Participatory Irrigation Management Experiment in Pakistan: Successes, Failures and Way Forward

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Abstract

Agriculture in arid environments heavily relies on irrigation. Pakistan has major reliance on the Indus Basin Irrigation System (IBIS) for agriculture, domestic, and industrial use. Historically, IBIS underwent many institutional changes, even before the independence of Pakistan. Canal and Drainage Act of 1873, particularly for Punjab, and the Sindh Irrigation Act of 1879 for Sindh province remained major instruments for irrigation management during colonial rule and, with some modifications, continued for irrigation management in post-colonial Pakistan. Later in the late 1990s, with the help of the World Bank, Pakistan introduced Participatory Irrigation Management (PIM) reforms in IBIS to improve water distribution and enhance the recovery rate of water charges through social collateral and trust among the community members. Evaluation of PIM using design principles proposed by Elinor Ostrom, identifies that the PIM reforms failed due to a lack of implementation and suggests that there is significant potential for self-governance in irrigation management in Pakistan, requiring appropriate policy interventions and ensuring implementation instead of just preparing policy documents.

Keywords: irrigation governance, irrigation management transfer, Ostrom's design principles, collective action, water management

1. Introduction

Irrigation plays a critical input in agriculture as more than 70% of freshwater withdrawals worldwide are used for agricultural purposes. For some developing countries, the agricultural water withdrawal is much higher compared to other sectors of the economy (FAO, 2021). Irrigation is considered a key resource for ensuring food security, economic growth and the development of rural communities. With the increasing population and growing demand from industry

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and other sectors of the economy, there is an ever-increasing pressure on the agriculture sector to be the biggest consumer to improve water use efficiency.

Largely being an arid country, Pakistan is heavily dependent on irrigation water for sustaining agriculture and relies mainly on the waters of the Indus River Basin (IRB). The irrigation system of Pakistan is facing the daunting challenges of increasing irrigation to fulfill food security requirements for an increasing population amid climate change, droughts, floods, glacier melting, over-extraction of groundwater, reservoir sedimentation, climate change, poor infrastructure, and mismanagement. The irrigation system mainly developed during the 19th and early 20th century is now facing issues of infrastructural aging, heavy maintenance costs, low water charge, poor water charge recovery rate and related water governance issues. There is a growing literature questioning the efficacy of the colonial design of irrigation infrastructure, its extractive institutional architecture, and its mismatch with the biophysical and socioeconomic context (Gilmartin, 1994; Mustafa, 2001; Farooqi and Wegerich, 2015).

Water governance is perceived as the most important factor for sustainable, efficient and productive irrigation management (Jayasiri et al., 2022). Management of irrigation systems is generally based on diverse sets of rules at different levels of operations and collective choices. The institutional environment is one of the important factors that affect rule formation. The institutional environment comprises governance systems, organizational structures, legal frameworks, and cultural norms, and these components collectively define the nature, scope and effectiveness of rules. Humans rely on institutional arrangements to deal with each other and institutions are humanly devised rules of governance (North, 1990).

Two types of institutional arrangements are mostly involved in irrigation management, local or community-managed and external or state-managed. In local institutional arrangements, irrigation systems managed by local communities and users develop the rules based on their interests, norms and necessities to allocate rights and responsibilities without the interference of external agencies. On the other hand, in state-managed irrigation systems, most of the rules are formulated by external officials and imposed on users, however, without the consideration for local context affecting its effective implementation.

Participatory Irrigation Management (PIM) through the involvement of the water users in the decision-making of the irrigation system is vital for the equity and efficiency enhancement of irrigation water (Zulfiqar et al., 2021). The decentralization of resource use management to local users is the global trend in

Common Pool Resources (CPRs) governance. Like other countries, Pakistan has made many institutional arrangements over the years to improve the performance of the irrigation systems and cope with the growing challenges of climate change and water scarcity. Given the recent water scarcity and climate change challenges, Pakistan reformed its irrigation systems by partially transferring management from a state-managed centralized irrigation system to a public-managed decentralized irrigation system (Nagrah et al., 2016).

Before the PIM reforms, The Canal Water and Drainage Act, 1873, was mainly used as a guideline for irrigation system management in Pakistan. Britain, for the supremacy of their 'Imperial' knowledge to extract revenue from local communities through water charges and levies, enacted the colonial Canal and Drainage Act of 1873 (Gilmartin, 2020) and Minor Canals Act of 1905 for small-scale community irrigation systems (Kamran and Shivakoti, 2013), particularly for Punjab and Khyber Pakhtunkhwa (KP) erstwhile the North Western Frontier Province (NWFP); similarly, the Sindh Irrigation Act of 1879 for Sindh. These Acts were mainly passed to control irrigation, navigation, and drainage in provincial territories. These acts intended to grant the provincial governments the right to use and manage all rivers, streams, and lakes for public purposes in the territories that flow in their natural channels. The irrigation system in the territory of each province was managed by the Provincial Irrigation Department (PID) of that province. Fig. 1 shows the organizational structure of the provincial irrigation department of Punjab and PIDs of other provinces that worked with similar organizational setups.

Irrigation systems fall in the category of the CPRs and the efficient management of CPRs requires effective governance. In the successful governance of the CPRs like the irrigation system, the Involvement of local users in decision-making has given greater importance to self-governance. A diverse collection of case studies from natural resources CPRs, particularly irrigation resources, established the self-governing resource system all over the world. Local users, by themselves and in some cases by cooperating with officials, have formed diverse set up of institutions to cope with CPRs management (Ostrom, 1999). The potential of resource users regarding self-management of CPRs was examined by Ostrom (1990, 2008). When a community develops rules that clearly describe the rights and responsibilities of its members, it tends to provide a public good beneficial for all members. In practice, this assumption has been witnessed to work well worldwide (e.g., India, Nepal, and Albania).

There are several case studies of community-managed irrigation systems, particularly hill torrent and snow melt systems in different areas of Pakistan, where available water resources are managed efficiently by local communities (Ahmad et al., 2007; Khan et al., 2014). This management approach can be adapted as a lesson for improving the management of irrigation systems in Pakistan, especially the canal system. The main features of these community-managed systems are strong social capital, well-defined community rules and effective conflict resolution mechanisms at the local level (Ahmad et al., 2007). Due to these features, there is a low rule violation, high participation in collective action and fewer conflicts, which are lacking in most of the larger state-managed irrigation systems in Pakistan. Adoption of positive features of community-managed irrigation systems can solve the problems of poor conflict resolution, rules violation, less collective action, low water fee recovery and focus can be shifted towards sustainable water management strategies; instead of remaining entangled in these issues which ultimately enhance water security in the country.

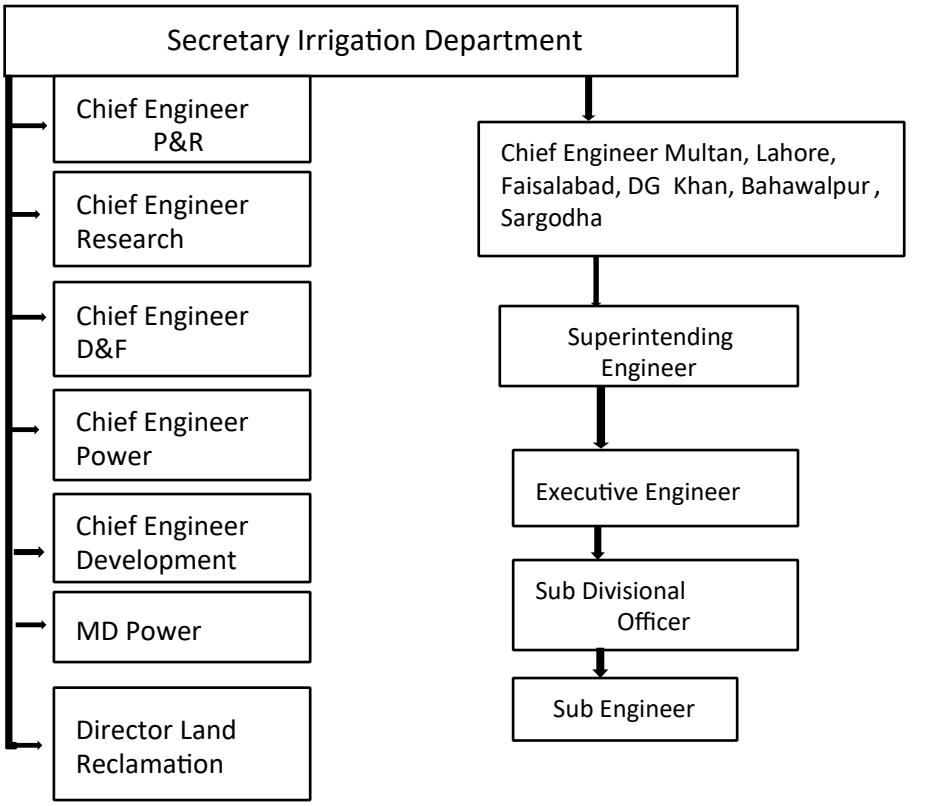

Figure 1. Organizational structure of the Punjab Irrigation Department.

In 1995, with funding from the World Bank, Pakistan introduced PIM reforms (Briscoe et al., 2005), intending to improve governance with minimal involvement of bureaucracy in the governance of the irrigation systems. This PIM reform package was initiated in the IBIS on specific canal command areas alongside the traditional working of the PIDs. The Provincial Irrigation and Drainage Authorities (PIDAs) were formed in 1997 and Farmer Organizations (FOs) were handed over the management of selected canal commands. PIM reforms were initiated to mitigate the inefficient management practices of the traditional bureaucratic setup of irrigation management in the country. Reforms were hypothesized to leave a positive impact on the distributional equity of water among its users and the productivity of crops. It was stated PIM through the establishment of localized self-managed FOs will improve the services. It was also assumed that FOs would increase the equitable distribution of water among its users, facilitate collective action, strengthen the bonds of trust and solidarity between head and tail reach, and promote financial self-sufficiency by lessening the financial burden which would otherwise take the form of a substantial subsidy to irrigation departments and enhance community well-being. Reforms were proposed for all provinces, but mainly introduced in two provinces i.e. Punjab Irrigation and Drainage Authority (PIDA) in Punjab and Sindh Irrigation and Drainage Authority (SIDA) in Sindh Conversely, the establishment of the Frontier Irrigation and Drainage Authority (FIDA) in KP saw limited implementation (Ali Shah and Nabeel, 2023). To adopt the concept of PIM, Area Water Board (AWB), FOs, and Khal Panchayats (KPs) were established with the following stated function:

1.1. Functions of PIDA and SIDA

- Design development, construction, operations and maintenance of the infrastructures regarding irrigation, drainage and flood control.
- Take steps to utilize water resources efficiently at the provincial level.
- Adopt the PIM concept through the establishment of self-managed AWB and FOs.
- Development and Implementation of policies regarding monitoring and evaluation.

1.2. Functions of AWBs

- Analysis and Monitoring of work and O&M of the canal.
- Develop, enforce and oversee the distribution of water among the distributaries and minors in the canal-commanded area.
- Examine and regulate the water charge collection process. Prepare a budget, allocate funds, and keep an eye on expenditures.

- Assist higher institutions in the formation of FOs and KPs.

1.3. Functions of FOs

- Management, operation, and maintenance of the distributaries and minors.
- Ensure due share of water from the main or branch canal equitably and efficiently.
- Collection of the water fee (abiana) and fines, etc., from the water users.
- Deposit 50% of the collected water charges in the government account as per the pre-defined share.
- Conflict resolution among the water users.

1.4. Functions of KPs

- Collection of water charges (abiana) at the watercourse level.
- Management, operation and maintenance of water courses.
- Conflict resolution among the irrigators.
- Equitable and efficient water supply at the watercourse level.

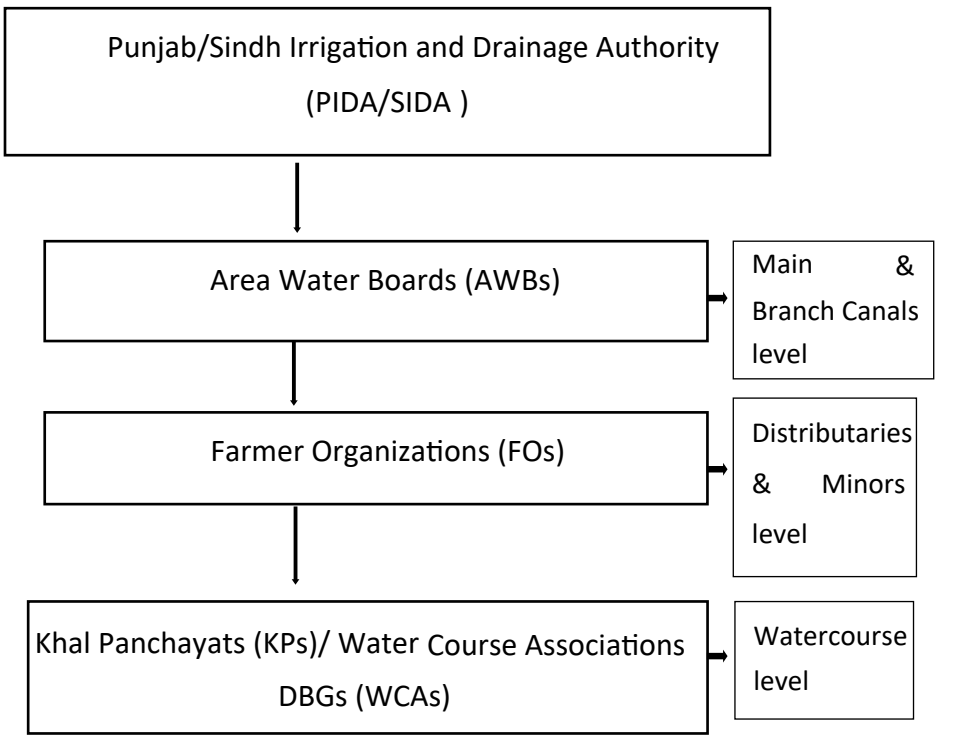

Figure 2. The governance structure of the participatory irrigation management system adapted from PIDA/SIDA).

1.5. Successes of PIM Reform

One of the main objectives of PIM was to ensure the participation of water users in the decision-making making which is very important for the efficient management of irrigation systems evident from research studies around the world. The underlying hypothesis of PIM was that the performance of the irrigation system would improve after the implementation of the reforms where local participation in decision-making was ensured. This improved system performance was expected by the involvement of local users to enhance their participation in collective actions. The participation of local users was, however, observed in a few locations, and not fully practiced according to the PIM guidelines. Some studies reported high participation in collective actions and O&M of the irrigation system was improved during PIM (Ahmad et al., 2020).

Social capital and self-governance of the irrigation systems provide a basis for community-managed irrigation. These factors are very important for the management of CPRs like irrigation systems and to ensure equity and sustainability of the irrigation systems. In most parts of the irrigation system with a strong social interaction; the performance of irrigation management has improved. Under the community management, the conflict resolution mechanism was improved as the conflicts on water were solved locally by village/community heads or by some respectable persons unlikely to time taking dispute settlement under state-managed systems.

It is reported that in some systems, water distribution was improved in terms of more equitable water availability at the tail ends of the systems (Ahmad et al., 2020). Two factors behind the equality of water distribution were observed during the reform period. One is the lining of canals and water channels, resulting in a reduction in water theft and wastage, and the other is the selection of the FOs presidents from the tail end, as they minimized the rule violation to ensure the water availability at the tail.

1.6. Failures of PIM Reform

Overall, the reforms have little success in the country, therefore, the PIDA in Punjab was withdrawn, and the old system was readapted, while SIDA still exists in some areas in Sindh. Many reform agendas were on paper *(de jure*), however, did not come into actual practice (*de facto*). One of the major reasons for the failure of PIM reforms was the inertia and post-colonial legacy of the bureaucracy and lack of effective communication among key stakeholders (Arfan, 2022). This

reform leads to disputes among relevant stakeholders, i.e., FOs and Public Irrigation Departments due to financial incentives (Nagrah et al., 2016).

During the initial years of PIM, *abiana* collection was higher, however, over time the interest of local users and elected officials has declined due to an increase in within-system politics among users and communication gaps among themselves and with irrigation department officials (Arfan, 2022). As a result of the weakened interest and focus of locals towards system management, *abiana* recovery was greatly affected and decreased (Bell et al., 2022), up to 30% in some areas of Punjab. Later on, low *abiana* recovery was one of the major concerns in the success of PIM in the Punjab. On the other hand, the situation was not different in Sindh under SIDA and KP under FIDA, where it was implemented on a small scale. Literature indicates that FOs could only collect the authority's share (60%) of total *abiana* in the system which to keeps on decreasing with time (Tariq, 2010; Arfan et al., 2020).

The implementation of PIM reforms aimed primarily at enhancing the efficiency and equity of water distribution in irrigation systems, seeking to address operational inefficiencies. However, the challenges persist post-reform, with instances of corrupt practices and misuse of resources by some individuals in leadership roles within FOs (Jacoby et al., 2021). One of the prominent reasons is the elite capture, as large landholders implanted themselves and their representatives in key positions of FOs, especially in rural Sindh (Memon and Mustafa, 2012). It was observed that a significant portion of the funds collected for operations and maintenance (O&M) activities was not efficiently used in intended activities. This situation highlights the absence of rigorous oversight mechanisms and accountability measures within the PIM framework, serving as one of the main obstacles to achieving the objectives of the PIM reforms.

Another challenging aspect of the reform was the limited authority vested to the local leaders for decision-making and rule enforcement (Arfan et al., 2020). With less power to address rule violations, particularly regarding non-payment of abiana and water theft, many FOs officials expressed their inability to take strict actions against violators, as a reason for poor performance and abiana collection under reform. It was also observed that water theft by upstream users also increased on channels taken over by local farmer organizations compared to those that remained under state management (Jacoby et al., 2021).

2. Evaluation of PIM for Self-Governance using Ostrom's Design Principles (DPs)

The PIM reforms largely remained on paper with limited success in Pakistan. The reforms were partially implemented across the country, but were handicapped, lacking the actual implementation of the original idea behind the reform process. The PIDA act was abolished in 2019, but SIDA is still functional in Sindh, while the FIDA act has not been formally repealed by the KP government, but in practice, it is not functional. However, there is no systematic literature to evaluate the performance of the systems. Elinor Ostrom, winner of the Nobel Memorial Prize in Economic Sciences in 2009 for her study of CPRs and their governance by local communities, proposed eight DPs for the examination of institutional mechanisms that influence both individual and group decision-making and to guide the formation of a reliable governance system. Various studies have applied these DPs to assess their presence in long-enduring irrigation institutions (Kamran and Shivakoti, 2013; Zulfiqar et al., 2021; Chowdhury and Behera, 2022). In this section, we seek to use DPs as an assessment framework to evaluate their application in the institutional setup for irrigation system management during PIM reforms. Ostrom's DPs are given in Table 1.

Table 1. Ostrom's DPs for Long-Enduring CPR Systems.

S. No	Design Principle	Explanation
1	Clearly defined Boundaries	The irrigation source boundaries and the authorized irrigators are well-defined.
2	Congruence between local conditions and rules	The irrigation rules and the biophysical and technology context are in conformance.
3	Arrangements for collective choice rules	Irrigators are involved in making and revising the rules and rules are not imposed from outside.
4	Monitoring of system	Monitors are selected by the irrigators or the irrigators themselves are involved in the monitoring.
5	Graduated sanctions	Sanctions for violation of the rules are graduated in nature depending on the severity of the violation.
6	Mechanisms for dispute resolution	Access to locally available and low-cost dispute resolution mechanism
7	Right to organize	The locally accepted rules are not challenged by other agencies or government departments.
8	Nested enterprises for large systems	Multiple levels of nested enterprises to organize irrigation system management activities.

Source**:** Adapted from Ostrom (1990).

This DP has two parts, resource boundary and resource users' boundary. Resource boundaries constitute the physical boundaries of the resource under study like the main canal, distributary, and water channel. On the other hand, a predefined fixed number of water users own lands with irrigation entitlements. In the case of resource and user boundary, rules *de jure* (rules-in-form) and *de facto* (rules-inuse) situations were similar in the PIDA regime as the boundaries were clearly defined and water was distributed according to these pre-defined boundaries. It is worth mentioning here that the boundary rule has the same status as the PIDAs under the Canal and Drainage Act. In this case, the boundary rule *per se* has the same situation before and post-reform in the country.

DP1: Boundary Rules

DP2: Congruence between Local Conditions and Rules

Congruence between the rules, i.e., between water appropriation rules and water provisioning rules and the congruence of the rules with the local conditions are integral parts of this DP. In the case of part one, it is mostly applicable under PIDA as the irrigation systems have simple structures for provision and the field-level use is directly matched with the water extraction from the resources. However, the component of the congruence between appropriation rules and the local conditions was found missing because the head-to-tail water turn continued despite the flexibility to craft reactive water rules under the participatory irrigation management acts. PIDA was expected to provide opportunities to the local communities to make favorable decisions that were found missing in practice. Literature has shown a similar situation in Sindh under SIDA and in KP under FIDA (Tariq, 2010; Arfan et al., 2020). Local users appeared to be the recipients of decisions from higher authorities; as the system was not responsive to the actual demands of users-based local conditions even after the PIM reforms implementation.

DP3: Collective Choice Arenas

The participation of the local users in decision-making was one of the main objectives of the PIM, however, in reality, there was less participation of local users in decision making and the management of the system was not fully transferred for decision-making with local participation (GoPb, 2013). Studies also identified the inability of irrigation systems to provide a collective choice environment in Sindh and KP (Tariq, 2010; Memon and Mustafa, 2012), resulting in the absence of users' participation in canal operations and their unwillingness to pay water fees. In literature, the elite capture is perceived as the major reason for poor participation

and failure to provide an arena for the collective choice of water users (Ali, 2020; Arfan et al., 2020; Jacoby et al., 2021).

DP4: Monitoring

Monitoring is an integral operation to control violations and maintain fair distribution among the irrigators of a system. A review of the outcomes of the monitoring provides sufficient evidence about the effectiveness of the rules (North, 1990). The de jure and de facto situations regarding monitoring were not the same in most of the locations where PIM reform was implemented. According to rules, FOs and KPs officials were responsible for the monitoring, but in only a few locations where officials were elected from the tail end, monitoring was effective, otherwise, the monitoring mechanism was missing. As discussed above, the elite capture and failure to redress grievances of the tail-enders related to water availability resulted in lower participation from the entitled tail-end users.

DP5: Graduated Sanctions

To prevent persistent violations of established rules in the management of CPRs, a system of graduated sanctions is required, depending on the severity of the violation and its repetition. The DP states that offenders are penalized following the severity of their offenses as determined by other resource users or officials acting on their behalf (Ostrom, 1990). Graduate sanction was not effective in practice during reform, contrary to the documents. The lack of sufficient power by FOs and KPs officials to take effective action to ensure compliance with rules has resulted in an ineffective graduated sanction mechanism, even after the enactment of PIM reform in the country (Arfan et al., 2020).

DP6: Conflict resolution mechanism

Low-cost and locally available conflict resolution forums are important to resolve issues between users and officials of the irrigation system. According to the evaluation report 2013 by the Planning and Development (P&D) Department of Punjab, in Kharif 2012, 597 police cases were registered against 2089 water theft cases in Circle LCC (East) and 369 police cases were registered against 2105 water theft cases in Circle LCC (East). This shows that a large proportion of cases go to the formal legal system reflecting the lack of effectiveness of local conflict resolution. Due to the top-down authority, one-sided contractual arrangement between WCAs, FOs and AWD, and the disempowerment of WCAs to seek help from regulatory authorities in dispute resolution, SIDA also failed to provide an effective local conflict resolution mechanism in Sindh (Arfan et al., 2020).

DP7: Minimal recognition of rights to organize

Recognition of the locally evolved and crafted rules and assurance that these rules are not superseded by the government rules is essential for the existence of local rules. This condition reflects the autonomy and recognition of the local rules and promotes collective action for the self-governance of the systems. This principle was applicable according to records as the FOs have the right to implement rules, but not the formation of the rules, while on the other hand, there was rare participation of local users in decision-making about rule implementation. Without the active role of the farmers, irrigation governance continues to remain weak (Arfan, 2022) as there is a considerable gap between the theory and practice of participatory management.

DP8: Nested Enterprises

The idea of the PIM reforms was to manage irrigation by multi-tier nested enterprises of irrigation department officials and local users. In reality, it proved to be quite difficult to bring these disparate organizations together to achieve a common goal. The communication gap due to the difference of interest among stakeholders impedes the formation of nested enterprises of the system under reform. As a result, a constant power struggle persisted between the old and the new structures and the stakeholders within those structures.

PIM in Pakistan underwent different phases and varying nature of challenges that hampered in achieving its stated goals. There was a general lack of political commitment due to power asymmetries among the irrigators and the political economy nature of the decisions under the reforms. There is always a case of inertia at the organizational level and there is a natural friction in the reform process. The friction resulted in conflict among the concerned stakeholders over financial incentives and authority (Nagrah et al., 2016). Arfan et al. (2020) blame the imported reform agenda and find it at odds with the principles of integrated water resources management.

3. Conclusions and Way Forward

Irrigation governance plays a critical role in ensuring water delivery and sustainability of the irrigation systems. The governance of irrigation systems remained a big challenge in Pakistan due to the colonial design of bureaucratic control which worked well with a smaller number of farmers having relatively large holdings. However, the governance became increasingly less efficient due to the aging of the infrastructure, land fragmentation, commercialization of agriculture and land use changes.

Table 2. Summary of Design Principles' Application during PIM (PIDA/SIDA).

No.	Design Principles	PIM Act (*De Jure*)	Implementation (*De Facto*)
1	Clearly Defined Boundaries	Applicable	Applicable
2	Congruence Between Local Conditions and Provision and Appropriation Rules	Applicable	Partially Applicable
3	Arrangements for CollectiveChoice Rules	Applicable	Partially Applicable
4	Monitoring	Applicable	Partially Applicable
5	Graduated Sanctions	Applicable	Not Applicable
6	Conflict Resolution Mechanisms	Applicable	Partially Applicable
7	Minimal Recognition of Rights to Organize	Applicable	Not Applicable
8	Nested Enterprises	Applicable	Not Applicable

After recognizing the challenges in the governance of its irrigation system, Pakistan has undertaken reforms to shift from a state-managed centralized irrigation system to a publicly-managed decentralized system. These reforms aimed to address pressing issues, like operational inequalities and inefficiencies, conflicts over water, poor recovery of O&M costs and water scarcity in the country's irrigation system and improve its adaptability to changing climate. In doing so, Pakistan seeks to ensure the sustainability of its agricultural sector, food security, and the overall well-being of rural communities.

However, the reforms largely remained on paper with less visibility on the ground. The existing literature shows few cases of success while the majority of the irrigation systems showed poor governance outcomes. The study used the design principles put forward by (Ostrom, 1990) to provide useful guidelines to evaluate the performance of the irrigation systems in terms of rules in form (*de jure)* and the rules in use (*de facto*). Looking at the designed principles and actual practices in the case of only one DP, the boundary rules were according to documents, while in the case of other DPs, the actual practice was contrary to documents. This shows that the PIM reforms failed due to a lack of implementation. It has also been seen that the local users were not provided with adequate power and autonomy to make independent decisions, especially in terms of rule formation and enforcement, which shows that the PIM model was never adequately tested and implemented.

Addressing these challenges necessitates a multi-faceted approach that includes improving water governance, enhancing water fee recovery, promoting community-based management, adopting modern irrigation technologies, and implementing water-saving techniques. At the national and provincial levels, water management policies should be developed with consideration of the benefits of community-based management practices in the past, the beneficial impacts stemming from PIDA/SIDA initiatives, and the valuable insights gained from previous shortcomings and failures. The policy should be implemented in actual practices. There is a National Water Policy and the provincial Water Laws and policies for surface and groundwater awaiting implementation. As a result, the surface water irrigation is in poor form and the groundwater resources are under heavy pressure. It is important to learn from the failures of the PIM experiment and leverage the success cases to formulate a better governance model with a major role of local communities in managing the resources.

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