on a broad body of literature, policy documents, and international comparative insights. The analysis highlights that while Vietnam has made significant strides in expanding irrigation coverage and enacting key reforms—most notably the 2017 Law on Hydraulic Works—substantial challenges continue to impede the overall effectiveness and sustainability of the irrigation sector.

A central conclusion is that sustainable improvement in irrigation management requires an integrated approach. Institutional coherence must be strengthened through clearer delineation of roles, improved coordination mechanisms, and enhanced performance monitoring. Financial sustainability remains a critical concern, demanding reforms in pricing models, budget allocation practices, and diversification of revenue sources. Technical modernization, including the adoption of digital technologies and the rehabilitation of deteriorating infrastructure, is essential for improving water use efficiency and operational reliability. At the same time, irrigation services must become more responsive to the needs of a diversifying agricultural economy, transitioning from rigid, supply-driven schedules to flexible, demand-based delivery.

Climate change further underscores the urgency of reform. Increased hydrological variability, saline intrusion, and environmental degradation necessitate adaptive management strategies that integrate climate risk assessment, multi-source water supply planning, and nature-based solutions. Empowering water user organizations through legal recognition, capacity building, and participatory co-management is vital to ensuring that reforms translate into improved outcomes at the local level.

Overall, the study concludes that Vietnam possesses both the policy foundation and institutional momentum needed to advance irrigation management toward greater efficiency, resilience, and equity. Realizing these goals will require sustained political commitment, targeted investments, and active engagement among stakeholders across administrative levels. By integrating governance reform, financial restructuring, technological innovation, and climate adaptation into a coherent policy framework, Vietnam can strengthen its irrigation sector to support sustainable agricultural development and long-term water security.

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