

FROM IMT/ PIM TO WATERSHED DECISIONS: A REFRAMING APPROACH TO IRRIGATION GOVERNANCE

DE L'IMT/PIM AUX DÉCISIONS LIÉES AUX BASSINS VERSANTS : UNE APPROCHE DE RECADRAGE DE LA GOUVERNANCE DE L'IRRIGATION

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ABSTRACT

Despite the relative success of Irrigation Management Transfer (IMT) and Participatory Irrigation Management (PIM) at the scale of irrigation schemes and projects, these approaches have proven inadequate in addressing systemic crises at the river basin scale. Drawing on the concept of reframing, this paper conceptualizes a transition from network-based governance to integrated basin governance. Within this perspective, distributive justice, sustainable development, and intergenerational justice are framed as overarching normative goals. The paper shows how current PIM/IMT practices may face limitations in achieving inclusive participation, and how phenomena such as the rebound effect, in the absence of multilevel governance, can turn gains in water-use efficiency into outcomes that undermine basin sustainability.

Methodologically, the study adopts a conceptual and critical review approach and develops a two-phase reframing of IMT/PIM. The first phase expands assessment at the irrigation-network level through a learning-oriented use of Social Impact Assessment (SIA), while the second phase repositions IMT/PIM within basin-scale, polycentric, and multilevel water governance supported by water social auditing and basin accounting. By critically reviewing international experience and introducing water social auditing and Social Impact Assessment (SIA) as learning-oriented rather than merely procedural tools, the study proposes a new conceptual framework for improving implementation practices and aligning bottom-up and top-down perspectives. It concludes by offering specific policy recommendations to facilitate this transition.

Keywords: reframing, rebound effect, Social Impact Assessment, water social auditing, polycentric governance, intergenerational justice.

RESUME

Malgré le succès relatif du transfert de la gestion de l'irrigation (IMT) et de la gestion participative de l'irrigation (PIM) à l'échelle des périmètres irrigués et des projets d'irrigation, ces approches se sont révélées inadéquates pour répondre aux crises systémiques à l'échelle du bassin versant. En s'appuyant sur le concept de recadrage, cet article conceptualise une transition d'une gouvernance basée sur les réseaux à une gouvernance intégrée du bassin. Dans cette perspective, la justice distributive, le développement durable et la justice intergénérationnelle sont présentés comme des objectifs normatifs primordiaux. Le document montre comment les pratiques actuelles de PIM/IMT peuvent rencontrer des limites dans la réalisation d'une participation inclusive, et comment des phénomènes tels que l'effet de rebond, en l'absence de gouvernance à plusieurs niveaux, peuvent transformer les gains d'efficacité de l'utilisation de l'eau en résultats compromettant la durabilité du bassin.

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Sur le plan méthodologique, l'étude adopte une approche de revue conceptuelle et critique et développe un recadrage en deux phases des IMT/PIM. La première phase étend l'évaluation au niveau du réseau d'irrigation grâce à une utilisation orientée vers l'apprentissage de l'évaluation de l'impact social (SIA), tandis que la deuxième phase repositionne l'IMT/PIM dans une gouvernance de l'eau à l'échelle du bassin, polycentrique et à plusieurs niveaux, soutenue par l'audit social de l'eau et la comptabilité des bassins. En examinant de manière critique l'expérience internationale et en introduisant l'audit social de l'eau et l'évaluation d'impact social (SIA) comme des outils axés sur l'apprentissage plutôt que simplement procéduraux, l'étude propose un nouveau cadre conceptuel pour améliorer les pratiques de mise en œuvre et aligner les perspectives ascendantes et descendantes. Elle conclut en proposant des recommandations politiques spécifiques pour faciliter cette transition.

Mots-clés : Recadrage; Effet de rebond; Evaluation d'impact social; Audit social de l'eau; Gouvernance polycentrique; Justice intergénérationnelle.

1. INTRODUCTION

In recent decades, Irrigation Management Transfer (IMT) and Participatory Irrigation Management (PIM) have been widely adopted in many countries as dominant institutional reform models in the irrigation sector, aimed at decentralization, improving efficiency, and strengthening user participation (Vermillion, 1997; FAO, 2001; Garces-Restrepo et al., 2007). Nevertheless, the effectiveness of these models particularly in the absence of inclusive participation and equitable representation of stakeholders has been subject to serious doubt. Moreover, under intensifying water scarcity, climate change, and growing cross-sectoral competition over water resources, it has become evident that even successful implementation of these approaches at the local scale does not necessarily translate into sustainability at the basin scale (Molle, 2008; Pahl-Wostl, 2015; WWAP, 2024). Despite the water-management literature's shift toward participatory, integrated, and multi-level governance, practical implementation remains strongly shaped by path dependence and institutional lock-in; accordingly, responses to complex and emerging water challenges are still often framed through the established, project-based instruments of PIM and IMT (Rogers & Hall, 2003; North, 1990; Molle, 2008; Wester et al., 2005).

The problem is that these models typically stop at the project's physical and institutional boundaries and are unable to adequately represent the complexity of decision-making at the basin scale such as conflicts among agricultural, urban, industrial, and environmental uses; inequalities between those served by irrigation networks and those excluded from them; and the need to transmit local demands and knowledge to meso- and macro-level decision-making arenas (Molle & Berkoff, 2007; Darnhofer et al., 2014). Furthermore, improvements in water-use efficiency at the farm or scheme level, in the absence of integrated basin governance, may lead to a rebound effect—that is, efficiency gains may intensify total water use at the basin scale rather than reduce pressure on resources, thereby contributing to greater long-term unsustainability (Ingrao et al., 2023; Grafton et al., 2018). Experience also indicates that participation without genuine stakeholder inclusion, power balancing, and attention to disadvantaged groups can reproduce inequality, which in turn undermines the sustainability of participatory arrangements (Meinzen-Dick, 2007; Cleaver, 2012).

Accordingly, the central concern of this study is that the dominant paradigms of IMT/PIM, although they have served important economic and operational functions at the project level, are insufficient for addressing the complex, multi-level, and justice-oriented challenges of water governance at the basin scale. These limitations help explain why, in recent years, these approaches have lost part of their former prominence in global water policy. Nevertheless, in practice, they have continued to persist through path dependence and institutional inertia, and they are still routinely employed as default operational reference points, even under conditions in which basin-scale challenges require broader, more integrated responses that extend beyond the boundaries of individual projects. This continued reliance, despite the inadequacy of these approaches in responding to the aforementioned challenges, underscores the need to redefine and reposition them within a governance architecture suited to contemporary conditions of water scarcity and cross-scale interdependence. Consequently, these approaches must be reframed so that participatory irrigation management is understood and

operationalized not as the ultimate end of governance, but as one component of a polycentric and multi-level governance system—one capable of linking micro-level decisions to basin-scale imperatives and of grounding decision-making in distributive justice, sustainable development, and intergenerational equity (Ostrom, 2010; Pahl-Wostl, 2015). Within this framework, the present article addresses three analytical questions: first, why do IMT/PIM approaches that appear successful at the local level remain insufficient for confronting sustainability and justice challenges at the basin scale? Second, how can social impact assessment and water social auditing make visible the neglected distributive dimensions of irrigation reform? Third, what kind of institutional repositioning is required to connect irrigation management at the scheme level with participatory governance at the basin scale? By engaging these questions, the article seeks to offer a redefined conceptual framework that links irrigation governance to the normative and institutional requirements of decision-making at the river basin scale.

2. METHODOLOGICAL APPROACH TO REFRAMING IMT/PIM

This study seeks to employ reframing as a deliberate analytical intervention by developing a more precise understanding of what falls outside the dominant framing of IMT/PIM. In doing so, it aims to reopen the ways in which the problem is defined, relevant evidence is identified, and possible solutions are formulated in the field of IMT/PIM, thereby creating space for alternative interpretations and responses more consistent with the principles of participatory governance and the requirements of basin sustainability.

It should be emphasized that identifying frames and attempting to reframe them is important because frames are by no means neutral. Rather, they are cognitive devices for organizing and making sense of complex information through processes of selective emphasis; that is, they bring certain dimensions of a phenomenon to the center of attention while pushing others to the margins. Reframing therefore becomes necessary when the dominant frame is excessively narrow, reductionist, or incapable of adequately explaining the problematic dimensions of a complex issue (Kaufman et al., 2003). Under such circumstances, reframing is not merely a conceptual shift, but a precondition for redefining the problem and reconsidering the logic of intervention. In irrigation planning and infrastructure policy, dominant techno-economic frames tend to place hydraulic efficiency, engineering design, and financial indicators at the center of analysis, while relegating social, distributive, institutional, and basin-scale sustainability dimensions to a secondary position. Even in IMT/PIM projects, there is often a tendency to reduce the issue ultimately to a techno-economic problem, with evaluation criteria and “acceptable solutions” defined accordingly (Van Hulst et al. 2025; Dodge & Metze 2024). As a result, many of the issues that later emerge in the form of social conflict, distributive inequality, exclusion of less powerful groups, weak accountability, or unsustainability at the basin scale were not incorporated into the original problem frame from the outset. It is precisely this analytical engagement with such neglected dimensions that highlights the necessity of reframing.

Methodologically, the reframing undertaken in this study is structured as a conceptual and critical review. This review rests on three foundations: first, a systematic review of the theoretical literature on IMT/PIM, social impact assessment, and water governance; second, a critical analysis of operational experiences and implementation trajectories in international cases; and third, an analytical synthesis of social assessment frameworks at the irrigation network level and participatory water governance frameworks at the basin level. On this basis, reframing is treated not merely as a conceptual exercise, but as a methodological strategy for redefining the unit of analysis, expanding the range of observable variables, and recalibrating the criteria for evaluating intervention. In this paper, reframing specifically entails three analytical moves: shifting the unit of analysis from the irrigation scheme to the basin; shifting the criteria of success from operational efficiency alone to basin compatibility, justice, and sustainability; and introducing learning-oriented tools such as Social Impact Assessment and water social auditing in order to connect local implementation outcomes to wider governance effects. The supporting evidence is drawn primarily from operational reports, policy documents, and major evaluation studies produced by international institutions—particularly the World Bank, FAO, and IWMI—over the past quarter century. The review focuses on materials most relevant to irrigation reform, participatory governance, and basin-scale management, and the analytical synthesis is organized thematically around scale, participation,

distributive effects, and governance alignment. This approach makes it possible to revisit IMT/PIM as a multi-scalar phenomenon with socio-institutional implications at the network level and participatory governance requirements at the basin scale.

As shown in **Figure 1**, the reframing proposed in this paper proceeds in two linked phases: first, a socially expanded assessment of irrigation management at the network level; and second, an institutional and hydrological repositioning of IMT/PIM within basin-scale governance.

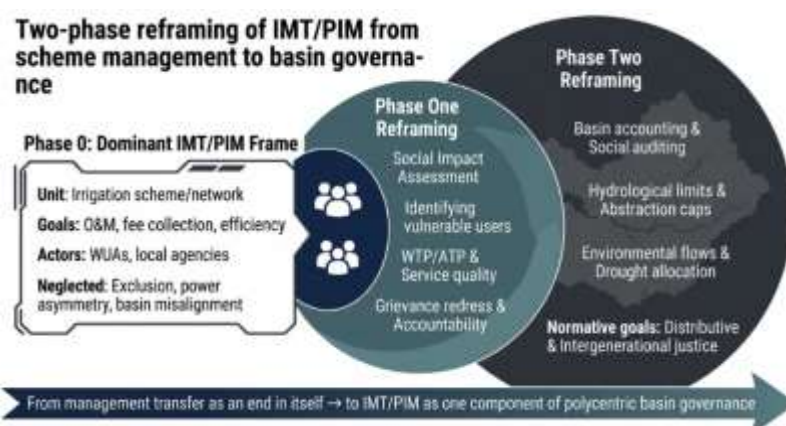


Figure 1. Two-phase reframing of IMT/PIM from scheme management to basin governance

3. THE LIMITS OF IMT/PIM IN ADVANCING PARTICIPATORY WATER GOVERNANCE

Since the 1980s, in response to technical inefficiencies, deteriorating infrastructure, and the high operation and maintenance costs of state-managed irrigation systems, Participatory Irrigation Management (PIM) and Irrigation Management Transfer (IMT) have expanded as major institutional reform approaches in the water sector (Garces-Restrepo et al., 2007). In this context, PIM primarily emphasizes users' participation in operational decision-making, maintenance, and, in some cases, water distribution at the scheme level, whereas IMT refers to the formal transfer of selected operational, maintenance, and sometimes financial responsibilities from the state to local organizations, water user associations (WUAs), or other user-based institutions (Garces-Restrepo et al., 2007; Senanayake et al., 2015). The underlying rationale is that end users, because of their direct dependence on system performance, have stronger incentives to maintain infrastructure, reduce losses, and optimize water distribution (Vermillion & Sagardoy, 1999). Despite the widespread use of the term "participation," it is essential to distinguish irrigation system management from participatory water governance. PIM and IMT are primarily instruments for improving management at the level of schemes, canals, or distribution systems; however, they are not equivalent to participatory water governance and do not necessarily resolve the more complex issues of allocation, justice, and sustainability at the basin scale (Senanayake et al., 2015; Molle & Sanchis-Ibor, 2019). Participatory water governance extends beyond the delegation of technical functions and requires effective power-sharing, transparent decision-making, institutional accountability, conflict-resolution mechanisms, and explicit attention to social and environmental justice (Mollinga, 2001).

As shown in Table 1, comparative evidence indicates that PIM/IMT reforms often remain confined to the project or scheme scale and generally lack the authority or capacity required to address broader water-governance challenges, including intersectoral water allocation, groundwater abstraction control, basin-scale drought management, environmental flow protection, and the resolution of inter-regional conflicts (Mukherji et al., 2009; Cambaza et al., 2020). This scalar disconnect means that even where scheme-level performance improves, hydrological and institutional sustainability at the basin scale is not necessarily secured. Moreover, comparative evidence suggests that many IMT/PIM programs have focused less on participatory governance and genuine local empowerment than on shifting operational and financial burdens from the state to water users (Merrey et al., 2002; Senanayake et al., 2015). Under such conditions, if management transfer is not accompanied by governance components such as

transparency, accountability, distributive justice, social inclusion, and legal support, a range of unintended consequences may emerge, including local elite capture, tokenistic farmer participation, the marginalization of smallholders and vulnerable groups, weak financial transparency, and the continued exclusion of women from key decision-making processes (Merrey et al., 2002; Mukherji et al., 2009; Cambaza et al., 2020). Therefore, transferring management to the local level without establishing the substantive foundations of participatory governance does not necessarily lead to distributive justice, long-term sustainability, or user empowerment. IMT/PIM should thus be understood as operational instruments in support of sustainable water governance, rather than as its equivalent. Their success depends on being embedded within broader frameworks such as integrated water resources management, transparent allocation rules, institutional accountability mechanisms, and effective linkages between the scheme and basin levels. Otherwise, management transfer may be reduced to a form of responsibility transfer without effective power transfer, in which users bear the costs of operation and maintenance while remaining excluded from the main arenas of authority and basin-scale decision-making.

Table 1. Selected comparative experiences of IMT/PIM and their basin-scale limitations and socio-structural challenges

Country / Region	Primary IMT/PIM focus	Basin-scale limitations	Socio-structural challenges
Mexico	Rapid transfer to WUAs; self-reliance and full fee collection	Intersectoral conflicts; weak legal standing of WUAs vis-a-vis industry; groundwater decline	Institutional capture by local elites; marginalization of smallholders
Türkiye	Rapid transfer to local organizations/municipalities to reduce state costs	Lack of integrated basin management; emphasis on physical maintenance; inability to enforce drought restrictions	Politicization of appointments and reduced accountability
Peru	Specialized institutions for physical upgrading and modernization	Fragmented resource management; weak coordination for maintaining environmental flows in Andean basins	Pressure to reduce tariffs; deferred maintenance and infrastructure deterioration
Madagascar	Rehabilitation conditional on 20 percent farmer contribution and high fee collection	Severe river-flow variability due to upstream deforestation	Exclusion of poor users unable to contribute cash or labor
Philippines	Multi-level participatory models; gradual transfer of canal management	Limited organizational capacity for basin-scale droughts; continued dependence on government	Upstream-downstream tensions; inequitable distribution during crises
Colombia	Transfer to private associations with emphasis on financial self-sufficiency	Disconnect between infrastructure management by associations and water resource management by the state	Low financial transparency; distrust and resistance to fee payment
Sudan	Transfer of secondary canal operation and maintenance to WUAs	Upstream control, including dams and main canals, remains with government; uncertainty in water deliveries	Limited participation of women in key decisions
China	Participation-oriented small-scale rural schemes to improve efficiency	Weak monitoring; limited basin-scale data on water quality and soil sustainability	Technical and knowledge gaps; organizational passivity vis-a-vis upstream decisions
India	Canal irrigation reforms and establishment of WUAs	Interstate tensions; neglect of conjunctive surface-groundwater management and aquifer decline	Reproduction of caste inequalities; vulnerability of tail-end users
Australia	Water markets and corporatized network management in the Murray-Darling Basin	Tension between network economic interests and basin ecological sustainability	Lobbying and local resistance to environmental reallocation

Iran	State-guided production cooperatives and WUAs in secondary networks	Path dependence; limited legal autonomy; exclusion from dam operation decision-making	Tokenistic participation; distrust and low social capital
Sub-Saharan Africa	Transfer aimed at reducing state costs; O&M transfer without sufficient capacity building or incentives	High costs of pump-based systems and energy; weak basin management and resource uncertainty; high drought vulnerability	Legacy of dependence on quasi-state institutions; weak credit and markets; insecure land and water rights; local capture risks; high vulnerability of smallholders

Source: Compiled by the author(s) based on Cambaza et al. (2020), Garces-Restrepo et al. (2007), Merrey et al. (2002), Molle and Sanchis-Ibor (2019), Mukherji et al. (2009), Senanayake et al. (2015), Vermillion and Sagardoy (1999), and Mollinga (2001).

Taken together, the comparative cases in Table 1 reveal a recurring pattern that supports the need for reframing. First, many IMT/PIM reforms exhibit a scalar disconnect: institutional improvements at the scheme level do not equip user organizations to engage effectively with basin-scale allocation, drought management, groundwater regulation, or environmental-flow protection. Second, the cases show repeated socio-structural vulnerabilities, including elite capture, exclusion of weaker users, gendered marginalization, and distrust linked to weak accountability. Third, even where formal transfer occurs, the legal and political authority required for meaningful participation in higher-level water decisions often remains elsewhere. These recurring patterns suggest that the central limitation of IMT/PIM is not simply uneven implementation, but the mismatch between project-bounded management reform and the multi-level nature of contemporary water governance challenges.

It is therefore useful to distinguish more clearly between the functions of Water User Associations (WUAs) and those of basin-level governance bodies. WUAs are typically designed to manage water distribution, operation, maintenance, and fee collection within a defined command area. Basin institutions, by contrast, are expected to address allocation across sectors and territories, hydrological limits, drought response, environmental requirements, and conflict resolution across scales. The challenge is not to collapse these functions into one another, but to build the institutional linkages through which scheme-level organizations can inform, participate in, and adapt to basin-level governance.

4. REVISITING IMT/PIM: INSIGHTS FROM A TWO-PHASE CONCEPTUAL REFRAMING

This section revisits IMT/PIM through a two-phase conceptual reframing designed to address the analytical limitations of conventional approaches. The first phase broadens the assessment at the irrigation network level, while the second extends the analysis to basin-scale participatory water governance.

To clarify the logic of the two-phase reframing, it is useful to state more explicitly that each phase addresses a different but connected governance problem. Phase One responds to the limits of techno-economic and scheme-bounded reform by expanding the assessment of irrigation management transfer through Social Impact Assessment and other socially sensitive design criteria. Phase Two responds to the limits of localized success by examining whether and how network-level arrangements are institutionally and hydrologically aligned with basin-scale sustainability requirements.

Accordingly, the first phase identifies the social and institutional conditions under which management transfer can become more inclusive, accountable, and socially sustainable at the network level. The second phase identifies the governance and allocation conditions under which such local arrangements can remain compatible with real water savings, abstraction limits, environmental needs, and cross-sectoral coordination at the basin level. Read together, the two phases do not replace IMT/PIM; rather, they reposition it within a broader governance architecture that is more responsive to scale, justice, and sustainability.

4.1 Phase One: Reframing Irrigation Management Transfer at the Network Scale with an Emphasis on Social Impact Assessment

The dominant approach to water and irrigation infrastructure development has largely relied on a techno-economic rationality, assuming that engineering design and cost-benefit analysis are sufficient for decision-making. The same logic is evident in water sector reforms, particularly when governments are unable or unwilling to fully finance irrigation systems and policies shift toward cost recovery, the user-pays principle, the establishment of water user associations, and the definition of clear agreements on service level and quality (Schultz & De Wrachien, 2002). However, this framework is often insufficiently sensitive to power relations, user heterogeneity, informal access to water, and the unequal distribution of costs and benefits. As a result, what appears technically and financially “rational” may in practice lead to distributive conflicts, reduced cooperation, mistrust, and institutional failure (Molle, 2009). Moreover, reliance on standardized governance models without adaptation to local realities can produce “formal institutions” that possess legal legitimacy but lack the capacity to address actual water governance problems (Mdee & Harrison, 2019; Shunglu et al. 2022).

At this point, the importance of Social Impact Assessment (SIA) becomes clear. In irrigation management transfer, the issue is not merely hydraulic efficiency or financial sustainability. Irrigation and drainage projects are often constructed with public financial support, and the question of who is recognized from the outset as a legitimate user, which groups are excluded, and how costs and benefits are distributed has a direct bearing on the success or failure of both the projects themselves and the subsequent reforms pursued under PIM/IMT. In this regard, the application of SIA—as a process for the systematic identification, prediction, management, and monitoring of the positive and negative, as well as intended and unintended, social consequences of planned interventions—can be highly valuable in irrigation and drainage projects (International Investment Bank, 2015; Kvam, 2018). By turning social data into a design input and linking engineering and financial objectives to local realities, this approach enables the early identification of risks such as inequality, social exclusion, and vulnerability. In doing so, it helps reduce adverse outcomes, strengthen conflict resolution, enhance ownership and participation, promote social sustainability in these projects, and ultimately facilitate irrigation management transfer and the development of participatory management (Dani, 2003; Asian Development Bank, 2007; Vanclay et al., 2015).

Furthermore, because management transfer usually involves the redefinition of use rights, decision-making rules, payment systems, and the procedures for water distribution and maintenance, its social impacts are often far deeper than commonly assumed. Since such reforms directly affect livelihoods, food security, and power relations at both farm and system levels (Garces-Restrepo et al., 2007), neglecting the social consequences of PIM/IMT can even undermine the technical performance of irrigation systems—for example, by intensifying head-tail conflicts or weakening cooperation in maintenance. Therefore, SIA should at a minimum focus on the following questions:

- Which groups are at risk of exclusion or loss, and what supportive mechanisms are needed to protect them (Asian Development Bank, 2007; Dani, 2003);
- How service quality, perceived value, and willingness and ability to pay are distributed across different parts of the system (Asian Development Bank, 2007); and
- What institutional arrangements are required to ensure meaningful participation, transparency, accountability, and grievance redress, so that cost recovery does not result in the exclusion of poorer users or the deepening of inequalities (Kvam, 2018; Vanclay et al., 2015).

Ultimately, management transfer should be understood as a socio-institutional reconfiguration whose success depends on ex ante assessment and continuous monitoring of social impacts, including through indicators such as willingness to pay (WTP) and ability to pay, in order to design supportive tariff structures and participatory, accountable governance mechanisms (Dani, 2003; Asian Development Bank, 2007; Vanclay et al., 2015; Garces-Restrepo et al., 2007; Molle, 2009).

4.2 *Phase Two: Reframing IMT/PIM at the Basin Scale: Why Network-Level Success Is Not Enough*

The second phase of reframing begins from a simple but consequential premise: even where IMT/PIM is implemented relatively successfully at the irrigation-network level, the broader problem of water management is not necessarily resolved. What counts as “success” at this scale—improved operation and maintenance, higher fee collection, more reliable water delivery, or stronger farmer participation—does not automatically align with sustainability, distributive equity, or resilience at the basin scale. In other words, IMT/PIM may perform well as a local management arrangement while remaining misaligned with basin-wide hydrological constraints and governance objectives, or even unintentionally intensifying pressure on the wider water system.

A first reason lies in the mismatch between the criteria of success at the network level and those relevant at the basin level. Within irrigation networks, performance is typically assessed through indicators such as improved water distribution, lower maintenance costs, or higher conveyance efficiency. At the basin scale, however, the more consequential questions concern real water consumption, the balance between surface water and groundwater, the preservation of return flows, and the allocation of water across sectors and places. Thus, a network may be managed more effectively in operational terms while simultaneously increasing pressure on basin water balances through expansion of irrigated area, intensification of production, or reduced return flows. The literature on the irrigation efficiency paradox shows clearly that gains in local efficiency do not necessarily translate into real water savings at the basin scale. Moreover, because IMT/PIM often strengthens organizations whose primary mandate is to secure water for their members within the command area, these institutions may become resistant to basin-scale restrictions such as abstraction cuts, drought reallocations, or environmental flow protections. In this sense, even locally successful institutions may remain incompatible with basin governance goals in the absence of effective cross-scale mechanisms (Grafton et al., 2018).

A second issue is that irrigation networks are not closed or self-contained units. They operate within broader socio-hydrological systems whose dynamics are shaped at the basin scale. Declining precipitation, rising evapotranspiration, groundwater depletion, shifting demand patterns, demographic growth, and changing allocation priorities all emerge beyond the network itself, yet directly affect its viability and performance. Schilling et al. (2020), for example, show that pressure on water resources in North Africa is not simply the outcome of weak local management, but of the combined effects of climate change, resource scarcity, structural dependence on agriculture, and uneven institutional capacities for adaptation. Under such conditions, even a well-organized irrigation network may face severe performance crises due to prolonged drought, declining reservoir inflows, or falling groundwater tables. Local institutional effectiveness, therefore, cannot by itself compensate for basin-scale ecological and political constraints.

For this reason, the analytical focus must shift from participatory management of irrigation networks to multi-level water governance, understood as the interaction between local institutions, basin arrangements, and higher-level policy structures (Ostrom, 2010; Pahl-Wostl, 2009). Yet the basin should not be treated as a neutral or self-evident unit of analysis. As Whaley (2022) argues, the basin is also a political-institutional construct in which the framing of problems, the legitimacy of actors, and the rules of decision-making are themselves contested. Linking IMT/PIM to the basin scale is therefore not simply a matter of adding a technical layer to existing arrangements. It requires rethinking the role of water user associations as actors involved in cross-scale coordination, allocation, negotiation, and basin-level decision-making. Lim et al. (2022) similarly show that many failures in integrated river basin management stem less from a lack of technical tools than from weak mechanisms for participation, organizational coordination, and joint decision-making.

Seen in this light, what must be evaluated is not only the internal performance of IMT/PIM within irrigation networks, but the reciprocal relationship between networks and basins: how local management outcomes affect basin sustainability and allocation, and how basin-level risks, constraints, and decisions shape the durability and effectiveness of local management. The core issue, then, is no longer merely management transfer, but institutional and hydrological alignment between local management and basin

governance. This requires moving beyond operational indicators alone and assessing IMT/PIM in ways that incorporate real water use, basin accounting, climate vulnerability, power relations, and multi-level decision-making structures (Mazzega et al., 2014; Neumann et al., 2011; Molle, 2009).

First, assessment of IMT/PIM performance should be connected to basin-scale water accounting and social water auditing. This is necessary to determine how local improvements affect real water consumption, return flows, groundwater abstraction, and the distributional and political consequences of water allocation. Without such a lens, network-level efficiency may be achieved at the cost of basin-scale unsustainability or inequality (Ward & Pulido-Velazquez, 2008; Grafton et al., 2018; Molle, 2009). **Second**, allocation and operational arrangements within irrigation networks should be recalibrated in relation to basin hydrological constraints and abstraction caps. Water user organizations should operate not merely on the basis of local demand or historically fixed entitlements, but in relation to ecological limits, drought risk, and the requirements of conjunctive surface–groundwater balance. Such proportional and hydrologically informed allocation is essential if local irrigation management is to remain compatible with basin sustainability under conditions of increasing climatic stress (Schilling et al., 2020; Parry (Ed.), 2007; Dessalegn et al., 2022).

Third, the institutional position of WUAs must be redefined. Rather than remaining confined to distribution and maintenance functions at the network level, they should be recognized as participants in multi-level, polycentric, and adaptive basin governance. This implies access to basin-balance information, involvement in allocation debates, and a role in coordination, learning, and cross-scale conflict resolution. Only through such institutional repositioning can a durable linkage be established between participatory irrigation management and the broader requirements of basin governance (Ostrom, 2010; Pahl-Wostl, 2009; Lim et al., 2022; Whaley, 2022).

DISCUSSION

The two-phase reframing proposed here moves beyond descriptive critique to clarify the analytical and normative requirements of basin-scale governance. The primary innovation is the repositioning of IMT/PIM: rather than standalone reform models, they are now viewed as subordinate, context-dependent components within a wider, polycentric governance architecture. This perspective resolves the tension between local irrigation efficiency and basin-scale sustainability by asserting that local management is only valid when aligned with, and nested within, broader hydrologic and social constraints.

A critical implication of this framework is the redefinition of “success.” Traditional IMT/PIM evaluation—focusing on water fee collection, infrastructure maintenance, or local participation—is insufficient in the face of basin-wide stressors. A reform program might be deemed successful by internal network metrics while simultaneously exacerbating unsustainable abstraction or widening social inequalities at the basin scale. Therefore, success must be measured through multi-scalar integration, where local management is continuously audited against its contribution to basin-wide water accounting and equitable distribution. The “rebound effect” serves as a central governance challenge here. Technical efficiency gains at the network level—such as lining canals or improved scheduling—often induce increased consumption or agricultural expansion if not constrained by robust basin-level allocation rules. This underscores the necessity of the second phase of our framework: local irrigation reforms cannot be dissociated from the hydrological oversight required to cap net abstractions and manage tradeoffs during scarcity.

Furthermore, operationalizing justice requires moving beyond abstract rhetoric toward structural inclusion. If irrigation reform is to remain relevant, it must explicitly engage with distributional impacts, representation, and accountability. This necessitates institutional mechanisms that allow local users not only to manage their networks but also to participate in the macro-level decisions that define the boundaries of their water rights. Consequently, the discursive shift from “transfer” to “governance integration” does not render IMT/PIM obsolete; rather, it makes their continued existence conditional upon their capacity to foster transparency, responsiveness, and fairness within a multi-level water governance system.

CONCLUSION AND POLICY RECOMMENDATIONS

This article argues that the future of irrigation reform lies in a shift from managerial transfer toward governance integration. By critically reviewing the evolution of IMT/PIM, we demonstrated that while these models succeeded in decentralizing specific operational tasks, they often remained “project-bounded,” failing to address systemic water crises at the river basin scale.

Our proposed two-phase reframing, (1) expanding network-level evaluation through learning-oriented Social Impact Assessment, and (2) embedding local institutions within polycentric, basin-level governance offers a pathway to bridge this gap. This approach ensures that local irrigation institutions remain relevant by aligning their practices with the imperatives of sustainability, resilience, and equity. To make this reframing operational, a minimum implementation package is essential:

1. **Integrated Assessment:** Implementation programs must move beyond technical metrics to include stakeholder maps, distributional impact matrices, and audits of excluded groups.
2. **Accountability Mechanisms:** Reforms require formal channels for grievance redress and meaningful representation of smallholders and marginalized users within both network and basin-level bodies.
3. **Hydrological & Social Auditing:** Efficiency-oriented interventions must be checked against basin-accounting systems to distinguish real water savings from nominal conveyance improvements, coupled with periodic social audits to monitor the equity of allocation during scarcity.
4. **Cross-Scale Linkages:** Formal institutional arrangements must connect Water User Associations to basin-level planning, drought response, and environmental flow decision-making.

Ultimately, the challenge for future irrigation reform is no longer whether water users can manage systems effectively, but whether institutional arrangements across scales can support fair and sustainable watershed decisions. This paper proposes a transition from seeing irrigation as an isolated technical domain to recognizing it as a key entry point for broader, more inclusive, and socially-just basin governance. Future research should empirically test this framework through comparative case studies and applied policy design in water-stressed basins.

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REFERENCES

- Asian Development Bank. 2007. Handbook on social analysis: A working document. Asian Development Bank.
- Cambaza, C., J. Hoogesteger and G.J. Veldwisch. 2020. Irrigation management transfer in sub-Saharan Africa: An analysis of policy implementation across scales. *Water International*. 45(1): 3-19.
- Cleaver, F. 2012. Development through bricolage: Rethinking institutions for natural resource management. Routledge.
- Dani, A.A. 2003. Social analysis sourcebook: Incorporating social dimensions into Bank-supported projects. World Bank.
- Darnhofer, I., D. Gibbon and B. Dedieu, eds. 2014. Farming systems research into the 21st century: The new dynamic. Springer.

- Dessalegn, B., E. Abd-Allah, S. Salem, A. Swelam and Y.A. Yigezu. 2022. Explaining shifts in adaptive water management using a gendered multi-level perspective (MLP): A case study from the Nile Delta of Egypt. *International Journal of Agricultural Sustainability*. 20(7): 1397-1414.
- Dodge, J. and T. Metze. 2024. Approaches to policy framing: Deepening a conversation across perspectives. *Policy Sciences*. 57(2): 221-256.
- FAO. 2001. Transfer of irrigation management services: Guidelines. Food and Agriculture Organization of the United Nations.
- Garces-Restrepo, C., D. Vermillion and G. Muñoz. 2007. Irrigation management transfer: Worldwide efforts and results. FAO/IWMI.
- Grafton, R.Q., J. Williams, C.J. Perry, F. Molle, C. Ringler, P. Steduto, B. Udall, S.A. Wheeler, Y. Wang, D. Garrick and R.G. Allen. 2018. The paradox of irrigation efficiency. *Science*. 361(6404): 748-750.
- Ingrao, C., R. Strippoli, G. Lagioia and D. Huisinigh. 2023. Water scarcity in agriculture: An overview of causes, impacts and approaches for reducing the risks. *Heliyon*. 9.(8)
- International Investment Bank. 2015. Environmental and social impact assessment guidelines. International Investment Bank.
- Kaufman, S., M. Elliott and D. Shmueli. 2003. Frames, framing and reframing. *Beyond Intractability*. 1: 1-8.
- Kvam, R. 2018. Social impact assessment: Integrating social issues in development projects. Inter-American Development Bank.
- Lim, C.H., H.L. Wong, R. Elfithri and F.Y. Teo. 2022. A review of stakeholder engagement in integrated river basin management. *Water*. 14(19): 2973.
- Mazzega, P., O. Therond, T. Debril, H. March, C. Sibertin-Blanc, R. Lardy and D. Sant'Ana. 2014. Critical multi-level governance issues of integrated modelling: An example of low-water management in the Adour-Garonne basin (France). *Journal of Hydrology*. 519: 2515-2526.
- Mdee, A. and E. Harrison. 2019. Critical governance problems for farmer-led irrigation: Isomorphic mimicry and capability traps. *Water Alternatives*. 12(1): 30-45.
- Meinzen-Dick, R. 2007. Beyond panaceas in water institutions. *Proceedings of the National Academy of Sciences*. 104(39): 15200-15205.
- Merrey, D.J., T. Shah, B. van Koppen, M. de Lange and M. Samad. 2002. Can irrigation management transfer revitalise African agriculture? A review of African and international experiences.
- Molle, F. 2008. Nirvana concepts, narratives and policy models: Insights from the water sector. *Water Alternatives*. 1(1): 131-156.
- Molle, F. 2009. Water, politics and river basin governance: Repoliticizing approaches to river basin management. *Water International*. 34(1): 62-70.
- Molle, F. and J. Berkoff. 2007. Irrigation water pricing policy: The gap between theory and practice. CABI and IWMI, Wallingford, UK.
- Molle, F. and C. Sanchis-Ibor. 2019. Irrigation policies in the Mediterranean: Trends and challenges. In *Irrigation in the Mediterranean: Technologies, institutions and policies*: 279-313.
- Mollinga, P.P. 2001. Water and politics: Levels, rational choice and South Indian canal irrigation. *Futures*. 33(8-9): 733-752.
- Mukherji, A., B. Fuleki, T. Shah, D. Suhardiman, M. Giordano and P. Weligamage. 2009. Irrigation reform in Asia: A review of 108 cases of irrigation management transfer.
- Neumann, K., E. Stehfest, P.H. Verburg, S. Siebert, C. Müller and T. Veldkamp. 2011. Exploring global irrigation patterns: A multilevel modelling approach. *Agricultural Systems*. 104(9): 703-713.
- North, D.C. 1990. *Institutions, institutional change and economic performance*. Cambridge University Press.
- Ostrom, E. 2010. Polycentric systems for coping with collective action and global environmental change. *Global Environmental Change*. 20(4): 550-557.
- Pahl-Wostl, C. 2009. A conceptual framework for analysing adaptive capacity and multi-level learning processes in resource governance regimes. *Global Environmental Change*. 19(3): 354-365.
- Pahl-Wostl, C. 2015. *Water governance in the face of global change: From understanding to transformation*. Springer.
- Parry, M.L., ed. 2007. *Climate change 2007: Impacts, adaptation and vulnerability: Working Group II contribution to the Fourth Assessment Report of the IPCC*. Cambridge University Press.
- Rogers, P. and A.W. Hall. 2003. *Effective water governance*. Global Water Partnership.

- Schilling, J., E. Hertig, Y. Trambalay and J. Scheffran. 2020. Climate change vulnerability, water resources and social implications in North Africa. *Regional Environmental Change*. 20.(1)
- Schultz, B. and D. De Wrachien. 2002. Irrigation and drainage systems research and development in the 21st century. *Irrigation and Drainage*. 51(4): 311-327.
- Senanayake, N., A. Mukherji and M. Giordano. 2015. Re-visiting what we know about irrigation management transfer: A review of the evidence. *Agricultural Water Management*. 149: 175-186.
- Shunglu, R., S. Köpke, L. Kanoi, T.S. Nissanka, C.R. Withanachchi, D.U. Gamage, ... and S.S. Withanachchi. 2022. Barriers in participative water governance: A critical analysis of community development approaches. *Water*. 14(5): 762.
- Van Hulst, M., T. Metze, A. Dewulf, J. De Vries, S. Van Bommel and M. Van Ostaijen. 2025. Discourse, framing and narrative: Three ways of doing critical, interpretive policy analysis. *Critical Policy Studies*. 19(1): 74-96.
- Vanclay, F., A.M. Esteves, I. Aucamp and D. Franks. 2015. Social impact assessment: Guidance for assessing and managing the social impacts of projects. International Association for Impact Assessment.
- Vermillion, D.L. 1997. Impacts of irrigation management transfer: A review of the evidence. International Water Management Institute.
- Vermillion, D.L. and J.A. Sagardoy. 1999. Transfer of irrigation management services: Guidelines. Food and Agriculture Organization of the United Nations.
- Wester, P., D.J. Merrey and M. de Lange. 2005. Boundaries of consent: Stakeholder representation in river basin management in Mexico and South Africa. *World Development*. 33(5): 797-812.
- Whaley, L. 2022. Water governance research in a messy world: A review. *Water Alternatives*. 15(2): 218-250.
- World Water Assessment Programme (WWAP). 2024. United Nations World Water Development Report 2024. UNESCO.