WATER GLOBAL PRACTICE

Governance in Irrigation and Drainage Appendix 2

Case Descriptions

UNDERSTANDING SERVICE

DEFINING PERFORMANCE

MANAGING PERSPECTIVES

MOVING TO ACTION

WORLD BANK GROUP

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Governance in Irrigation and Drainage Appendix 2

Case Descriptions

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Case Descriptions

Insight and Inspiration behind the Case Narratives

Case studies from different regions of the world are described in appendix 2. These were selected for their diversity in type of governance arrangement, geographical location, and system characteristics. They cover a wide range of the governance spectrum that the resource book users are expected to encounter. While they number only 13, they provide a reasonably wide sketch of world diversity, though should not be viewed as a complete set of options.

Each case includes a description of the project context, challenges, and innovations. The transformative actions and interventions are explained, and the roles and responsibilities of each of the relevant actors (and their perspectives) are discussed. The set of cases highlights both positive and negative outcomes. Together, these provide a practical overview of irrigation and drainage (I&D) institutional problems and some of the possible solutions that have been formulated.

The cases cover small and large schemes, community-managed and private-sector operated, state-initiated, and farmer-led irrigation development. Cases involving irrigation management transfers (IMTs) and water user organizations (WUOs) are also described. The regional spread is illustrated in map A2.1, and the list of cases with key characteristics is presented in table A2.1.

MAP A2.1 Case Study Locations

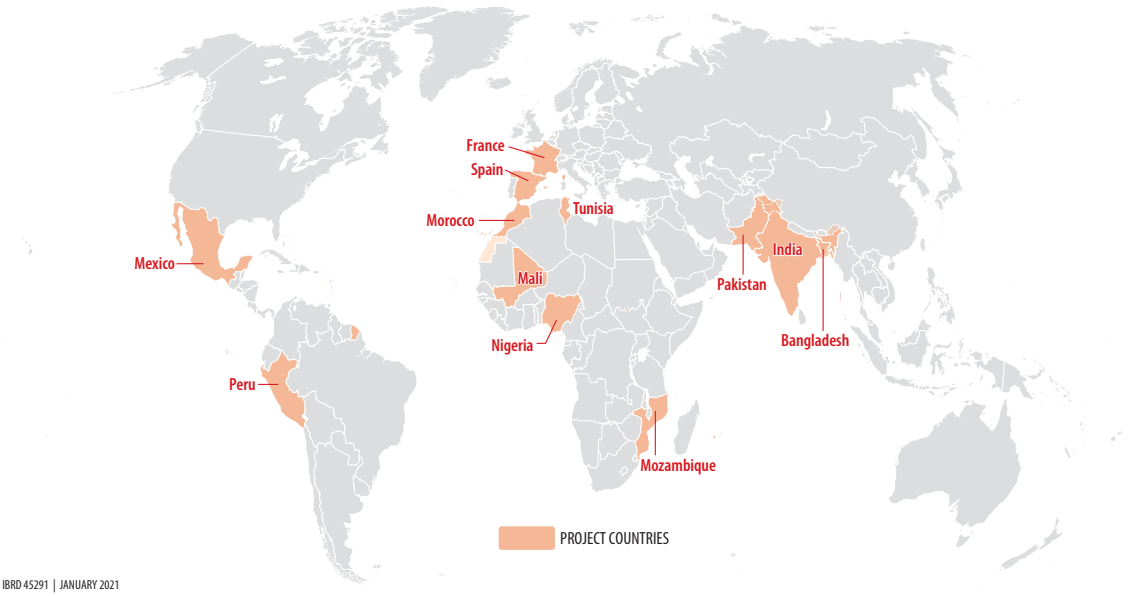

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TABLE A2.1 List of Case Studies

	Region	Country	Case Title	Highlight
1	LAC	Peru	Irrigation Management Transfer (IMT)—A Complete Transfer Process to WUOs	IMT of the whole large-scale irrigation system, including dams, bulk and distribution systems to water user organizations (WUOs).
2	LAC	Mexico	Groundwater User Associations—Limited by the Scope of Allocated Functions	Collective management arrangements with a consultative rather than functional mandate.
3	MENA	Tunisia	State-Owned Enterprise (SOE)—A National Irrigation Operator	A financially autonomous, customer-oriented parastatal functioning as operator.
4	MENA	Morocco	A Classic PPP at Guerdaine Irrigation Scheme	The evolution of one of the world's first public-private partnerships (PPPs) on a large-scale irrigation scheme.
5	SA	Bangladesh	Decentralization Leads to Operational Success	A comprehensive participatory process supported by a detailed water policy framework.
6	SA	India	Championing Change with Leadership	Reform on large-scale gravity irrigation schemes is possible when there is strong and dynamic leadership.
7	SA	Pakistan	Lessons from Comprehensive National-Level Irrigation and Drainage Reforms	An evolutionary process overcomes challenges on the long, slow road to comprehensive institutional reform.
8	SA	India	Policy Actions Avert a Groundwater Crisis	A successful learning process that focussed on energy and policy rather than a water-centered initiative.
9	SSA	Mali	Office du Niger: Transfer of Land and Water Functions to Semi-Autonomous Agency	Semi-privatized operations, management, and maintenance (OMM) can transform irrigation services and production.
10	SSA	Mozambique	IMT and Contract Farming at the Chókwè Irrigation System	Irrigation and drainage (I&D) agency and water user association (WUA) comanaging water with an outgrower link to a rice mill.
11	SSA	Nigeria	Irrigation Management Transfer (IMT) and Participatory Irrigation Management (PIM) on the Kano Irrigation Scheme	A transformative participative planning process that led to a restructured water management arrangement.
12	OECD	Spain	Modernization of an Ancient Flood System—New Governance Challenges	Technical conversion from canal to drip irrigation brought new governance challenges and unintended outcomes.
13	OECD	France	Evolution of the French Regional (Water) Development Companies (SARS)	Regional development companies with public and private shareholders as water service providers.

Note: EAP = East Asia and Pacific; ECA = Eastern Europe and Central Asia; LAC = Latin America and Caribbean; MENA = Middle East and North Africa; OECD = Organisation for Economic Co-Operation and Development; SA = South Asia; SSA = Sub-Saharan Africa.

Summary of the Case Studies

Case 1 Peru: A complete transfer of irrigation management to water user organizations

While an irrigation management transfer (IMT) is often executed half-heartedly, with only the management of tertiary blocks being handed over to water user organizations (WUOs), this was not so in the Peru case. In 1993 the Government of Peru decided to turn over the complete management of the large-scale irrigation systems in the North Coast desert to WUOs. This included the operation and maintenance (O&M) of the reservoirs and main canals and drains. It also included the budgeting and recovery of the fees. This IMT process was largely successful despite the many smallholders, deficient infrastructure, on-demand scheduling, and low level of training of the operators. The success can be explained by the high level of accountability of the elected board members of the WUO, the long history of irrigation in the area, and the extreme dependency of the farmers on irrigation water.

Case 2 Mexico: The role of aquifer management councils in the sustainable use of groundwater

In Mexico, aquifer management councils (COTAS) have been established in the State of Guanajuato since 1998. Guanajuato faces severe overexploitation of groundwater. Originally, the idea behind the COTAS was that the users would regulate their water use among themselves (as all would benefit when the race to the bottom of the aquifer stopped). The government shared data on concessions and wells, and monitoring by the 20 aquifer monitoring committees discovered many illegal wells. However, in the 2004 National Regulation, the COTAS became consultative associations only, with the task of advising the government's National Water Commission (CONAGUA). The COTAS cannot decide on groundwater extraction concessions, nor monitor the compliance to existing concessions. While there has been a clear step forward in participatory governance, the limitations in relation to concessions have left the COTAS ineffective in curbing the overexploitation of the aquifers.

Case 3 Tunisia: A national irrigation operator in the form of an SOE

Tunisia's irrigated agriculture subsector is performing below its potential output, despite the investment in modernizing the country's irrigation infrastructure. The decentralized institutional model for service delivery has contributed to this problem by creating confusing and overlapping functional roles between the public agencies (CRDAs) and the local farmer groups (GRDAs). This led to a lack of control and accountability between the various service providers and the users or clients, resulting in poor cost recovery and unreliable service delivery. As a result, in 2018 the World Bank and the Government of Tunisia initiated the Irrigated Agriculture Intensification Project, which will create a single service provider in the form of a state-owned enterprise (SOE) that will be autonomous, financially self-sustainable, and client-oriented. The direct relationship between the service provider and the client will help

create greater accountability and, consequently, reliable service delivery. The institutional modernization in the project is complemented by activities related to targeted rehabilitation, ensuring O&M cost recovery through increased tariffs, and assisting the farmers in enhancing agricultural value.

Case 4 Morocco: A classic PPP in the El Guerdaine Irrigation Scheme

The Guerdaine project, one of the first public-private partnership (PPP) transactions in large-scale irrigation worldwide, was signed in 2005. It is an important case given the scale and success in turning around the overexploitation of groundwater resources. The process of project generation is particularly interesting and evolved through different options starting with classical public irrigation development and management, then the establishment and inclusion of water user associations (WUAs), and finally the effective solution under a PPP design. The PPP design addressed (a) the division of risks between the private investment and operating company, the public entity, and the farmers; and (b) the setting up of a maintenance fund, leading to successful water service provision to farmers using both groundwater on their farms and surface water supplied by the PPP operator.

Case 5 Bangladesh: Decentralization leads to operational success

The case study highlights how a decentralized organizational strategy for the Irrigation and Drainage (I&D) agency was effective in achieving service delivery. The strategy included comprehensive policy changes and participatory governance processes. Bangladesh has an exemplary sequence of successful small-scale water resources management projects. These are premised on close ties between beneficiary communities—registered as cooperatives—and a comprehensive participatory process that is part of a detailed water policy framework, and a decentralized local government engineering department. This case shows how a learning organization approach can achieve success through evolutionary improvements developed from the observation of lessons learned, and highlights the enabling factors that contributed to success.

Case 6 India: Championing change with leadership

India's second-largest state, Madhya Pradesh, has demonstrated how incremental institutional reform in large-scale gravity irrigation schemes is possible when there is strong and dynamic leadership. To combat corruption and turn around agricultural performance, the chief minister of Madhya Pradesh recruited an upright and energetic officer as the principal secretary for Water Resources, and to run the Irrigation Department. A more results-oriented modern management approach was implemented. This included close communication, reforming canal management protocol, revising human resource practices to motivate staff, and adopting modern technology for improving monitoring performance. The results were significant. Canal-irrigated areas expanded from less than 1 million hectares in 2010 to 2.39 million hectares by 2015. The combination of a champion focused on delivering results and strong support from the political leadership were pivotal in the irrigation turnaround that made headlines all over India.

Case 7 Pakistan: Lessons from comprehensive national-level irrigation and drainage reforms

Ambitious goals can overstretch institutions and lead to less-than-satisfactory outcomes, but there can also be longer-term benefits. Pakistan was one of the first countries in Asia to take on a major irrigation reform process at the national level. Though the National Drainage Program did not achieve all of the intended objectives, the case study highlights how we can tailor solutions to complex challenges more effectively. It shows why locally generated ideas and close consultation are essential to tackle reform, and that small, steady steps are often the best way forward. Pitfalls and successes in the evolutionary reform processes are highlighted, lending optimism to practitioners embarking on the long road to comprehensive institutional reform.

Case 8 India: Policy actions avert a groundwater crisis

Improving governance in groundwater use is often tackled with a conventional approach. In India, power subsidies drive over abstraction from aquifers, and have a major fiscal impact on the exchequer. The case shows how a rigorous solution of demand management can be employed by tackling the challenge through the energy and financial sectors. The case study describes the policy actions taken and progress to date of an Asian Development Bank initiative. The study highlights energy and water links, and demonstrates that not all solutions to irrigation management need to be approached from the water sector. It also shows how policy changes can catalyze demand management actions.

Case 9 Mali: Office du Niger Agency: Transfer of land and water functions to a semi-autonomous agency

The Office du Niger irrigation scheme was constructed from 1978 and covers 100,000 hectares. Crop production and irrigation was originally managed by the state. From 1992 the land tenure was made more secure. Water management, O&M, land leases, and fee collections were managed by an operational parastatal, and crop choice was liberalized. This caused an expansion of the irrigated area from 60,000 hectares to 80,000 hectares. The farmers of the 200 villages elect three delegates each. These delegates elect zonal representatives and a representative for the general board of the irrigation system. Price regulation was achieved through a tripartite review every two years, including the farmer organization, the Office du Niger administration, and the government. The case shows how semi-privatized operations, management, and maintenance (OMM), compulsory fee payments for access to land and water as a joint fee, and an entrepreneurial private sector that responds to agricultural supply and marketing needs can transform irrigation services and production.

Case 10 Mozambique: IMT and contract farming in the Chókwè Irrigation System

Developed in the 1950s for settlers (after independence in 1977), the Chókwè Irrigation System was made a state-operated irrigation system. In 1997 the system was transferred to a parastatal organization, and water management at the secondary canal level and below was transferred to WUOs. The 26,000

hectares of land equipped for irrigation are not fully used. Rice production increased when contract farming was introduced.

Case 11 Nigera: IMT and PIM in the Kano Irrigation Scheme

The Kano case highlights a participative and transformative planning process that led to a jointly formulated and completely restructured water management arrangement and a major shift in functional roles of all key players. While the construction aspect of the modernization was still being implemented at the time of writing this report (2018), the attitudinal change, participative redesign, and legal transformations reported here were established, and contributed to the reform of the irrigation sector at national level.

Case 12 Spain: Modernization of an ancient flood system—new governance challenges

The Acequia Real de Jucar is an example of a centuries-old irrigation system managed by a WUO. Its construction began in the 13th century. The system has some 20,000 hectares of irrigated land and about 29,400 farmers. Pressure over water in the Jucar watershed has made the government reduce the yearly water allocation to the system. In return, the government has granted subsidies for installing a piped distribution system so the farmers can install drip irrigation. Preliminary studies show that the water saved by reducing the concession of the irrigation system equals the reduction of the drainage water that now flows into the Albufera Lake and wetlands, confirming Perry's basin view of efficiency. Thus, no net water savings are made from a basin perspective, but due to difficulties with the technology shift, farmers have lost control over their irrigation practices.

Case 13 France: Evolution of regional (water) development companies

The current institutional setups of France's regional development companies (SARs), operators with private and public shareholders, are quite unique worldwide, and are the fruit of a long historical process that may resonate to many large-scale irrigation (LSI) public service providers. Created as classic public companies for development and management of LSI schemes in the 1950s, the SARs faced several crises that obliged them to reinvent the model toward a more customer-oriented and privately managed service provision, without losing the perspectives of long-term public asset management.

Case 1. Peru: A Complete Transfer of Irrigation Management to Water User Associations

MAP A2.2 Chancay-Lambayeque Irrigation System

Water Management Arrangement

- Irrigation Management Transfer (IMT) of complete system
- Water user associations (WUAs) at three levels
- Apex IMT has company for operation and maintenance of the main system
- Ministry of Agriculture determines water use rights
- On-demand scheduling

Farmer Profiles

- Average plot size: 5 hectares (ha)
- Size range: 0.1 ha to 300 ha
- No. of farmers: 28,600
- 5% registered female farmers
- Business and cash income orientation

Scheme Overview

The Chancay-Lambayeque irrigation system is ancient: its main canal was first constructed about 1,000 years ago. The scheme is situated in the extremely arid coastal zone on the North Coast of Peru, with no effective rainfall in normal years. Only during El Niño years does rainfall occur. The water comes from rivers of unpredictable regime that run from the Andean Mountains (see map A2.2).

The irrigated area is about 119,000 hectares. In 2018 approximately 28,600 users had water rights; this ownership pattern has evolved since the land reforms of 1969. At the time of research, three sugarcane enterprises had large estates in the head of the system. The rest of the users were smallholders with an average of 5 hectares each.

Water Infrastructure

- Irrigation system more than 1,000 years old
- 119,000 ha
- Tinajones Reservoir
- 13 secondary canal WUAs

Value Chains

- Rice
- Sugarcane
- Maize and beans
- Export fruit and vegetables

To urban and distant markets

Groundwater not used. No groundwater is used in the system due to the salinity of the groundwater, and because the small net returns to staple crops such as rice do not support pumping costs. Deep percolation from canals and fields contribute to waterlogging.

Area- and crop-based allocations. Water is allocated according to water rights tied to landholding. The maximum amount of water allocated is based on the type of crop authorized by the Ministry of Agriculture (farmers can request a change in crop each year, but normally only to a less water-consuming crop).

On-demand system. Water distribution is on-demand and scheduled according to advance payment of water turns. The Tinajones Reservoir, built in 1968, has a capacity of about 300 million cubic meters, which is about one-third of the yearly water use. In case of water scarcity, quotas apply and are proportional for larger water users.

Open canals with manual gates. Water is conveyed in open, mainly unlined canals and regulated with manually operated vertical sliding gates. Discharges are measured only at the entrance of the secondary canals.

Drainage. In the 1970s, a drainage system was constructed to prevent waterlogging and salinization. Return flows outside the system are rarely used due to the proximity of the irrigation system to the ocean (into which the main drains discharge directly).

Problems in Public Agency Management

From 1969 to 1993, the Ministry of Agriculture managed the system with many deficiencies in operation and maintenance (O&M) and very low fee (and cost) recovery. During the 1980s, the collective farms (ex-haciendas) were sold to the cooperative holders.

IMT of the Complete System in 1993

In 1993 the government implemented a sweeping irrigation management transfer (IMT) program. The water user associations (WUAs) at the secondary canal level became the concession holders and managers of the system. Every two years all registered water users elect the board of the secondary canal WUAs.

Role of the WUAs

The boards of these WUAs plan and execute the O&M, hire technical and administrative personnel, and recover fees (photo A2.1). They discuss the annual budget (and corresponding fees) and the budget spending with the water users. They collect the on-demand fees (paid one day in advance of a water turn). At the tertiary block level, WUAs are organized more informally: they have an elected board, and might hire an operator (*repartidor*) of the gates inside the tertiary canal system.

The chairpersons of the 13 WUAs at the secondary canal level elect the board of the main system, the Apex WUA (Junta de Usuarios). The 13 WUA chairmen are also the board members of the company COPEMA, which manages the main system (reservoir and main canal). COPEMA oversees the daily operation of the reservoir, main intake work, and main canal, and distributes the irrigation water to the secondary canals. It also operates and maintains the heavy machinery used for canal and drain maintenance. From 1993 to 2007, the Apex WUA was successful in providing good O&M service, raising the irrigation service fee (ISF) from US$3.50 to US$10.00 per 1,000 cubic meters. The fee recovery was sufficient to cover O&M cost. Figure A2.1 outlines the organizational chart of the WUAs, as well as the regional and national government agencies.

Line agency

The only functions remaining for the former irrigation line agency, the local water authority (ALA), are granting water use rights to individual farmers, deciding which crops are allowed to grow, establishing the yearly allocation of water (together with the WUAs in the Water Allocation Committee), and resolving conflicts that cannot be resolved by the WUAs.

Regional government

The government agency Proyecto Especial Olmos Tinajones (PEOT) acts as regulator and monitors the functioning of the WUA. It can modify or end the transfer concession.

PHOTO A2.1 WUA Meetings

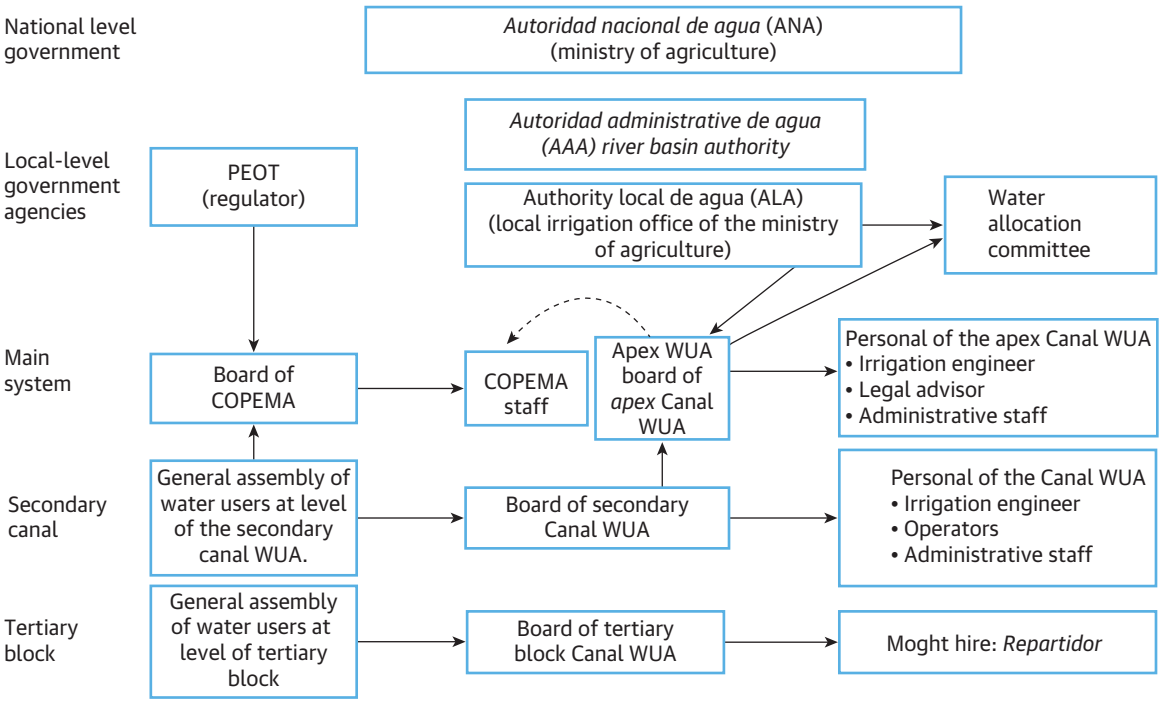
Performance of the water delivery is high. Most water is delivered at plot level according to the complicated on-demand schedule. This high level of performance is possible for three main reasons: high levels of accountability of WUAs toward the water users and social control among the water users (who make sure they get the volume of water they paid for); high skills of the operators; and the complete dependency of agriculture on irrigation. Paddy yields are high, from 5 to 10 tonnes per hectare.

Key to the success of the WUAs are the long discussions of elected boards with their constituencies on irrigation management and budgeting issues during the general assembly meetings.

The well-functioning Chancay-Lambayeque irrigation system is also highly related to its long history; many rules (such as the two different types of water rights: permanent and surplus water only) have been in place since Incan rule. In addition, the social relationships (patronage) between the chairmen of the WUA boards and the water users have a long history. Water users are very knowledgeable about their irrigation system and its management.

An unusual driver of delivery performance. Interestingly, the operators manage to sell and deliver extra "illegal" water turns as well. They do so by distributing water put into the system as compensation for

FIGURE A2.1 Organizational Chart of WUAs and Regional and National Government Offices in Chancay-Lambayeque



Source: Vos 2002.
Note: WUA = water users' association.

water losses from the canals to the farmers. These losses are estimated to be 25 percent of the water to be delivered, but in reality, might be less due to waterlogging. The sale of illegal water turns raises good money for the operators, who share this money with their superiors. The farmers know this and are very keen to monitor their paid-for water turns, which they do by estimating the volume received by the rise in water level in their paddy fields. In this way, the illegal water turns actually make the operator work very precisely, delivering just enough water to the farmers to "save" water for an extra illegal water turn, and thus the overall distribution performance is better. Overall, this does not save water, and the real effect is a diversion of part of the irrigation service fee from the official to the illegal circuit (making the officially unpaid position of chairman of a WUA more attractive); however, the level of water delivery precision becomes incredibly high.

New Problems and How They Were Overcome

In 2007, a chairman of the Apex WUA came to power who embezzled money and "bought" the support (for re-election and mismanagement) of the majority of his 12 fellow WUA chairmen. The government regulator finally intervened after many years of protests by water users, by cancelling the license of the Apex WUA to manage the main system and collect the irrigation service fees. The corrupt chairman was finally succeeded by a newly elected chairman in 2017.

Suggestions for Further Improvement

The problem of the corrupt chairman of the Apex WUA showed a weakness in the representation and accountability structure of the three-tier WUA. The water users could not prevent the reelection of the corrupt chairman, because this position is not elected by direct vote of all water users, but by vote of the 13 chairmen of the secondary canal WUAs. By bribing seven of them, he maintained power. The election of the board of the Apex WUA in general elections by all water users could prevent the reelection of a malfunctioning chairperson of the Apex WUA.

Reference

Vos, J. M. C. 2002. *Metric Matters: The Performance and Organization of Volumetric Water Control in Large-Scale Irrigation in the North Coast of Peru.* Wageningen, The Netherlands: Wageningen University.

Case 2. Mexico: The Role of Aquifer Management Councils in the Sustainable Use of Groundwater

MAP A2.3 Guanajuato, Mexico

COTAS (Groundwater user associations in Guanajuato)

- Groundwater use: 4,100 hm^3
- No. of COTAS: 14
- Farmer members of COTAS: 8,610

Farmer profiles in Guanajuato

- 62% of land belongs to big private landowners
- 32% of the land belongs to *ejiditarios* (communal smallholders)
- Average plot size in *ejidos*: 5 ha
- No. of farmers using groundwater: 18,000
- Business and cash income orientation

Groundwater Management

It is well established that very few examples of sustainable groundwater management regimes exist in areas of intensive groundwater use. Hence, the collective management of groundwater by water users—self-regulation or local-level governance—is increasingly advocated as an alternative, or complementary, to state regulation. Since the early 2000s, the World Bank has recommended frameworks to promote the development of aquifer management organizations as an integral component of Integrated Water Resources Management (IWRM).

Groundwater Use in Guanajuato, Mexico

Reaching sustainable groundwater extraction levels is the most critical issue in Guanajuato's water management (map A2.3). All its 18 aquifers are overexploited, with annual extractions around 1,200 million cubic meters more than recharge. Total groundwater extractions fluctuate around 4,100 million cubic meters while recharge is around 2,900 million cubic meters for the whole state. The level of overexploitation is thus around 40 percent of recharge. The result is an annual mean aquifer drawdown of more than 2 meters, with important regional differences.

Value Chains

- Export fruit and vegetables
- Maize and beans

To urban and distant markets

Water Infrastructure

- Deep tube wells
- Drip irrigation

This aquifer drawdown is leading to problems of high arsenic and fluoride concentrations in groundwater, increased pumping costs, drying up of wells, land subsidence, and the desiccation of springs.

Aquifer Management Councils (COTAS)

One of the responses to this problem was the formation of aquifer management councils (COTAS) in the state from 1998. The creation of COTAS was institutionally led by the Guanajuato State Water Commission (CEAG). COTAS were created as councils of water user representatives. These councils were envisioned to consist of all water users, who would unite to work on implementing IWRM actions in their aquifers. These councils were supported by a consultative group consisting of government agencies. Through a trust fund established by the state government, COTAS were financially supported to have a technical office run by a manager, a technician, and a secretary. The membership of the COTAS, which would represent the highest decision-making body through its general assembly and elected board members, was to consist of all the water users of an aquifer. These were defined as those with a concession title to extract groundwater for agricultural, industrial, or commercial use, while urban water users would be represented through the municipal water supply utilities. The CEAG intended that the COTAS would be legally recognized local water management organizations that would focus on regulations and water by reaching agreements on aquifer management through actions to regulate, conserve, and efficiently use water.

Reduction of Consultative Organizations

In the national regulations of 2004, COTAS were recognized by the National Water Commission (CONAGUA) as consultative organizations that would support and advice CONAGUA in formulating the rules and regulations of an aquifer. COTAS do not take part in the granting of groundwater concessions and the implementation and control of legal regulations. As a result, COTAS have the legal status of civil society organizations that work based on the collaboration and goodwill of the water users.

Development of the COTAS

The development of the 14 COTAS in Guanajuato from 2000 to 2006 strongly hinged on the financial and technical support of CEAG. CEAG's efforts to strengthen the COTAS during this period focused on increasing user participation and formulating a groundwater management model that would lead to concrete actions. These aimed to reduce groundwater extractions by reaching agreements with all agricultural water users, who were supported to make changes to their irrigation technologies and production practices. As a result, the number of users who became members of the COTAS rose from 225 in 2000 to 8,610 in 2006 (of an estimated 18,000 groundwater users), and 20 aquifer monitoring committees were formed (CEAG 2006). An important achievement of the COTAS is that

each has updated and verified the database on groundwater wells, in the process identifying many irregular wells.

Training of farmers and help desk

The COTAS were very actively involved in training around 5,300 users in water issues, together with government agencies, and extensive information campaigns on the "new water culture" were held. The aquifer monitoring committees have led to enhanced awareness. For many farmers, the COTAS have become important help desks or service windows that support them in their interactions with government agencies. Especially concerning groundwater concession titles, the COTAS play an important role as intermediaries between farmers and CONAGUA and other state and federal agencies for obtaining and renewing the titles (most titles are valid for 10 years). The COTAS have also become intermediaries for users, who through them can get support to access government programs aimed at more efficient water use, a practice many farmers would like to see expanded.

Administrative tasks of COTAS

The COTAS have gained the recognition of CONAGUA, which has delegated several programs to them while also giving them a role in supporting the users in the required administrative procedures for renewal of water use permits in each aquifer.

PHOTO A2.2 Export Farming in Guanajuato

PHOTO A2.3 Groundwater Well with Electric Pump

Limited Results in Reducing Groundwater Depletion

COTAS have not become fully fledged user organizations in which strategies for reducing groundwater overexploitation have been devised. The result is that they have not achieved significant reductions in groundwater extractions, nor have they led to user self-regulation in the aquifers of Guanajuato. Three main reasons can be mentioned for the limited results in curbing groundwater depletion:

- The large number of users per aquifer (between 800 and up to almost 1,200 for most aquifers).
- Pressure to sustain and increase economic development, and the increasing demand by international markets for fresh vegetables exclusively produced with groundwater on Guanajuato's fertile soils.
- Very limited control by the sole national authority in groundwater administration, the CONAGUA.

Future of COTAS

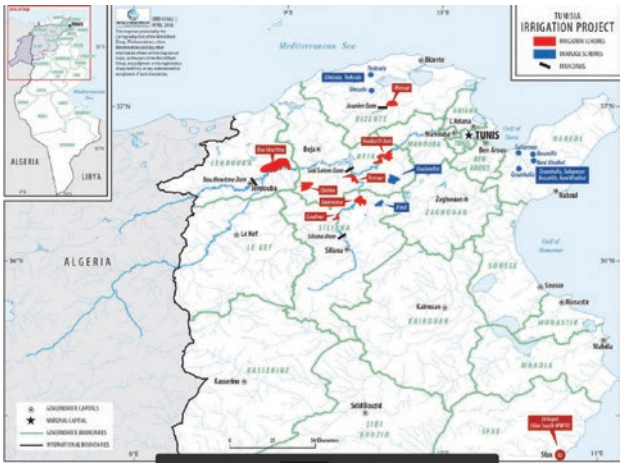
Today COTAS form a platform for groundwater users to find solutions for the vexing problem of groundwater depletion. To move forward, groundwater users would need to devise aquifer agreements with substantially lower levels of groundwater extractions, either through an adjudication of pumping rights on the basis of mutual prescription, or through a negotiated downward adjustment of groundwater concessions with the federal government. To do so requires continued financial support for these organizations and far-reaching changes in the institutional arrangements for water management that prevail in Mexico.

Reference

CEAG (Comisión Estatal del Agua de Guanajuato). 2006. *Memoria Institucional 2000-2006 de la Comisión Estatal del Agua de Guanajuato (CEAG)*. Guanajuato City, Mexico: CEAG.

Case 3. Tunisia: A National Irrigation Operator in the Form of an SOE

MAP A2.4 Irrigation and Drainage Schemes in Tunisia



Water Management Arrangement

- Regional Agricultural Development Directorates of the Ministry of Agriculture (CRDAs) operate the main system
- Agricultural development groups (GDAs) responsible for water distribution

Farmer Profiles

- 516,000 farms, av. 10 ha (in 2005)
- Only 3% of farms > 50 ha

Value Chains

- Olive oil (main export)
- Cereals
- Tomatoes
- Dates and grapes
- Citrus fruits

Sector Overview

Tunisia has invested substantially in modernizing its irrigation system (map A2.4). Two-thirds of the country's irrigated area is equipped with sprinkler or drip technology for on-farm irrigation, yet irrigated agriculture performs below its potential output. The return on irrigation investments is low, and public schemes rely on recurrent subsidies for the O&M of public schemes. Some areas that are equipped for irrigation have not been exploited, and cropping intensity is also below its potential (90 percent versus 130 percent). Photos A2.4 depict examples of drip irrigation in Tunisia to grow crops such as watermelons.

In 2018 the World Bank initiated the Tunisia Irrigated Agriculture Intensification Project in response to the Tunisian government's recognition of the need to shift from a supply side response (increasing water mobilization) to a demand management approach (more efficient and productive water use). As part of the project preparation, the World Bank and the Government of Tunisia diagnosed the problems plaguing the irrigation subsector and developed a framework to improve demand management. The project includes a combination of physical infrastructure upgrades, creating accountable institutions, and providing support to the farmers in increasing agricultural value addition.

Water Infrastructure

- 33 large dams
- 253 small dams
- 837 reservoirs
- 55,512 boreholes
- 130,000 wells
- 410,000 ha equipped for irrigation

Lack of Reliability in Service Delivery

The dilapidated state of irrigation infrastructure has impacted the reliability of service delivery. Frequent irrigation system failures can cause up to weeks of delay in service. This unreliability of service has prevented agricultural intensification on irrigation schemes. Farmers are hesitant to take the additional risk of investing in more profitable crop production because of the high probability of technical failure on the irrigation schemes. This is especially true for the northwestern region, where outdated systems are susceptible to repeated breakdowns, causing multiple service interruptions in the irrigation season. Figure A2.2 depicts the cyclical impact of unreliable irrigation services on farmers, who are then unable to invest in high-value crops, leading to low cost recovery and lack of O&M of schemes, which can lead to unreliable irrigation services.

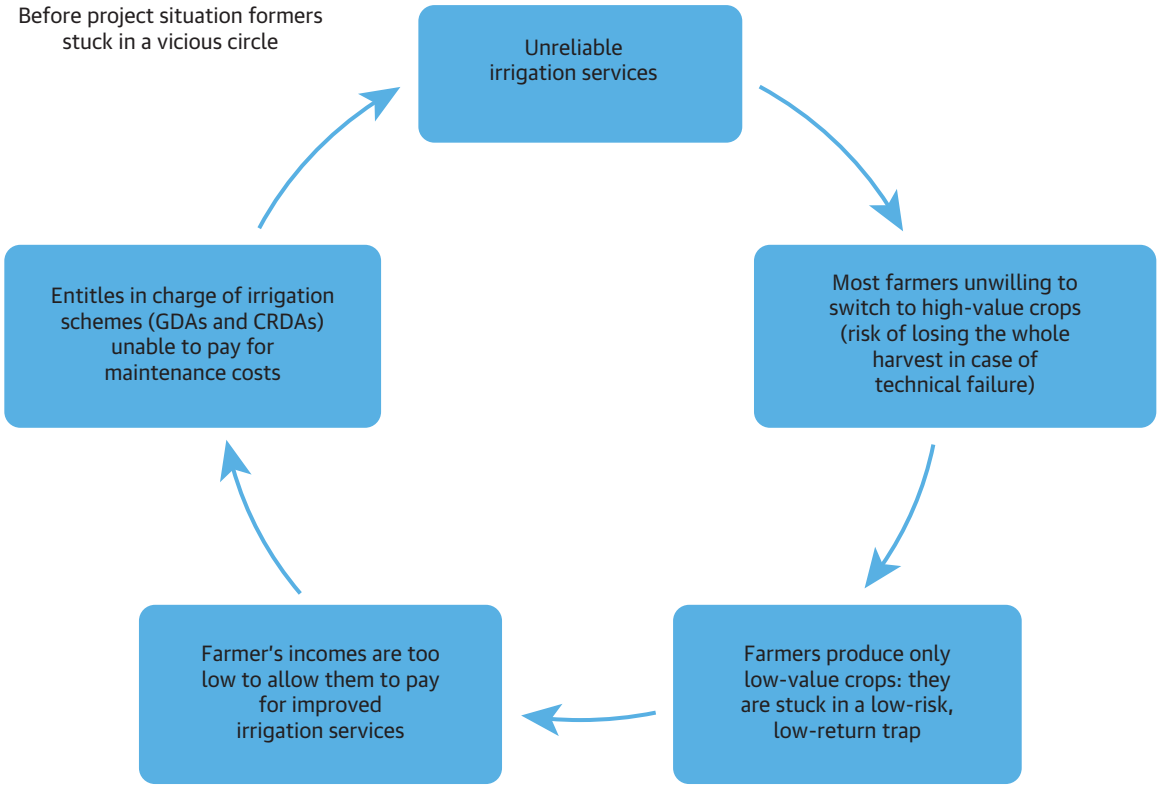
Institutional Failure

While the diagnostic by the World Bank and government notes multiple factors limiting the potential of irrigated agriculture, an important constraint is the current institutional model, in which there is a *lack of accountability* from the service provider to the users (in delivering the service), and from the user to the service provider (in paying for the service).

The institutional model in all public irrigation schemes is a decentralized system, in which the Groupements de Développement Agricole (GDAs, or Agricultural Development Groups) are delegated the responsibility of water distribution, and the Centres Régionaux de Développement Agricole (CRDAs, or Regional Agricultural Development Directorates of the Ministry of Agriculture) operate the

PHOTO A2.4 Drip Irrigation in Siliana Region, Tunisia

FIGURE A2.2 Cyclical Impact of Unreliable Irrigation Services in Tunisia

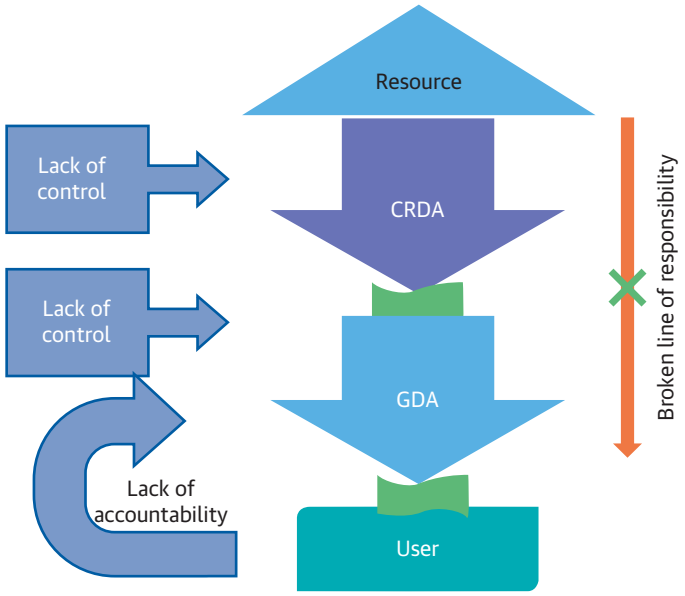


Note: CRDAs = Centre Régionaux de Développement (Regional Agricultural Development Directorates of the Ministry of Agriculture); GDAs = Agricole Groupements de Développement Agricole (Agricultural Development Groups).

main system. Figure A2.3 depicts the confusing and overlapping functional roles in the current institutional model that create a lack of control and accountability within the various organizational tiers. The project appraisal document (World Bank 2018) outlines five reasons for its failure:

- A uniform model is applied across all public schemes, ignoring specific characteristics such as the size and social cohesiveness of each scheme.
- The model does not differentiate between regulatory and operational functions.
- Neither the CRDA or GDA is "fit for purpose." The CRDA is an administrative body that does not have the flexibility needed to provide commercial services, while GDAs lack the mandate and proper training to ensure reliable service delivery.
- The interface between the CRDAs and the GDAs is vague (there are few delivery points equipped with flow meters), creating a lack of accountability to the final user.
- The arrangement for tariff structure and cost sharing between the CRDAs and GDAs does not correspond with the system's O&M costs. Consequently, GDAs often face significant managerial

FIGURE A2.3 Institutional Model in Tunisia, 2018



Note: CRDA = Centres Régionaux de Développement (Regional Agricultural Development Directorates of the Ministry of Agriculture); GDAs = Agricole Groupements de Développement Agricole (Agricultural Development Groups).

challenges. Out of the 1,253 GDAs in Tunisia, only 20 percent are functional with a cost recovery rate above 60 percent, but also with significant debt to either the CRDAs or the electricity supplier.

Institutional Reform Options

An independent study funded by Public-Private Infrastructure Advisory Facility was conducted during project preparation to find institutional options for the creation of autonomous, financially viable, and client-oriented irrigation management entities (World Bank 2018). Table A2.2 shows the five options identified and their main advantages and disadvantages.

To ensure political feasibility of these options, consultation activities with important stakeholders were conducted during project preparation. Eventually, the Tunisian government's preference for option II, establishment of a public company with participation from the private sector, was adopted. This institutional model will apply to seven large irrigation schemes located in the North-West. The project will first set up the state-owned enterprise (SOE), and will open its capital to private investors after a few years, once the technical and financial records are available and there is a reasonable level of cost recovery. For one of the smaller irrigation schemes under the project with adequate social cohesiveness, the proposed option is a farmer-based association.

TABLE A2.2 Institutional Options in Tunisia

Option	Advantages	Disadvantages
Etablissement Public (EPA)	Simple to set up (with Special law)	Same as CRDA: too bureaucratic, little financial and operational autonomy
Public company (SOE)	Corporatized utility, relatively flexible in its management Relatively simple to set up (with Special Law) Low stakeholders risk (political economy) Possible evolution to models with private capital	Some degree of political influence remaining
Public company with minority private capital	Same as above, except stakeholders' risk higher	Unlikely to attract private capital at this stage
PPP (majority private capital)	Simple to set up, no law required	Complexity of defining terms of contract Highly unlikely to attract private capital at this stage
User organizations	Ownership by the users Can be cheaper Transparent (in principle)	Lack of capacity Weaknesses of legal framework (even with new Code des Eaux) Accountability more challenging in practice

Note: CRDA = Centre Régionaux de Développement Agricole (Regional Agricultural Development Directorates of the Ministry of Agriculture); PPP = public-private partnership; SOE = state-owned enterprise.

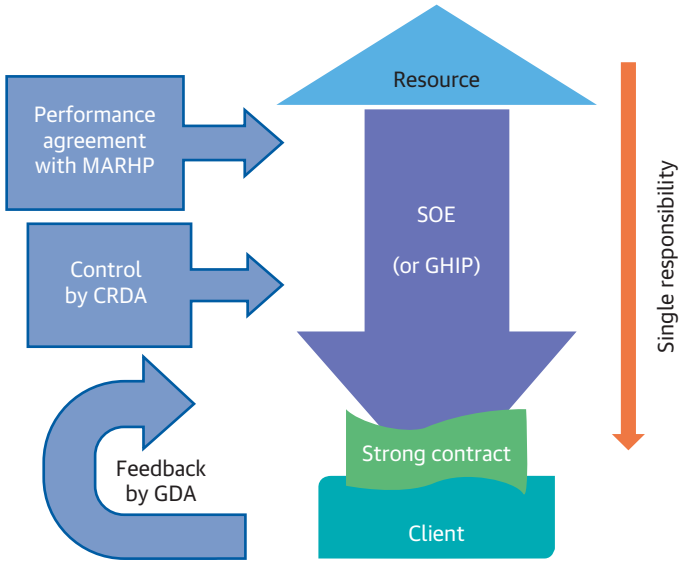
Institutional Model for Greater Accountability, Greater Reliability of Services

The Ministry of Agriculture, Hydraulic Resources and Fisheries (MAHRP) will establish the SOE and transfer to it the responsibility of all the irrigation and drainage (I&D) schemes rehabilitated under the project in the North-West. An agreement will be signed between the MAHRP and the SOE, giving the public company authority over the I&D assets, the right to collect irrigation service fees, and responsibility for delivering services. The government will transfer O&M subsidy payments during the transition period until the SOE achieves full cost recovery from water tariffs. The new provider will also receive assets from the CRDA, including offices, workshops, and necessary equipment. Some technical and administrative staff from the CRDA and the GDA staff will be transferred to the SOE.

Figure A2.4 illustrates the direct relationship between the service provider and the client in the new institutional model that will ensure accountability. The commercially oriented relationship to the client farmer, with an adequate performance monitoring system and financial autonomy through improved cost recovery, complemented by performance-based subsidies, will help break the vicious cycle of low-cost recovery and unreliable irrigation services. The short-term aim for the new SOE will be to recover the annual O&M cost, and in the medium to long term, recover the depreciation (the investment cost).

Figure A2.5 depicts the project's three-pronged approach to agricultural intensification in Tunisia. This institutional modernization will be complemented by targeted rehabilitation, ensuring O&M cost recovery through increased tariffs, and assisting farmers in enhancing the agricultural value addition.

FIGURE A2.4 New Institutional Model in Tunisia



Note: CRDAs = Commissariats Régionaux de Développement Agricole (Regional Agricultural Development Directorates of the Ministry of Agriculture); GDAs = Groupements de Développement Agricole (Agricultural Development Groups); GHIPs = Groupements Hydrauliques d'Intérêt Public; SOE = state-owned enterprise.

Summary of Key Functions from Six Perspectives

Perspective 1: Farmer involvement

Approximately 8 percent of the farmers own more than half of the cultivable land, while about 62 percent are smallholders with less than 10 hectares each. About 25 percent of the rural population is landless (Qamar 2013). Under the World Bank project, farmers will be provided with advisory services to improve productivity gains and strengthen linkages for local value addition. Since citizen engagement is an important part of the institutional reform process, the new provider will be more accountable to farmers.

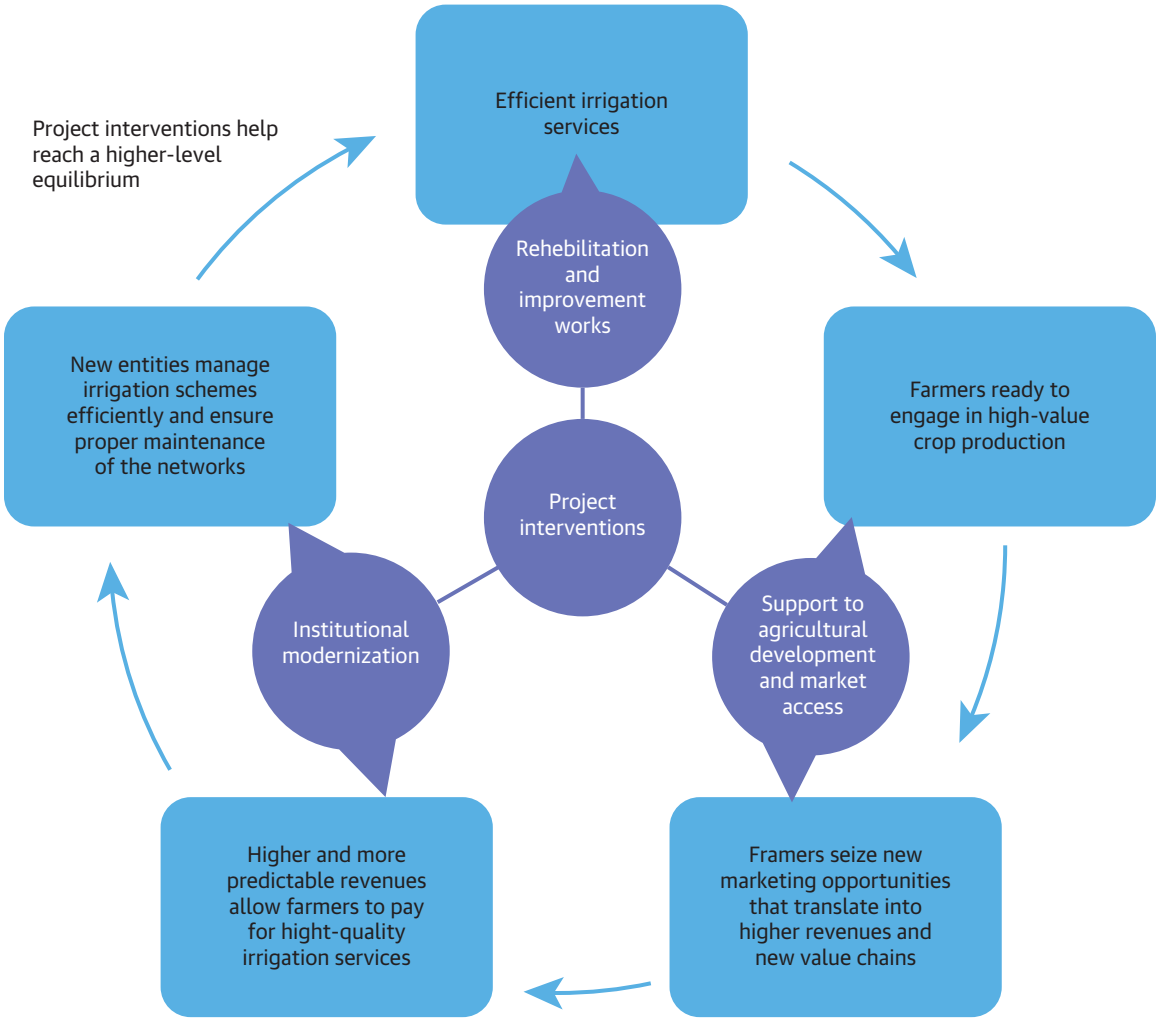
Perspective 2: WUA (GDA)

GDAs previously were delegated the responsibility of water distribution. In the new institutional structure, existing GDAs will be the counterparts representing the interests of the users to the operator, through an appropriate citizen engagement mechanism. In schemes in which the GDA will remain in charge of the O&M, they will evolve into Groupements Hydrauliques d'Intérêt Public (GHIP) with strengthened capacity.

Perspective 3: Agency (CRDA)

The CRDAs are the regional service providers that are part of the MAHRP and oversee the operations of the main irrigation systems. Under the new institutional model, the CRDA will transfer its responsibilities as a service provider to the newly established entity, SOE. The CRDA will have a project owner role, monitoring the performance of the schemes' operations against agreed indicators.

FIGURE A2.5 Theory of Change for Agriculture Intensification in Tunisia



Perspective 4: Line ministries (MAHRP)

The MAHRP had been the main public service provider. All the regional service providers (CRDAs) are part of the MAHRP. Under the new institutional structure, the MAHRP will sign a performance-based contract with the new operator.

Perspective 5: Private sector

While the Tunisian government has tried to encourage private sector investment in irrigation, there are currently no private companies that provide I&D services. Under the new institutional model, the new operator will open its capital to private investors after a few years (Qamar 2018).

Perspective 6: Non-irrigation user

Renewable water resources are about 420 cubic meters per year per inhabitant, which is below the level of absolute water scarcity, and agricultural consumption takes about 80 percent of the water resource.

However, rapid urbanization is putting immense pressure on water resources. Between 2012 and 2013, water consumption increased by 12 percent due to the rise in urban population (World Bank 2014). Climate change also has a strong impact on water users in the country, as evidenced by the severe drought in 2016 and 2017.

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Case 4. Morocco: A Classic PPP in the El Guerdaine Irrigation Scheme

MAP A2.5 El Guerdaine

Scheme Overview

The Souss-Massa-Draa Region (see map A2.5), located in the Province of Taroudant, produces nearly 60 percent of the region's citrus exports (Houdret 2008). The El Guerdane irrigation scheme of the Souss Region, because of its semi-arid climate, has traditionally been impacted by water scarcity. Due to the region's limited rainfall, before the project farmers have always relied on individual wells exploiting the groundwater from the Souss Aquifer for the irrigation of their crops.

Key Problems and Challenges

Due to the high quantities of water withdrawals, the Souss Aquifer began to experience gradual overexploitation. Water that was accessible at 25 meters in the 1960s was extracted at depths reaching 200 meters in the early 2000s (Houdret 2008). This made the extraction of water more expensive for farmers, resulting in abandoned farmland, because farmers no longer found it profitable to continue irrigating with such high extraction costs.

Water Management Arrangement

- Public-private partnership (PPP) contract (build-operate-transfer)
- Private sector in charge of construction of hydraulic infrastructure and operation for 30 years

Farmer Profiles

- Size range: 5 ha to 20 ha
- No. of farmers: 600
- Business and cash-income orientation

Value Chains

- Citrus (orange trees)

Water Infrastructure

- Before the project: farmers used individual wells
- After the project: 10,000 ha equipped with pressurized collective network, using water from an existing dam (Aoulouz Dam)

In 1995, the Watershed Management Plan of Souss-Massa allocated an annual 45 million cubic meters of water to the El Guerdane irrigation scheme, which encompasses 10,000 hectares. The water would originate 40 miles from the El Guerdane perimeter at the Aoulouz Dam (IFC 2013). The government's intention was to complement the current irrigation with surface water, alleviating the stressed aquifer. Every hectare was projected to receive around 4,000 cubic meters of additional surface water, or 50 percent of the total amount needed to irrigate citrus crops. Various schemes were explored to use the newly available water for irrigation resourcefully.

The first option was the classical approach of public development through the Code of the Agricultural Investments (CIA), which would require the Government of Morocco to pre-finance all investments. The government would then recover the installation costs in the form of direct participation from the farmers receiving the services. Through the CIA, however, it would be difficult for the government to pre-finance capital expenditures (CAPEX) for construction and provide adequate operating expenses (OPEX) for infrastructure maintenance.

A second attempt to co-finance an irrigation scheme with the regional WUA (AUEA Al Moustaqbal) was discussed. Under this structure, the state would finance 40 percent of the project and the farmers would finance the remaining 60 percent.[1] This structure, however, would result in expensive water prices and an expensive right to connect for the farmers, thus proving equally unviable.

Approach and Solutions

Given the constraints of the first two options, the Government of Morocco gradually began to support the idea of developing the region's irrigation infrastructure through collaboration with the private sector, because publicly funded projects were predicted to result in substantial public investments or in a lower quality of service provided. Accordingly, the world's first public-private partnership (PPP) in irrigation was launched in El Guerdane to assist the region's agricultural sector. Through the implementation of PPPs in irrigation, the Government of Morocco sought to:

- Reduce the public sector's subsidies for investment and O&M.
- Improve sustainability and quality of I&D services to its farmers at an affordable cost.
- Promote the modernization of irrigation practices.
- Promote efficient use of water resources using the right incentives (such as volumetric billing).

In this new venture, the private sector would work with the government of Morocco in a BTO (build-transfer-operate) contract. In a 30-year partnership, the private sector would be responsible for (a) the construction of a 90-kilometer conveyance structure (pipeline) from the Aoulouz Dam to the El Guerdane perimeter; a 300-kilometer irrigation network covering the project's 10,000 hectares; and the O&M of all hydraulic Infrastructure.

Transformation Strategy in Detail

A long and tortuous pathway to find a private operator

The El Guerdane project had to undergo two distinct bidding processes. The first began with a prequalification round for interested investors, which identified potential candidates based on their financial and technical backgrounds. The technical capacity criteria included the number of years of experience in irrigation network operations and years of experience in the construction of hydraulic infrastructure (World Bank 2005). The technical criteria also required the interested companies to demonstrate a total of US$200 million in hydraulic infrastructure works performed over the previous eight years (from 1996 to 2004). The financial criteria included a net worth of at least US$100 million, and either a debt ratio below 60 percent, or a net operational result of at least US$40 million.[2]

Once the interested companies were prequalified, the second phase of the prequalification round began: the structuring of consortiums, led by local financial investors. Lead investors were allowed to team up with both local and international construction firms (or other firms through which their services could be provided). Once the consortiums were created, the official bidding process was opened. The single criterion for the bid was the lowest tariff offered per cubic meter of water provided. During the first bidding process two consortiums, one led by Suez S.A. and the other by Omnium Nord-Africain (ONA), met the prequalification criteria and moved on to the technical and financial round. After the prequalification round, ONA wished to make changes to the composition of its consortium. Unsettled by this request, Suez S.A. withdrew its technical and financial bids. While the Government of Morocco could have continued the tender with ONA, the government decided to terminate the bidding process to avoid dealing with a unique bidder.

Consequently, a second tender was launched welcoming all investors wishing to participate to directly submit technical and financial proposals. The prequalification phase of the bidding process was eliminated, but the prequalification criteria were not. In other words, any interested company could submit their technical and financial proposals, but only those that met the prequalification criteria would have their envelopes opened. The contractual documents remained unchanged from the first attempt, the only difference being the elimination of the prequalification round, reducing the tender evaluation from a two-phase to a one-phase process.

A total of two bids were received from two consortiums that had met the prequalification requirements, ensuring the opening of both their proposals. The winning consortium, Amensouss, offered a tariff of LD 1.48 (US$0.168) per cubic meter. The second consortium, which included HOLDING-YNNA (HY), DIMATIT, and Société Nouvelle Travaux Maroc (SNTM), offered LD 1.88 (US$ 0.213) per cubic meter of water (World Bank 2005). The contract was thus awarded to Amensouss in 2004 and signed in 2005. The Amensouss Consortium had the ONA Company (currently called NAREVA) as a major shareholder, but also consisted of Igrane Fund from Morocco's Caisse de Depôt et Gestion (CDG), France's Compagnie Nationale d'Aménagement de la Région du Bas-Rhône et du Languedoc (BRL), and Austria's Infrastructure Development and Management (Inframan). It should be noted that HM King Mohammed VI, the current king of Morocco, held notable stock in ONA, the winning concessionaire, which blurred, in many aspects,

the line between the public and private sectors. This situation has changed since the award of the PPP contract because the king is no longer a shareholder of NAREVA.

Difficult balance between incentives and risk allocation in PPP arrangements

Signed in 2005, the El Guerdane concession is regarded as the world's pioneering PPP in irrigation. The El Guerdane project is a BTO. Under this 30-year model, the private sector (concessionaire) is responsible for the construction of a 90-kilometer conveyance pipeline stretching from the Aoulouz Dam to the El Guerdane perimeter, and an irrigation network of approximately 300 kilometers encompassing El Guerdane's 10,000 hectares.

The completion of these projects had to take place within the first two years of the 30-year contract period. Upon completion the infrastructures were transferred to Morocco. The O&M of the infrastructure, however, was delegated to the private sector for the remaining time of the contract.

CAPEX

The total cost of the infrastructure was estimated at US$105 million, an amount that was directly co-financed by the private sector, the public sector, and the users (IFC 2013). The public sector, which financed nearly US$50 million, was able to contribute its share through the assistance of the Hassan II Fund for Economic and Social Development. The water users were responsible for paying a subscription tariff at the onset of the concession period, which accrued to approximately US$8 million (farmers were responsible for paying only half of their subscription tariffs upon subscription; the remaining amount was spread throughout the contract period). This money was used to cover part of the initial investment cost. Of the total investment, the state covered approximately 48 percent; the private concessionaire, 44 percent; and the users, the remaining 8 percent. The private sector was able to finance 75 percent of its contributions from commercial loans and the rest from its equity.

OPEX

Throughout the years, the water users continued to pay a tariff for the provision of I&D (US$0.168 per cubic meter initially, but the tariff evolves), and an additional public domain fee (LD .02 [US$0.00545] per cubic meter). The revenue from water tariffs is transferred to the private company as reimbursement for its initial investment, while the public domain fee goes to the River Basin Agency. The government, through its substantial initial investment, subsidized a large part of the construction to facilitate the concessionaire's ability to offer a better tariff. Because the government was not going to subsidize during the operation period, the goal was to secure a tariff not too high for farmers to pay, but not too low for water to be used frivolously.

The tariff for the service of water had two components: *fixed* and *variable*. The fixed component was an annual prepayment of 20 percent of the subscribed water volume determined at initial subscription. The variable component, in contrast, was based on water consumption. Due to the high water demand, the concessionaire was given the right to suspend water provision to nonpayers and to prioritize making the nondistributed water available to farmers on the waiting list.

Risk allocation

In relation to risk, the PPP arrangements aimed to transfer as much of the risk as possible to the service provider without discouraging the private sector to bid. The payment risk was fully transferred to the private party. The supply risk, in contrast, was divided between the public sector, private sector, and users. In cases when water is deficient in the system, the amount that the private sector may lose is capped. The following measures were or will be taken to mitigate the supply:[3]

- In the case of a 0 percent to 15 percent water deficiency, the private sector must bear the full financial loss.
- In the case of 15 percent to 22.75 percent water deficiency, the private sector must bear the first 15 percent of financial loss, and the user will bear the remaining amount (through an increase of water tariff).
- The Government of Morocco will compensate the service provider for any water deficit above 22.75 percent.
- Users already assume partial supply risk through tariff surcharges (limited to 10 percent of the tariff).

Through the public contribution to initial investment, the water tariffs charged by Amensouss outcompeted the increasing price of groundwater, incentivizing farmers to subscribe to their service.

The following was or will be done to mitigate demand risks (World Bank 2005):

- Construction did not start until 80 percent of the water was subscribed for.
- An initial subscription was organized in which identified subscribers paid an initial tariff.
- Water was allocated among subscribers according to overall and individual demand.
- Water (4,000 cubic meters per hectare) that is not subscribed for is reallocated among farmers who need more.
- Farmers who do not use part of their water *lose their right to the unused volume*, to the benefit of other farmers.
- If demand is insufficient, subscription will be opened to other farmers in the area (beyond target beneficiaries).

Creation of Renewal Fund as a major innovation of PPP design

The El Guerdane project included a Renewal Fund, which is not scheduled to begin until the 21st year of the contract period. From year 21 to year 30 of the concession, the concessionaire will be responsible for financing the Renewal Fund (approximately US$18.8 million), which is to be used for the renewal and restoration of the irrigation system after the 30-year contract expires, irrespective of the entity in charge of the irrigation scheme. Tables A2.3 and A2.4 summarize the main financial information of the PPP design.

TABLE A2.3 CAPEX of PPP Design in Renewal Fund, El Guerdane Project

Percent

Concessionary (public sector)	48
Concessionaire (private sector)	44
Users	8

Source: World Bank 2005.

TABLE A2.4 OPEX of PPP Design in Renewal Fund, El Guerdane Project

Item	Comments
Public subsidy for operation	None
Payment from users to concessionaire	US$0.168 per cubic meter (evolving tariff)
Payment from concessionaire to Basin Agency	LD .02 cents (US$0.00545) per cubic meter (approximately)
Payment from concessionaire to Renewal Fund	US$18.8 million over the last nine years

Source: World Bank 2005.

Summary of Key Functions from Six Perspectives

In December of 2001, the International Finance Corporation (IFC) began supporting Morocco, and served as the lead technical and financial advisor to the Moroccan government. Prefeasibility studies and risk analysis began in 2002, and upon signing the concession in 2005, the IFC was no longer involved in negotiations between the Government of Morocco and Amensouss.

Perspective 1: Farmer involvement

Farmers are customers of an on-demand, individual, and pressurized irrigation service (hydrant on the plot). They pay the irrigation fee on a volumetric basic based on actual water consumption, and are subject to service interruptions.

Perspective 2: Regional WUA

The regional WUA (AUEA Al Moustaqbal) plays no specific function in the PPP arrangement.

Perspective 3: Government irrigation agency (ORMVASM)

Morocco delegated the responsibility of representing the public sector to the Office Regional Mise en Valeur du Souss-Massa (ORMVASM, or the Regional Office for Agricultural Development of Souss Massa). The ORMVASM's primary responsibility is to interact with the Agency of Souss Massa Basin, the regional basin agency, to ensure the availability of water. The ORMVASM also interacts closely with the concessionaire and the users, supervising compliance with the terms of contract.

Perspective 4: Line ministry (Ministry of Agriculture)

The Ministry of Agriculture signed the 30-year PPP contract with the concessionaire (private consortium), representing the public party (concessionary). The contract regulator is a PPP unit created within the Ministry of Agriculture.

Perspective 5: Private sector/concessionnaire

The main obligations of the private operator are the following. Financing 50 percent of the costs for the investment, design, and equipping of 10,000 hectares, which includes the construction of a 90-kilometer pipeline and a 300-kilometer distribution network to transport the water, and a distribution system to deliver it to farmers (based on the size of their citrus groves).

Thirty years of O&M of the irrigation system and all related costs, which should be covered by irrigation tariffs paid by the farmers. The obligation to commence construction was delayed until enough farmers had subscribed (and paid the initial fee) to cover 80 percent of the water supply expected through the scheme. Contributing to the Renewal Fund, which is scheduled to begin the 21st year of the contract period.

Summary of Key Learnings from El Guerdane

An overall positive experience

The El Guerdane experience has proven to be a successful one for all parties involved:

- The *public sector* was able to minimize its public funding (for initial investments and O&M subsidies) through the mobilization of the private sector while getting new hydraulic assets.
- The *farmers* were able to receive better and more sustainable I&D services at a price no higher than they previously paid.
- *The private sector* made a profit thanks to distributed contractual risks and the constant incorporation of innovation.

A huge demand from farmers for I&D services

A year after the signing of the concession (2005), the **total capacity for subscriptions was maxed**. A total of 10,000 hectares, as planned, would be irrigated upon completion of the construction. Another 5,000 hectares were placed on a waiting list. While the recharge rate of Souss Aquifer has not been determined since the signing of the concession, it is presumed that less water is being pumped for irrigation of the perimeter. Several reasons for El Guerdane's success include the practice of a "take-and-pay" method as opposed to a "take-or-pay" scheme. In the former, the farmers are not responsible for paying for water they have not used. This financial tool allows for more flexibility when balancing the supply and demand of water for the region.

A well-designed risk allocation

Another notable aspect of the **PPP was the risk allocation** at the supply, demand, and investment levels, which may have further attracted private investors. A prime example is the distribution of the supply risk between the concessionaire, the government, and the users according to the water deficiency in the system. While the benefits of the Renewal Fund have yet to be reaped, the El Guerdane project is innovative in that the concession plans for the renewal of the irrigation system beyond the 30-year contract period. Another key element is the farmers' financial capacity to pay for the water. Without the provision of water, it is very possible that many farmers would have to stop the production of their high-value crops targeted toward the international market.

Room for improvement

Despite its success, El Guerdane has encountered roadblocks that serve as learning tools for future PPPs. The total cost of the construction works, for instance, was lower than the total amount anticipated. The private sector was able to reap the entire benefit of not having spent all the funds, because the public sector had no mechanism through which it could retract unused money allocated for construction.

A few years after the works construction, heavy rains caused a destructive flood that damaged the 90-kilometer pipeline. The public sector had to pay for the repairs (force majeure). It is believed that this issue may not have arisen if better works design had been practiced during the construction phase.

While noting the overall positive outcomes, it is important to assess the limitations and negative outcomes. Research at Guerdane has identified losers in the process. Houdret (2012) calls for more careful evaluation of the ecological and the social impacts before replicating the model elsewhere. The following main issues were identified[4]:

- The low-income farmers in the area viewed themselves as having lost access to land and water in the process. Small farmers reportedly lost access to water that was reallocated to the project, and due to the technical and financial requirements to switch to drip irrigation, could not afford to be included. Small-scale farmers (comprising 62 percent of the headcount) cultivate one-third of the land, but have access to only 13 percent of the groundwater (El Mahdad 2003).
- Irrigation expansion reduced opportunities for cattle breeding, a traditional form of investment and financial security for farmers in the region, though this loss was offset by growing involvement in milk production.
- The selection of beneficiaries was reportedly highly contentious and favored farmers owning large plots rather than those owning small plots, adding to the marginalization of the less powerful and contributing to accumulation of resources of the more powerful. It was reported that information on registration processes, for example, was relayed too late to certain groupings for them to enter the process.
- Several large landholdings in the irrigation system were owned by the same people who invested in the infrastructure, further increasing rather than decreasing economic and social inequalities.

Guerdaine success is difficult to replicate, even in Morocco

From 2008 to 2010, the Government of Morocco began to carry out feasibility studies in nine other regions around the country in which potential PPPs in irrigation could be implemented. Legal, economic, financial, institutional, and technical studies have been carried out for the existing large irrigation schemes, but the institutional model has been difficult to replicate for existing schemes for many reasons:

- The existence of different appetites for the modernization of irrigation services and capacity to pay from farmers within the scheme (subsistence farmers of cereal compared to commercial farmers).
- The need of a higher public subsidy for CAPEX to make the model attractive to the private sector.
- Local resistance due to the socio-political impacts of transferring the management of the scheme from a public entity (ORMVASM) to the private sector (concessionaire).

Notes

1. See the Syngenta Foundation for Sustainable Development website, https://www.syngentafoundation.org/.
2. See the Syngenta Foundation for Sustainable Development website: https://www.syngentafoundation.org/.
3. See the Syngenta Foundation for Sustainable Development website: https://www.syngentafoundation.org/.
4. The concerns regarding the performance of PPP contracts and social impacts reported in this document include criticisms identified in scholarly literature (Houdret 2008, 2012). These are included in the interests of presenting diverse views, and to prompt further reading and critical reflection. The findings reflected by various authors are not endorsed by the World Bank Group by their inclusion in the document.

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Case 5. Bangladesh: Decentralization Leads to Operational Success

MAP A2.6 Bangladesh

Bangladesh Water Challenges

- Flat topography, frequent flooding, river erosion
- Climate change impacts
- Seasonal water shortages
- Inadequate water management infrastructure
- Poor operation and maintenance of water resources infrastructure
- More than two-thirds of the rural population is landless or functionally landless (owning fewer than 0.2 ha of land)

A Robust Policy Environment

Bangladesh is characterized by heavy rainfall during the monsoon seasons and water shortages during the dry seasons (map A2.6). Water management interventions have had a tendency to ignore project beneficiaries and designs often have had a single purpose that neglected and interfered with needs of other users (such as navigation, fisheries, and wetland conservation).

In 1995 the government initiated a robust policy, planning, institutional, and legal framework for the sector. The National Water Policy (NWP) provided guidelines to effectively manage critical water resources, emphasizing (a) stakeholder participation; (b) strategic planning;

Small-Scale Water Resources Development

Typical interventions on systems of 1,000 ha or less:

- Construction of flood protection embankment
- Conservation of water for irrigation
- Construction of water control structures and rubber dams
- Excavation and re-excavation of canals
- Training stakeholders and Water Management Cooperative Association (WMCA) members

PHOTO A2.5 Images from the Asian Development Bank–Financed PSSWRSP

(c) decentralization; (d) sound management of social and environmental issues; (e) sustainable O&M through management transfer to WMAs; and (f) autonomy, transparency, and accountability of sector institutions (ADB 1995).

An important provision under the NWP was the jurisdiction of local government institutions over small (those 1,000 hectares or fewer) water schemes, which had previously been the responsibility of the Bangladesh Water Board. By bifurcating responsibility for large and medium systems (those above 1,000 hectares) with small-scale, it enabled closer attention to be paid to the subproject development cycle, community participation, and, importantly, improved O&M.

Supporting Guidelines for Participatory Water Management were approved in 2000 under the policy framework. These provided the guidance on how to establish WMAs on large and medium schemes, and water management cooperative associations on small-scale schemes (Ministry of Water Resources 2000).

The National Water Management Plan (2004) provided a comprehensive framework for short- to long-term strategy and priority programs. It was the final piece of the jigsaw, resulting in an elaborate and comprehensive policy framework.

A Novel Institutional Setup

The Local Government Engineering Department (LGED) under the Ministry of Local Government, Rural Development and Cooperatives (MLGRD&C) is responsible for small-scale water resources (SSWR) development. It was established in 1984 and is considered to be one of the most successful water sector institutions in Asia.

The LGED is a highly decentralized organization with more than 90 percent of total staffing at district and *upazila* (subdistrict) levels. The chief engineer is the head of the organization, supported by four additional chief engineers, with supporting staff. The total staff under permanent payroll is 10,287 (at headquarters and field levels).

A decentralized institutional setup with main staffing strength at the upazila level enables the LGED to provide closer support to the development of Water Management Cooperative Associations (WMCAs). The upazila engineer, being based in the field and close to beneficiaries, facilitates construction and O&M supervision, conflict resolution, and other participatory actions that can otherwise suffer in heavily centralized agencies. The LGED has achieved notable results in two phases of SSWR development projects, financed by the Asian Development Bank (ADB) with co-financing from the International Fund for Agriculture Development and the Government of the Netherlands. There is an on-going ADB-financed Participatory Small-Scale Water Resources Sector Project (PSSWRSP) and a subsequent phase in planning stage.

Intermediate Level: Circle Offices

- 10 LGED circle offices are below the headquarters and above the district level.
- Circle office is headed by a superintending engineer.
- Circle offices monitor O&M and train LGED staff and WMCAs.
- Training is focused on technical issues with special reference to quality control.

Beneficiary Participation

Water management in Bangladesh was historically dominated by top-down approaches, steeped in bureaucracy and with an engineering bias. There was very little or no beneficiary involvement, resulting in suboptimal performance. Absence of O&M funds and lack of beneficiary participation resulted in system disrepair and loss of benefits from production.

Encouraged by the success of the privatization program of tube well irrigation, the government undertook transfer of management of flood control, drainage, and irrigation schemes to beneficiaries. This transfer was enacted under the Bangladesh Water Development Board Act, 2000. The Guidelines for Participatory Water Management provide a systematic and comprehensive process for stakeholder participation in six stages of subproject development and management:

- Identification, prefeasibility
- Feasibility study
- Detailed planning and design and stakeholder institution building
- Implementation and trial operation
- O&M
- Monitoring and evaluation

District Level

LGED is responsible for:

- Guiding and monitoring the LGED at upazila level.
- Registering monitoring reports in subprojects.
- Taking actions based on monitoring report recommendations.
- Reporting issues and progress to the supervising engineer circle level and the additional chief engineer (IWRM).

The District Small-Scale Water Resources Development Committee supports and assists project implementation at the district level.

Upazila and Union Level

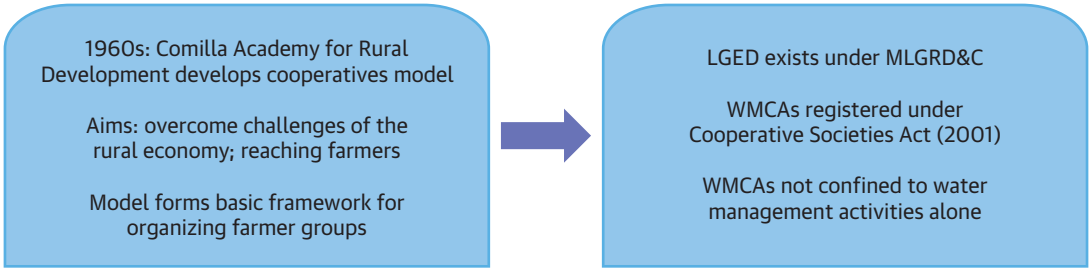
The upazila engineer is closest to and most regularly in contact with WMCA, and responsible for:

- Guidance to WMCA in the walkthrough and preparation of annual plans.
- Monitoring subprojects, including the WMCA functioning.
- Actions to improve functioning.
- Registering and conveying major maintenance needs to LGED district level.

The Development Coordination Committee and the *union parishad* (lowest administrative unit) monitor progress.

Under the ADB-financed PSSWRSP, much emphasis was placed on further refining key elements of the subproject development process, specifically further enhancement of the O&M phase. A comprehensive set of guidelines was developed for O&M (including rationalizing budgets, condition assessments, and fund management), which was approved under the overall policy framework.

Farmer Cooperatives: More than Water Management



The advantage of registering WMCAs as cooperatives is that they have evolved into multipurpose cooperative societies, with microcredit forming a significant activity (de Silva 2012). A 2006 study (ADB 2006) finds that the reason some WMCAs were thriving was because of the diversification of their activities. They had more group cohesion and were also performing water management responsibilities very well. Activities in addition to water management, particularly microcredit, thus provide the scope for more

Impressive Results and Lessons

Successive SSWR investments demonstrate that better rural water management and crop production technologies enable water users to increase productivity, strengthen household food security, improve nutrition, and safeguard rural livelihoods by reducing the risk of flooding. ADB's evaluation reports for Small-Scale and Second Small-Scale Water Resources Sector Development Projects (ABD 2007; ADB 2012) finds that:

- Decentralized, community-managed SSWRs have improved rural incomes and are an effective means of reducing rural poverty.
- Successful WMCAs have farming, entrepreneurial, management, and leadership skills among members; enthusiastic leadership; a common goal; salaried staff for maintaining accounts and records; and a transparent system for raising and utilizing funds.
- Between 2002 and 2008 (a) average cropping intensity increased by 28 percent (from 170 percent to 198 percent) compared with only 8 percent within the control area; (b) paddy production increased by 57 percent.
- Beneficiary engagement at all stages of the subproject development process improves the sustainability of WMCAs.
- WMCAs have not collected or spent enough on maintenance to prevent a gradual build-up of deferred maintenance. Deferred maintenance leads to a "build-neglect-replace" cycle and a loss of benefits, and affects the sustainability of WMCAs. Activities to institutionalize WMCA-managed O&M through a detailed strategy should be initiated at an early stage of subproject development.
- Women's participation in WMCAs has an encouraging effect on subproject implementation. Although there is one-third reserved membership for women in WMCA managing committees, women's effectiveness depends on their capabilities, which can be improved through training.

sustained activities (as a group) throughout the year. The financial surplus that may be generated by other activities can contribute to O&M costs and the socioeconomic development of the WMCA members.

The water management organizations (WMOs) surveyed (ADB 2006) were strongly favorable to a single-tier, registered cooperative association being the appropriate legal institution for LGED WMOs. Ensuring accountability and transparency by observing the cooperative rules and laws is considered more appropriate for organizations such as WMCAs, which are likely to handle more funds for O&M.

LGED and the Department of Cooperatives continue to work closely in the formation and nurturing of WMCAs. ADB has supported the MLGRD&C in strengthening the Department of Cooperatives (under the PSSWRSP) with the establishment of a dedicated Water Cell that focuses on WMCAs' registration and training needs. Being under one ministry surely facilitates the development process.

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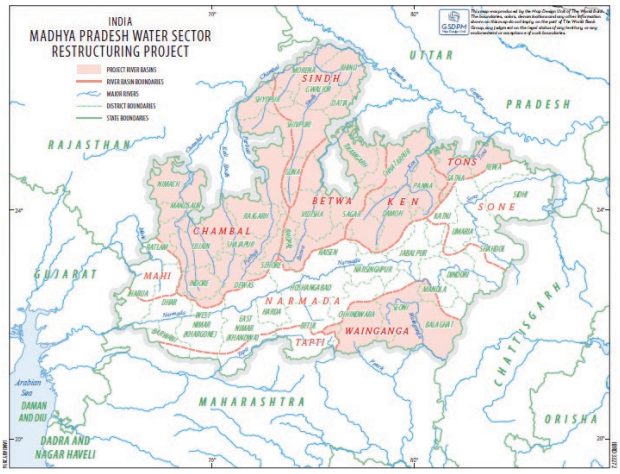
Case 6. India: Championing Change with Leadership

MAP A2.7 Rivers and River Basins in Madhya Pradesh



Madhya Pradesh's Irrigation Turnover

Madhya Pradesh, despite being one of India's poorest and most infrastructurally underdeveloped states, became the country's agricultural success story (map A2.7). Between 2005 and 2015, the sector grew on average 9.7 percent annually (Gulati, Rajkhowa, and Sharma 2017), and achieved a record agricultural growth rate of 20.4 percent in 2013-14. This impressive and sustained growth has been unmatched by any of the other major agrarian states in India, as depicted in figure A2.6.

One of the factors driving this accelerated agricultural drive in Madhya Pradesh is its irrigation sector. The state government, by guaranteeing water and power supplies to farmers during the wheat season, increased wheat production significantly (Gulati, Rajkhowa, and Sharma 2017). The irrigated area in the state expanded threefold since 2010-11 (Burton and Stoutjesdijk 2017). This irrigation turnover is largely due to improvements in management in the state's Water Resources Department (MPWRD), instituted by the state's senior bureaucratic and political leadership. This case study outlines the features of this management approach and the leadership that championed this change.

Water Management Arrangement

- Nodal state government agencies operate major irrigation systems
- MPWRD is the public irrigation agency
- Minor systems operated jointly with WUAs, farmer groups, and contractors

Value Chains

- Rice
- Wheat
- Other cereals
- Pulses
- Oilseeds
- Cotton

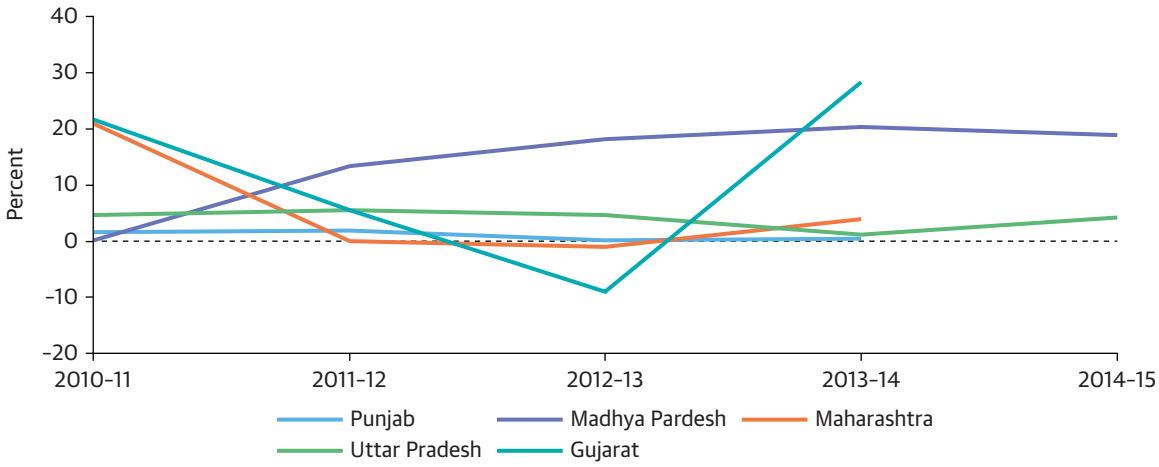
Water Infrastructure

- Gross irrigated area: 10.3 million ha
- 67% wells and tube wells, 17% canals, 13% other sources, 3% tanks/ponds

Farmer Profiles

- Cultivators: 9.84 million
- 37.6% are female
- Agricultural labor: 12.1 million

FIGURE A2.6 Share of Agriculture and Allied Activities Growth Rate in Indian States, in 2004-05 Prices



Source: NITI Aayog 2014.

Sector Overview

Madhya Pradesh is India's second-largest state, with an estimated population of 72 million (map A2.7). It is sourced by 10 rivers that are rainfed, mostly in the monsoon season (June to September). During the monsoon season the annual rainfall ranges from 800-1,600 millimeters (World Bank 2004), but this is usually insufficient for a full crop harvest, and supplemental irrigation is required. The winter crops rely completely on irrigation because the river flow between December and May is quite low (Julaniya et al. 2016).

Problems in Service Delivery

Operability of the irrigation system

Most of the I&D systems lacked sufficient O&M attention, with less than 50 percent (on average) of the created potential being utilized. The gap between the irrigation potential created (IPC) and irrigation potential utilized (IPU) ranged from 70 percent in minor schemes to 50 percent in medium schemes to 40 percent in major schemes (World Bank 2015).

Unreliability

Due to the lack of rehabilitation and remodelling of irrigation infrastructure, the supply of water tended to be less predictable. This was aggravated by insufficient extension, and the lack of use of agricultural technology, inputs, and diversification (World Bank 2004).

Multiple-use services

Competing demands from other sectors, such as domestic, power, and industrial, for storage water resulted in groundwater exploitation for irrigation. This has put greater pressure on the state's groundwater resources (World Bank 2004).

Organizational Resources and Governance Challenges

The problems in service delivery are indicative of the governance deficit in public irrigation in India, in which investment in irrigation is insufficiently planned, implemented, and managed (Shah et al. 2016). The key issues in public irrigation that the MPWRD set out to tackle were (a) extended project gestation periods; (b) deferred maintenance in many projects; (c) poor canal management; (d) low motivation among the staff; (e) inadequate communication between the department, farmers, and WUAs pertaining to service delivery and asset management; and (f) setting low targets with an outdated monitoring system (Julaniya et al. 2016).

Strategies for Improvement

Shivraj Singh Chouhan, Madhya Pradesh's chief minister, prioritized agricultural growth through irrigation expansion as part of his development strategy (Shah et al. 2016). His initial approach involved improving power supply for irrigation, especially during the wheat irrigation season. The popularity of this strategy was reflected in his electoral success in 2008 and provided a basis for greater intense irrigation reform. In 2010, he appointed RS Julaniya, an honest and competent official, as the new head of the Irrigation Department. With the political support of the chief minister, Julaniya pushed for management reforms that involved not only investing in new water infrastructure but also improving water management in the existing irrigation schemes (Julaniya et al. 2016). The following are some of the critical reforms that led to Madhya Pradesh's irrigation turnover.

Canal irrigation management protocol

Traditional principles of canal management that had been abandoned in most irrigation schemes were reinstated: rationalized irrigation schedules; tail-to-head irrigation; operating canals by strict rotation; and operating canals at full supply level. Outdated irrigation schedules were replaced by new schedules that corresponded to new cropping patterns (Shah et al. 2016). Even though pumping from the head reaches of the canals was illegal and amounted to theft, it was a regular practice. Pumping was legalized, with pumps limited to 5 horsepower capacity, and farmers in breach of this were penalized. Tail-end-first irrigation and operating canals through rotation have led to a greater supply of water: fields are irrigated faster, and farmers are able to save time and labor (Shah et al. 2016).

Completing last-mile projects

With the help of the World Bank's Madhya Pradesh Water Restructuring Project (MPWRP) loan, the MPWRD prioritized completing last-mile projects. This included lining large old dirt schemes to ensure water to tail-end users faster (Julaniya et al. 2016; Shah et al. 2016).

Effective monitoring

The revised management system involved greater emphasis on improving monitoring through modern technology. Gatekeepers send daily reservoir water-level gauge readings by SMS to the central web-based management information system (MIS), at which depth readings are converted into stored

volume based on reservoir-specific depth-volume curve. This helps the senior management set reservoir-specific irrigated crop area targets for the coming winter season (Julaniya et al. 2016). On a weekly basis, the executive engineers enter the cumulative area irrigated on the MIS, and regular weekly video conferences, chaired by Julaniya and the engineer-in-chief, are held with the staff to discuss the status during the irrigation season.

Maintenance planning

Julaniya identified timely preventative maintenance for better service delivery performance (Julaniya et al. 2016). In India, most nodal irrigation agencies have limited or negligible resources for modernization and maintenance. In Madhya Pradesh, the state government has authorized the MPWRD to allocate more resources for annual repairs and maintenance (Julaniya et al. 2016; Shah et al. 2016). The MPWRD staff is responsible for ensuring, prior to the irrigation season, that the system is suitable to deliver water at full supply levels. Civil works of value on subminor canals and filed channels are delegated to WUAs (Julaniya et al. 2016; Shah et al. 2016).

Staff performance

Julaniya recognized that improved irrigation delivery required a motivated staff, and therefore revised human resource practices to reward staff contribution for well-performing systems. In 2011-12, staff with improved or satisfactory performance were rewarded with certificates and monetary bonuses. This created motivation and healthy competition within the public agency. In systems that performed poorly, the divisional staff assess the cause and provide proposals to improve performance in the next season (Julaniya et al. 2016).

Partnership with WUAs

About 2,000 WUAs were established but were not functional and played an insignificant role in service delivery. With the improvement in irrigation systems and water reaching the tail-ends, the WUAs found a new role. They became involved with prewinter desilting of minor and subminor canals and became critical partners of the MPWRD in irrigation scheduling, maintenance, and orderly water distribution (Shah et al. 2016).

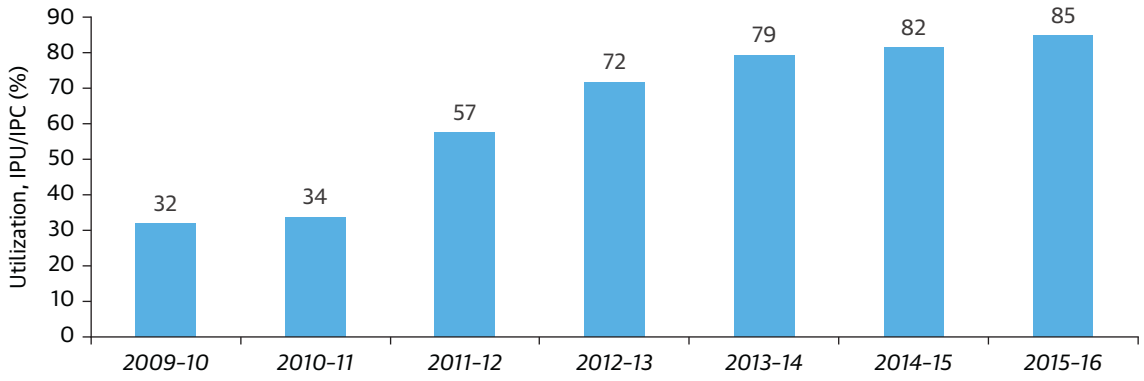
Change in Irrigation Service Delivery

The state government in MP has invested far less financially than have other dominant agrarian states (such as Maharashtra) in its public irrigation infrastructure, but nevertheless managed to almost triple the irrigated area in canal commands. The area irrigated by public canals surged from less than 1 million hectares in 2010, to 1.56 million hectares in 2011, to 2.02 million hectares in 2012, and to 2.33 million hectares in 2013 (Shah et al. 2016). Since 2009, the state managed to bridge the gap between the IPC and IPU, as depicted in figure A2.7. The improvements in irrigation service delivery have led to increased crop yields, varied crop patterns, and a shift from a mono-crop regime to double cropping. In 2000-01, the irrigation ratio in the state was 24 percent, which was around 17.2 percent points lower than the all-India average. By 2014-15, the irrigation ratio in Madhya Pradesh reached 42.8 percent, less than 5 percentage points below all India average (Gulati, Rajkhowa, and Sharma 2017).

Championing Change through Leadership

The partnership of Chief Minister Shivraj Singh Chouhan and RS Julaniya as principal secretary are fundamental elements of this success story. Chouhan promised Julaniya a stable tenure and political autonomy. This created the space for change that Julaniya needed to implement reforms without any political pressures. His dynamic leadership inspired a motivated irrigation bureaucracy that set out to establish order and rule of law in canal commands. The chief minister's steady support also enabled coordination with other sectors, such as agriculture, forestry, and revenue departments and district collectors. Unlike its counterparts in other Indian states, the MPWRD evolved into an animated bureaucracy with the purpose of ensuring efficient and reliable water service delivery to as many users as possible (Junaliya et al. 2016; Shah et al. 2016).

FIGURE A2.7 Share of IPU against IPC in Irrigation System Utilization, Madhya Pradesh, 2009-16



Source: Julaniya et al. 2016.
Note: IPC = irrigation potential created; IPU = irrigation potential utilized.

Summary of Key Functions from Six Perspectives

Perspective 1: Farmer involvement

Farmers are an important constituency group in Madhya Pradesh; about 70 percent of the state population is involved in agriculture. Most groundwater pumps are owned and operated by the farmers. Prior to 2005, farmers operated at low efficiency, wasted water, and were unmotivated to diversify their crops. Due to the lack of reliability in the delivery of water, farmers would often interfere in the water distribution systems. However, since the state implemented irrigation reforms, and with the help of a World Bank loan, the expansion of irrigated land has helped farmers to increase their net income from the major crops by 18 percent in the head reaches, 29 percent in the middle reaches, and 35 percent in the tail-end (World Bank 2004, 2015).

Perspective 2: WUA

In 1999, new legislation pushed for the establishment of WUAs, and for the most part, these were largely nonoperational. Now, WUAs are responsible for maintenance in minor canals and field channels. The World Bank loan allowed them to be provided with training and capacity building for this role. The electoral process for the WUAs was also revised, so that currently one-third of the committee is re-elected every two years. WUAs are now important partners of the MPWRD in irrigation scheduling and ensuring disciplined water distribution.

Perspective 3: Irrigation agency (MPWRD)

The MPWRD is the main irrigation agency in the state, responsible for managing surface water resources that are stored in about 5,000 dams and tanks. In 2010-11, the total irrigated command area under the MPWRD was 2.79 million hectares (Julaniya et al. 2016). The MPWRD is structured under divisional offices under executive engineers at the district level. They report to the circle offices under superintending engineers, and the superintending engineers report to basin offices under chief engineers. The chief engineers report to the engineer-in-chief, who in turn reports to the principal secretary, MPWRD. The principal secretary is directly responsible to the minister (Burton and Stoutjesdijk 2017).

Perspective 4: Line ministries (Ministry of Water Resources and Ministry of Agriculture)

The two relevant ministries are the Ministry of Water Resources and the Ministry of Agriculture. The state government created the Krishi Cabinet, which is a committee of the Council of Ministers, led by the Chief Minister Chouhan. It is responsible for developing an overall plan for agriculture.

Perspective 5: Private sector

Currently, there is a limited role played by the private sector because most of the surface water systems are managed by the public agency or farmers.

Perspective 6: Nonirrigation users

While the irrigation sector accounts for 90 percent of water use in Madhya Pradesh (World Bank 2004), multiple competing demands for water have increased in the state, especially demand for storage water for drinking purposes.

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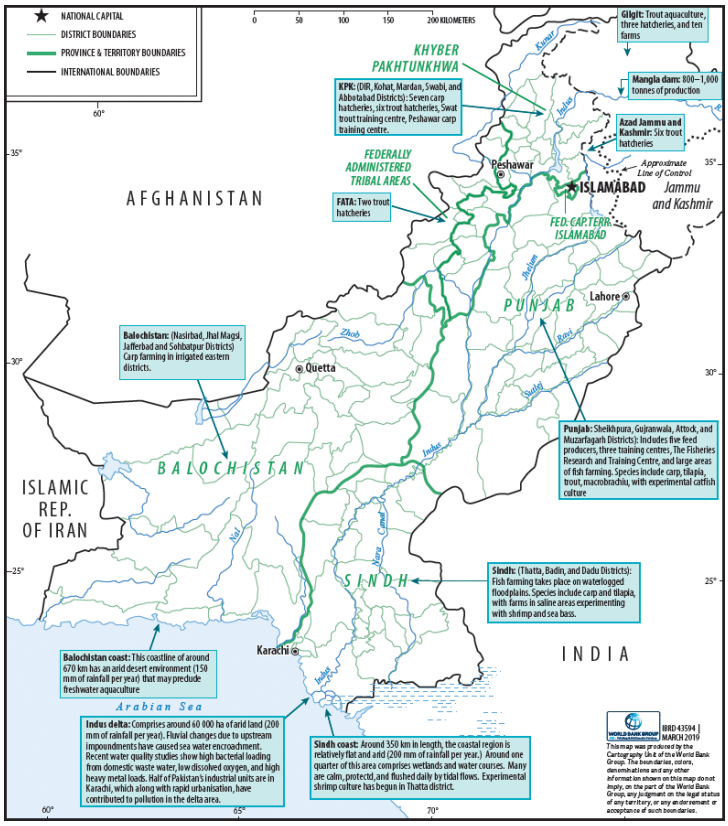
Case 7. Pakistan: Lessons from Comprehensive National-Level Irrigation and Drainage Reforms

MAP A2.8 Pakistan



Agriculture: A Lifeline

Agriculture is the backbone of Pakistan's economy, contributing 23 percent to the GDP, accounting for more than 40 percent of labor engagement, and the major contributor in overall export incomes (map A2.8). The sector plays a significant role in livelihoods, since 64 percent of the population is rural (in 2017).

The Indus River is the world's largest irrigation network: the Indus Basin Irrigation System (IBIS) accounts for 80 percent of Pakistan's agricultural production. The majority of IBIS flows through Punjab and Sindh provinces. Relatively smaller command areas are found

Program Overview

- Aim: to improve efficiency of the irrigation and drainage (I&D) system in Pakistan and ensure its sustainability
- Program cost (at appraisal): US$785 million
- Implementation period: 1997–2004

Key Components

- Establish appropriate policy environment and institutional framework
- Strengthen sector institutions
- Improve sector policies and planning
- Strengthen technical foundations on I&D
- Improve I&D infrastructure network

Extent of Salinity and Waterlogging

- 21% of irrigated land is affected by varying levels and types of salinity
- 30% of irrigated area has groundwater levels within 1.5 m of the soil surface
- 70% of tube wells installed in IBIS are pumping sodic water

in Khyber Pakhtunkhwa and Balochistan provinces. Following signing of the Indus Waters Treaty with India in 1960, Pakistan began an extensive irrigation development program, administered by the World Bank. Works included major barrages and link canals to replace flows in eastern tributaries that India began to divert in accordance with the terms of the treaty.

Neglected Drainage: A Curse to Sustainable Irrigation

Pakistan focused its early efforts primarily on irrigation rather than drainage development. This was to boost food production in a recently created nation. Over time, irrigation without drainage, overirrigation, infrastructure development (which impeded drainage), a lack of focus on drainage from irrigation institutions, and limited stakeholder engagement led to severe waterlogging and salinity. Experts estimated a reduction of 25 percent in productivity due to increased waterlogging and salinity.

In 1993 the government responded with a Drainage Sector Environmental Assessment, recommending policy and institutional reforms for the drainage subsector and a 25-year drainage investment program. This envisaged improved irrigation management and major institutional reforms to complement drainage investments.

In 1997 the World Bank National Drainage Program (NDP) project was approved. It aimed to address waterlogging and salinity through a combination of institutional reforms of the irrigation subsector and drainage infrastructure development (World Bank 1997).

Mismatch in Transfer of Powers and Policy Making

Pakistan provincial assemblies approved the enabling legal framework to support institutional reforms in 1997. The PIDA Acts provided the legal framework for establishment of PIDAs, AWBs, FOs, and regulation of the decentralized water sector. Importantly, the enactment took place more than a decade before Pakistan undertook overall transfer of power and policy-making authority from federal and provincial levels to local governments. This led to a fundamental mismatch in how decisions were made for irrigation reforms, and the participation of local government and beneficiaries.

From Irrigation Developer to Irrigation and Drainage Service Provider

Pakistan's century-old Provincial Irrigation Departments (PIDs) were established during British colonial rule. Following independence and rapid irrigation development, these institutions simply added new functions of drainage to their administrative structure rather than integrating with the existing institutional structure. No additional funds were provided for the O&M of drainage systems, which subsequently fell into disrepair. This was much the same situation as for the case of the irrigation systems, in which 63 percent of the annual budget allocation was for sustaining the establishment, not related to irrigation scheme maintenance activities. This could be considered the fundamental issue, compounded by the lack of accountability and transparency in service provision.

The NDP attempted an ambitious transition from institutions focused on infrastructure development to ones focused on service orientation. This entailed institutional reforms of the Federal Water and Power Development Authority and PIDs, specifically:

- Redefining roles and functions
- Decentralizing roles and responsibilities
- Streamlining
- Transferring management responsibility for functions that should be managed by other (lower tier) entities that will succeed PIDs: Provincial Irrigation and Drainage Authorities (PIDAs), area water boards (AWBs), farmer organizations (FOs), or the private sector
- Capacity building for Water and Power Development Authority (WAPDA) and the new public and private institutions

Too Much Too Soon: Ambitious Reforms

The crux of the institutional reforms rested on the structural transformation of I&D service provision at the provincial level. These were based on the following:

- Reorientation of WAPDA from an executive agency to that of a planning agency with a national, interprovincial, and river basin management orientation.
- Devolution of O&M and fee collection to FOs.
- Transformation of PIDs to autonomous PIDAs, which would manage subunits of the province's part of the Indus River Basin within a suitable legal framework.
- Establishment of financially self-sustaining AWBs over a seven- to 10-year period, as informed in the PIDA Act (AWBs would be based on former irrigation canal circles, which encompass a main and distributary canal system within an overall irrigation zone; a superintending engineer would head the irrigation canal circle, reporting to a chief engineer at the zonal level).
- Devolution of O&M and collection of water charges to FOs.
- Promotion of the formation of FOs on a pilot basis (these would be owned and controlled by farmers, and would take over I&D system management below the distributaries and minors).

The project agreed on the establishment of one pilot AWB in a canal command in each province (in Punjab, for example, the province comprised 17 irrigation circles), within one year of the establishment of the PIDA. At project closure Sindh Province was most advanced, with the establishment of the Sindh Irrigation and Drainage Authority, three AWBs, and 150 FOs. But instead of being autonomous, AWBs remained under the control of the Irrigation Department and had only changed in name, not function. Though FOs had commenced system O&M and fee collection, limited capacity building efforts and skepticism from the PID were key limitations to success.

Punjab province established one AWB and several FOs, then progress stopped. Distributary canals were put under the joint management of PID and FOs, thereby reverting to former arrangements.

Importantly, the collection of water charges remained with government, leaving FOs with no main function. The other provinces made limited progress. In Khyber Pakhtunkhwa, O&M and water charge collection were not devolved to farmers. Balochistan made minimal progress, mainly since much of its irrigated area was under communally managed irrigation schemes. The World Bank Implementation Completion Report (World Bank 2007) notes that "... the project has not achieved its first objective ... irrigation and drainage system management has remained practically the same as pre-reform, with minimal changes." The overall outcome was disappointing, given the scale, time frame, and efforts to undertake a much-needed but ambitious process.

Learning from a Painful Process

Subsequent to closure of the NDP and a hiatus period, Punjab Province moved forward. The Punjab Irrigation Sector Development Policy Loan, approved in 2007, provided US$100 million financing to the Government of Punjab for a major reform agenda to improve fiscal management and service delivery. The project built on the base work of the NDP for FO strengthening and carried it forward with improvements. These included O&M budget rationalizations, water resource management reforms to make water allocation and distribution more transparent, and actions for improved irrigation service provision and system management.

The World Bank Implementation Completion Report (World Bank 2010) reported a moderately successful outcome given that progress was made on areas such as O&M cost recovery. However, improved irrigation service delivery through participatory irrigation management remained more challenging, mainly due to PID reforms being put on hold after project closure. FOs similarly had become less effective due to unresolved institutional problems.

Sindh Province continued its efforts to progress the reform process. By 2003, five out of 13 AWBs were notified, and 80 FOs had taken over O&M responsibility. The other two provinces have less to report, due in part to their more limited command area within the IBIS.

What has been learned through this lengthy and at times contentious reform process? First, the intent was valid and timely as Pakistan had focused its efforts on irrigation development within the IBIS for too long, and sustainable agricultural production was under threat from the lack of attention to drainage. But if we look deeper, there are pertinent points to learn for future reform programs.

Commitment. Leadership and ownership of the reform process is fundamental. In this case, the PIDs were the "doctors operating on themselves," a painful process unlikely to succeed unless there is inherent ownership of the need for change.

Tailored solutions. The one-size-fits-all strategy rolled out across all provinces was inappropriate, given the subtle and at times obvious differences in irrigation systems and, importantly, social structures. For example, the feudal system in Sindh results in skewed land distribution and power asymmetries. Expecting egalitarianism and the democratic appointment of FOs could therefore be much more challenging than in Punjab. Likewise, Balochistan is dominated by community-managed irrigation systems,

for which there was no clear approach within the PIDA. A project-driven Community Irrigation Services Unit was established in the PIDA, but this lost momentum following project closure, again for a lack of buy-in.

Streamlined and convergent processes. Irrigation reform took place a decade in advance of power devolution to provincial local governments. This mismatch in timing may have impacted on the engagement process and on developing more tailored, province-specific strategies.

Time frames and staying the course. Undertaking the same set of reforms simultaneously across all provinces was challenging because the provinces worked at their own pace. During implementation, the commitment from different participants varied. The federal government stopped NDP implementation for a year and a half, and Balochistan withdrew from NDP for more than a year.

The lessons reiterate the need for tailored solutions, a very rigorous consultation process to develop appropriate strategies, consistency with broader reform programs and processes, and, importantly, long-term commitments from the public sector. Pakistan continues to proceed with province-specific initiatives—perhaps a more pragmatic approach in hindsight.

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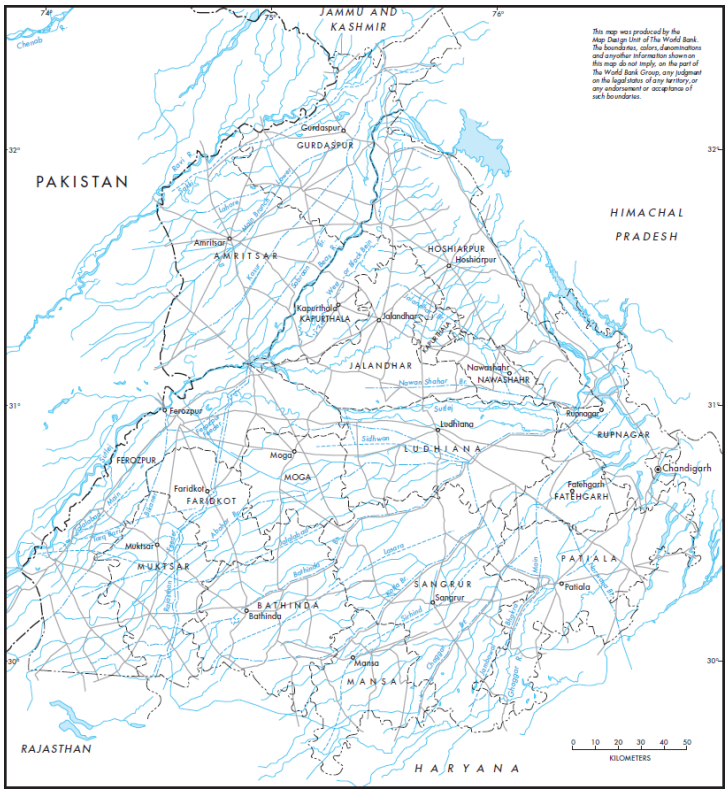
Case 8. India: Policy Actions Avert a Groundwater Crisis

MAP A2.9 Surface Water Map of Punjab State, India



Water and Energy Demand Management

- Power subsidies have led to groundwater overconsumption
- About 1.2% of Punjab State's GDP is composed of power subsidies
- State-level policy actions undertaken to rationalize power consumption

Key Actions

- Introduce normative-free power requirements for agriculture
- Segregate agriculture feeder line
- Introduce 100% feeder metering
- Introduce distribution meters

Farmer Profiles

- Agriculture constitutes 36.5% of Punjab workforce in FY2011[a]
- Average landholding: 3.95 ha
- Rice: 3,046,000 ha
- Wheat: 3,500,000 ha

Setting the Scene

India leads the world in groundwater depletion, with groundwater providing up to 70 percent of the water used in agriculture. Over the past three decades there has been massive growth in private agricultural tube wells to supplement the surface water resources (see map A2.9 for a visual of the surface water availability in the state).

The State of Punjab, India, was a star performer during the green revolution. Its agricultural gross domestic product (GDP) grew at 5.7 percent per annum between 1971/72 to 1985/86, which was much higher than India's overall agricultural growth rate of 2.31 percent. By 2005, this had crashed to

1.6 percent per annum, with a dramatic decline in rice and wheat production, which dominated 80 percent of the cropped area (Gulati, Roy, and Hussain 2017).

Much of the slowdown in production is linked to policy actions, including free power for agriculture and minimum support prices for rice and wheat. While these may have resulted in a boom in the past, their impact today is increasingly detrimental to the efficient use of energy and water.

As much as 77 percent of the cultivable land in the state is irrigated by tube wells (Khanna, 2018). Between 1980 and 2015, the number of tube wells increased from 600,000 in 1980-81 to 1,400,000 in 2015-16. With the fast-depleting water table (70 centimeters per year during 2008 to 2012) the number of submersible motors also increased from 619,197 (56.7 percent) in 2009 to 978,874 (72.4 percent) in 2017. This increased agricultural electricity consumption from 6.97 million kilowatts in 1974-75, to 11. 5 million kilowatts in 2015-16.

Supporting Demand Management

Agricultural producers with access to unlimited free power for their operations consume about 87 percent of the power subsidy. Untargeted power subsidies are a huge cost on both the environment and the fiscal health of the state through a vicious cycle. The cost of providing free power for agriculture (about US$1 billion) is no longer sustainable.

The ADB is facilitating implementation of a Comprehensive Fiscal Consolidation Program in Punjab. This US$200 million policy-based program loan, approved on November 19, 2014, is to generate fiscal

PHOTO A2.6 Tube Well Irrigation in Punjab

savings and make better use of scarce budgetary resources, and thereby help with the socioeconomic development of the state. Its outputs include fiscal management, revenue reforms, and, importantly, expenditure rationalization focusing on power subsidy (ADB 2014).

Actions Taken

Key actions to be undertaken under the program include:

- Introducing normative free power requirements for agriculture and incentivizing efficient uses of power.
- Segregating agricultural feeder lines and using the agriculture feeder data for subsidy calculation.
- Introducing 100 percent feeder metering.
- Introducing distribution meters.

To improve targeting of the power subsidy, the state government developed a Strategy Paper to implement a scheme that would gradually optimize power supply to agricultural producers. The option selected was to restrict the power supply to agricultural producers as per the "normative supply hours" requirements to ensure required irrigation of the zone.

A detailed study by Punjab Agriculture University analyzed electrical tube well operating times for groundwater for different seasons and crops to determine normative supply hours. Based on these recommendations, the Department of Power issued notifications in 2015 and 2016 on the schedule of power supply to the agricultural pump set connections in the state for different crops and seasons.

The power supply hours are followed, but keeping in view weather conditions such as drought, excessive rains, floods, or other factors beyond the control of Punjab State Power Corporation Limited (PSPCL), supply hours can also be modified so that farmers' crops do not suffer. The power supply hours to vegetable, floriculture, and horticulture farming may vary according to crop and seasonal requirements.

Direct Benefits to Replace Subsidies

Aligned with the power subsidy targeting under the program, the Cabinet of the State of Punjab approved a new pilot scheme on Direct Benefit Transfer for Electricity for agriculture consumers on January 24, 2018.

A comprehensive public awareness campaign was rolled out in advance to facilitate implementation of the selected agricultural power subsidy targeting plan. The aim was to sensitize water users on the urgent need to conserve water and to motivate the public to reduce water consumption. The target audiences were mainly farmers, village *panchayat* (council) members, agricultural employees, general villagers, local municipalities, and students. Key messages of the campaign included (a) using suitably sized pumps; (b) avoiding water wastage; (c) storing water; and (d) avoiding overirrigation.

Under the scheme, a cash subsidy would be paid directly to the bank accounts of 990 farmers (on six rural feeders) in advance for the consumption of electricity, to the amount of INR 50,000 a year. The farmers, participating voluntarily, would then be metered. If the farmers saved on their electricity bill through prudent water consumption, they would be allowed to retain the subsidy, minus the bill amount. The scheme will help curb wasteful energy consumption, save precious groundwater resources, and rationalize the subsidy pay-out by the Government of Punjab. The benefits of the pilot were explained to the farmers, who voluntarily participated. The PSPCL will collaborate with Abdul Latif Jameel Poverty Action Lab (J-PAL) South Asia and the World Bank to evaluate the pilot results.

Solving a Complex Challenge

Overall, ADB support for power sector reforms and technical measures to improve power distribution have helped control the power subsidy requirements. While the state's overall spending on power subsidies has increased since FY2014, this is primarily the result of a greater number of agricultural electricity consumers, the subsequent increase in energy consumed, and the jump in subsidy payouts in FY2017 and subsidy arrears from previous years. Overall, the subsidy per hectare of gross cropped area decreased from INR 6,428 in FY2013 to INR 6,157 in FY2016. The average unit rate for the subsidy payout for agricultural consumption declined by 13.7 percent from ₹5.1 per kilowatt-hour to ₹4.4 per kilowatt-hour in this period. Further net benefits are expected in the coming years with expected further outreach of these programs.

PHOTO A2.7 Farmer in Punjab

Under the ADB program, 19.6 percent of agricultural power consumers have been metered (268,733 out of 1,368 million consumers). Despite this encouraging result, the state government faces considerable opposition from FOs on tube well metering. Persuading farmers to move forward with these changes remains challenging (ADB 2018). Apprehensions persist, mainly around the reliability of receiving cash subsidies instead of free power; the skewed benefits, given that not all farmers (especially small and marginal farmers owning less than a hectare) have electric tube well connections; and a suspicion that this is the first step toward outright removal of the subsidy.

Is Demand Management a Realistic Approach?

Water—being intrinsically linked and cross-cutting across almost all sectors—requires broadened approaches to finding solutions, including from the non-water project perspective. The impacts of one user on the other cannot

be tackled with sector specificity. Opening new horizons is essential to consider how one user can benefit another, or to highlight trade-offs between users.

Fiscal reforms, particularly when tackling sensitive issues such as rationalizing power subsidies (as attempted in Punjab), is challenging. Introducing measurements and replacing subsidies with direct benefits cause resistance from farmers, who may be more concerned with immediate benefits. Power and land distribution asymmetries further compound the understanding of who truly gains from changes to the status quo.

Demand management has the potential to be highly effective if designed with strong stakeholder participation, long-term commitment, and, critically, political ownership. A policy-based lending approach that requires specific policy actions to trigger release of subsequent tranches of financing provides an effective instrument.

As with any public resource management program, the introduction of direct benefits to replace subsidies can be tricky and requires robust public awareness campaigns. Perhaps most challenging is the marrying of concepts across sectors and placing equal emphasis on the socioeconomic analysis of stakeholders, to develop a suitable awareness campaign and set of incentives. With the Punjab Development Finance Program, the state government has demonstrated high political commitment to bring about essential but difficult reforms despite the interruptions caused by the state election, turnover of key government officials, and political sensitivities and vested interests.

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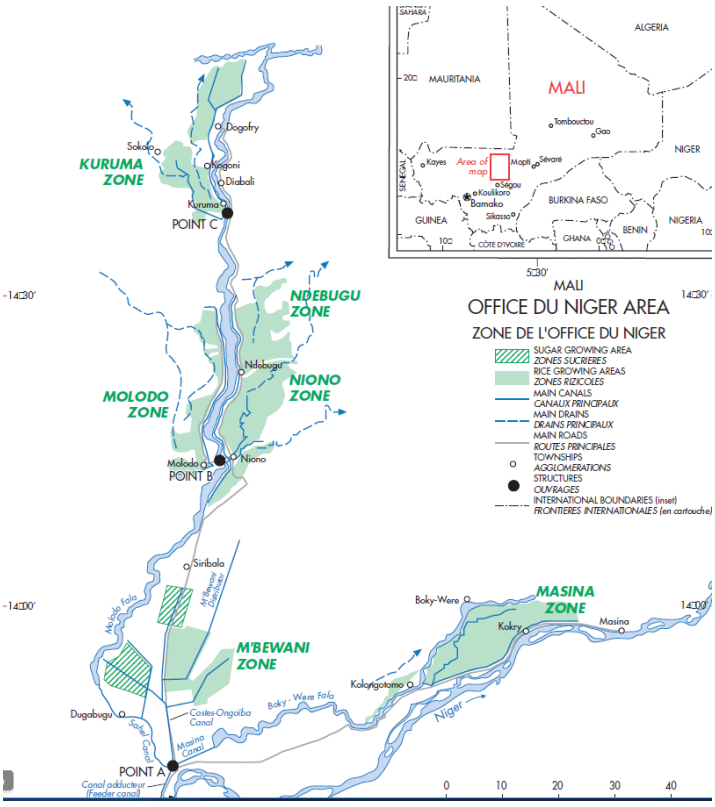
Case 9. Mali: Office du Niger Agency: Transfer of Land and Water Functions to Semi-Autonomous Agency

MAP A2.10 Office du Niger Agency, Mali



Value chains

- Rice
- Onions
- Vegetables
- Cotton (prev.)

To local, urban, anddistant markets

Water infrastructure

- 80,000 ha of moderninfrastructure
- 1930s' gravity canal scheme
- Markala diversion works onNiger River
- Five zones apart from privatizedsugar estateValue

Water management

- Performance contract betweengovernment, office du Niger,and farmer reps
- Variety of (dys) functional userorganizations at local level

The Office du Niger scheme in Mali has been hailed as an outstanding success of IMT after three decades of gradual reform (map A2.10). The reforms entailed a heavily donor-funded green revolution package, the empowerment of settlers by means of cooperatives and rice mill associations, and the thorough rehabilitation of the canal network during the 1980s and 1990s.

The thrust of the reforms accelerated after the collapse of the Traore regime in 1992 and refusal of the settlers to deliver their paddy crop to the office, inaugurating multiparty elections and the introduction of neoliberal policies that favored market liberalization and devaluation of the CFA in 1994. In the same year the office organization, known as a state within the state, was drastically downsized (from 3,000 plus to about 400 staff), and a radical irrigation management turnover program was implemented. Today, both the production output and size of the scheme is larger than ever before.

Despite the success of the reforms, a number of pernicious challenges have remained unaddressed. Recent efforts to establish effective and sustainable WUAs have floundered and resulted in a deadlock and confusing situation at ground level. In addition, recent massive investments by foreign companies in the expansion of the Office du Niger threaten to undermine the production successes of the past. The anticipated expansion of the scheme will result in increased competition over water, making the establishment of effective, inclusive, and sustainable WUAs capable of dealing with increased water scarcity paramount. Rather than a one-size-fits-all approach, this case study is going to argue for a context-specific, diversified approach toward the establishment of effective user organizations.

Incremental Reforms and Drivers of Change

Various drivers for the ultimately successful reforms can be identified with hindsight. Steady *donor pressure*, starting in 1978, with later successor initiatives in 1982, and between 1996 and 2002. The mix of pressure and financial support for a gradual but steady rehabilitation of the scheme's infrastructure proved pivotal in overcoming technical impediments to increased cropping intensities and production.

The 1992 *political regime change* (a shift to multiparty democracy and the adoption of macroeconomic neoliberal policies) and, in particular, the crop liberalization combined with tenure reform offered the right mix of tenure security and opening up of market links to allow most farmers to convert irrigated production from prison-like conditions into an economically attractive proposition. This shift in policy also allowed previously illegal irrigated perimeters (the so-called *hors cashiers*) to become legally recognized irrigated command areas, expanding the total command area from around 60,000 to 80,000 hectares in the mid-1990s.

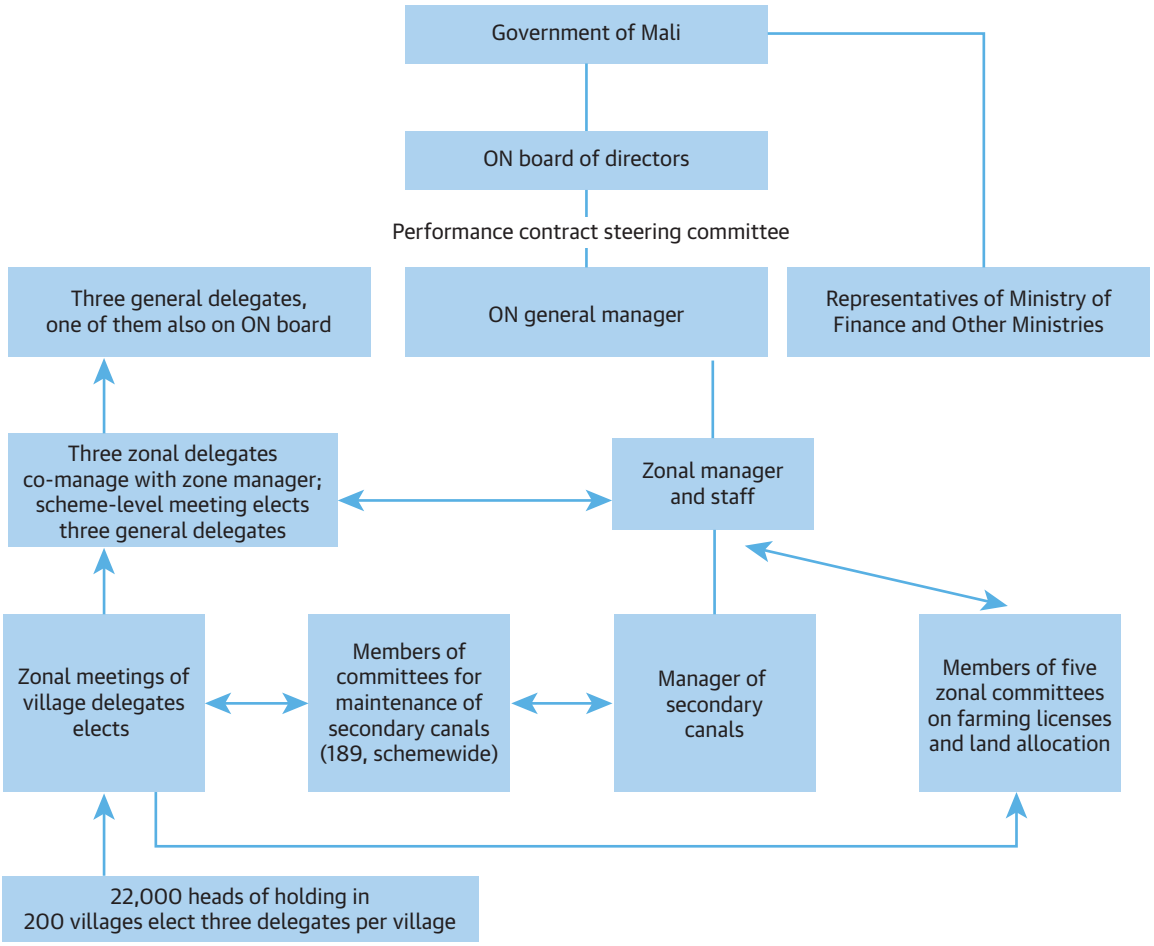
The very fact that *most donor support* inside the scheme (both technical and institutional) *was offered through bilateral donors* meant that the scheme as a whole became a field laboratory for different kinds of technical rehabilitation and institutional development approaches. The French, the Dutch, and the Germans (under a European Union [EU] banner) all applied improvement approaches, resulting in a diversified technical and institutional irrigation-scape. It also meant that the long-term reforms were incremental and showed that one could learn what worked best by comparing the different field laboratories of donor-driven improvement processes.

Tripartite Zonal Performance Contracts and the Missing Link at Village-Tertiary Level

While the tripartite, three annual performance contracts spell out at zonal level which objectives must be attained on the part of government, Office du Niger, and the farmers, there is no effective link at the village-tertiary unit level, despite this being the very level where collective action with regard to both water distribution and maintenance has to be made effective. See figure A2.8.

At village and tertiary level, there have been two initiatives to establish some form of user organization beyond the existing village cooperatives. In practice, what users do when confronted with an operational or maintenance issue is to mobilize informal leadership.

FIGURE A2.8 Postreform Accountability Relations in Context of Tripartite Performance Contracts, Mali



Source: Aw and Diemer 2005, 81.
Note: ON = Office du Niger.

Stakeholder Roles and Responsibilities in I&D Management

The roles of the stakeholders are outlined in relation to four perspectives regarding water management:

- Farmers (both in schemes and individually).
- WUOs (framing boundaries and systemic linkages—roles, responsibilities, legal and financial flows) at the levels of water user groups (WUGs), WUOs, and apex bodies, plus links to IWRM bodies. In the case of Office du Niger, we focus on the tripartite performance contracts that spell out O&M targets at zonal level.
- Line ministries and regulatory bodies (government and Office du Niger).
- Private sector (for example, PPPs, service providers for water and agriculture, value-chain entities).

Institutional Design in Context of Case Analysis Framework

Rather than a one-size-fits-all approach, one needs to think about an inclusive process that pays tribute to what works at the local level. Certain drivers work in favor of such a tailormade, context-specific approach.

The office has benefited from having a relatively ample water supply (because the system was over dimensioned to start). With the on-going expansion of the scheme this will change, providing incentives at farmer level to organize and instigate effective forms of collective action to deal with water scarcity situations (Wade 1987).

As in many other large-scale canal irrigation schemes in Africa, private investors are cherry-picking land inside the scheme's perimeter, engaging in a variety of contract farming arrangements. While these arrangements and the associated agro-processing development may benefit farmers who have not been included in the contract farming arrangement (through opening up new market opportunities), it is also likely to introduce new inequities in terms of water distribution, as private parties tend to receive preferential treatment on the back of their monetary buying power through the managing agency. This development calls for a context- and scheme-specific approach toward the arrangement of O&M responsibilities.

At river basin level, a similar challenge of competition over scarce water is revving up. This means that the Office du Niger's water abstraction will come under scrutiny, inviting new initiatives to engage in innovative forms of water savings and increased irrigation performance.

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Case 10. Mozambique: IMT and Contract Farming in the Chókwè Irrigation System

Overview

The Chókwè Irrigation System is a large-scale open canal irrigation system (26,000-hectare command area) for monoculture rice production, developed under Portuguese colonial rule in the early 1950s as the Colonato do Limpopo. The system is located about 200 kilometers northeast of Maputo. The scheme takes its water from the Limpopo River at the Macarretane diversion weir, at which water enters the canal system by gravity. In 1997, the state agent responsible for the scheme's management was replaced by a parastatal, the Hydraulics of Chókwè Public Company (HICEP). This involved a reform in which old buildings were sold, staff numbers reduced, and water management responsibilities transferred to WUAs, or Associações dos Regantes. These were established at the level of the secondary canal, or Distribuidor.

In 2005 the Government of Mozambique supported a foreign agribusiness investor in buying and rehabilitating a rice processing factory in Chókwè. The investor developed a contract farming program to increase the paddy inflow into the processing plant. This led to a far-reaching rural transformation: increasing the cropped area and total production while also affecting water management practices. In 2013 the company withdrew from the area after having struggled to make a profit from the operation and being confronted with a flood that damaged the irrigation system and the factory. The case describes this period between 2005 and 2013.

Historical Path

The current Chókwè Irrigation System was originally developed in the 1950s as a settlement scheme for Portuguese colonizers, under the name Colonato do Limpopo. Mozambican families were evicted from the fertile Limpopo Valley. In 1977, after

Farmer proles

- Family sector: approx. 11,000 farmers, av. 0.9 ha
- Private sector: approx. 900 farmers, average 6.6 ha
- Companies: approx. 15, av. 350 ha

Value chain

- Rice

Contract farming with a foreignowned rice processing factory

Water infrastructure

- 26,000 ha open canal scheme with max. 7,500 ha cropped
- Former Portuguese colonial scheme of 1950s
- Direct diversion from Limpopo River 50 sectors (av. 280 ha)

Water management

- Parastatal and WUA comanagement
- Private contracting company pressures parastatal

independence and inspired by Marxist-Leninist ideals, the scheme area was transformed into the largest state farm in the country: the Complexo Agro-Industrial de Limpopo (CAIL). The creation of CAIL meant that a single state organization took control over all aspects of agricultural production within the boundaries of the irrigation system, with the exception of managing the canal system, which was brought under the control of an irrigation agency called Sistema de Regadio Eduardo Mondlane (SIREMO). In 1983 CAIL was divided into 10 smaller state enterprises, each with an area of approximately 1-2,000 hectares. In 1984 the Mozambique Liberation Front (FRELIMO) moved toward policies aimed at stimulating a more cooperative agriculture, creating incentives for the establishment of agriculture cooperatives of smallholder farmers and farmers' associations. In 1986, 436 private farmers occupied 4,600 hectares, with an average of 10.5 hectares each. These farmers were obliged to follow the agricultural planning for the irrigation system and had contracts with the government stipulating production targets and the percentage of production to be sold to the state. In parallel, 14,000 peasant farmers had received between 0.5 and 1 hectare each, and by 1990, all the state farms had been dismantled.

The peace treaty of 1992 brought an end to a civil war that had lasted almost 20 years. The following political democratization and economic liberalization gave a new impetus to Mozambique's economic development. In 1993, Chókwè's cooperatives were transformed into farmers' associations, creating three production sectors: the company sector (which replaced the former state sector) with farms from 40-400 hectares; the private sector, with farm sizes of 4-40 hectares; and the family sector (farms up to 4 hectares). In 1997 SIREMO was heavily reformed and downsized to become the parastatal HICEP. Associações dos Regantes (or WUAs) were established to become responsible for water management at the level of the secondary canal and below.

Low Utilization and Productivity

The 26,000-hectare equipped area had not been cultivated completely for a long time. Between 2001 and 2006, only about 10 percent of the area was used for rice production, the result of a combination of challenges:

- Poor state of the I&D network.
- Very limited access to agricultural inputs (seeds and fertilizers).
- Farmers' lack of finance to investment in capital-intensive production.
- Unreliable markets (with fluctuating prices, long distances, and unreliable buyers).
- Salinization of large areas.

In 2007, fewer than 40 percent of smallholders produced rice, while others preferred to grow vegetables or maize, often on just a small part of their land. While rice production is not profitable for smallholders in Chókwè, for larger-scale rice production it is. Other crops, however, are on average 60 percent more profitable. The difference is mainly attributed to higher fertilizer use, a substantially higher labor allocation, and more secure access to water.

Irrigation Management Transfer and Contract Farming

In the reforms of 1997, WUAs became responsible for water distribution and the maintenance of the irrigation infrastructure from the secondary canals downward. HICEP remained responsible for water distribution and maintenance of the primary infrastructure. When producer associations were dissolved, WUAs took an important role in the coordination of rice production. They also formed an essential link with HICEP and external investors with regard to (re)allocations of land in some of the tertiary units. However, HICEP still plays a central role in the process of irrigation management and the coordination of production down to the tertiary level, making WUAs auxiliary bodies to HICEP, with little autonomy and decision-making power in the O&M of the system.

Between 2003 and 2007, the Investment Coordination Center of Mozambique developed a strategy to attract private investors into the rice sector, an initiative that attracted a British investor. The green revolution strategy (2007) also encouraged private sector–led development, aiming (among other things) to end rice imports, which were running at an annual value of about US$70 million. The investor acquired the old rice processing facility, previously operated by a state company that had gone bankrupt. The rationale of investment was creating a stable market link for local producers.

Even though the investor was not looking for quick profits, it did aim to operate profitably. The processing unit can break even at 10,000 tons per year, although its full capacity is double that amount. To source enough rice, the investor tried to get 14,500 hectares to run as a nucleus estate, but the government eventually obstructed this attempt. The investor then made deals with WUAs to use part of the land in their areas, which would be vacated by farmers who had earlier been allocated the land. In exchange, farmers were supported in their remaining field with mechanized land leveling, ploughing, seeding, and harvesting, and provided with fertilizers and improved seeds. See photos A2.8 and A2.9. After two years these contracts were not renewed, and the investor changed its strategy to working with individual farmers through contract farming arrangements.

Farmer who engaged in these contracts were called associated producers and signed contracts that committed them to cultivating their land with the obligation to:

- Prepare the land with equipment approved or provided by the investor.
- Exclusively use seed varieties approved by the investor, sown at recommended densities.
- Apply fertilizers and pesticides in quantities recommended by the investor.
- Follow good agronomic practices as recommended by the investor.

PHOTO A2.8 Contour Bunds Constructed with Highly Sophisticated Laser-Level Machinery

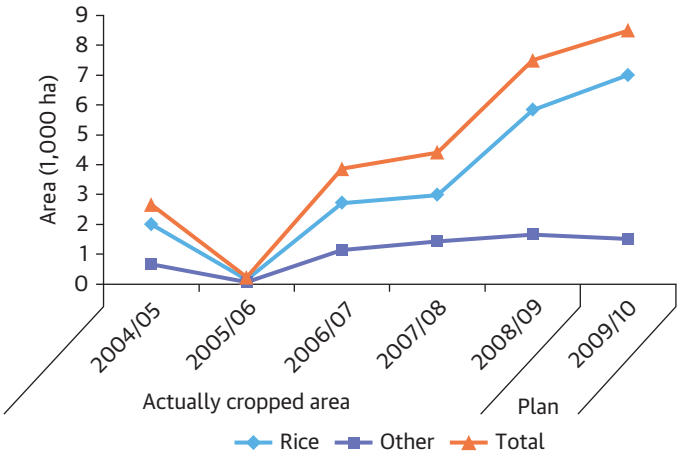
PHOTO A2.9 Harvesting the Field of an AP with a Combine Harvester

- Obey the recommendations and instructions provided by the investor during the season.
- Sell the produced rice at the price determined by the investor for the season.

In return, the investor guaranteed to buy the whole harvest at a fixed price level, although adjustable to several quality characteristics stipulated in the contract. Through job interviews the investor selected 229 associated producers, of which 50 were women. Those who did not have a minimum of 8 hectares were allocated large pieces of land by HICEP to be used for contract farming. With an average of almost 15 hectares, the associated producers occupied an area of about 3,400 hectares. The investor's exclusion of farmers with fewer than 8 hectares was informed by the optimization of machine use, and on the understanding that small farmers would keep a substantial share of the harvest for themselves.

The investor also stepped in as a broker toward HICEP in order to guarantee adequate water delivery and drainage services for its associated producers. To that end, the payment of the water fees collectively through the investor's accounts helped. According to the investor, the average paddy yield on AP fields was 4 tonnes per hectare, substantially higher than the 2-3 tonnes per hectare that these farmers produced before. In addition to the contract farming scheme, the investor produced rice seeds on 600 hectares (see figure A2.9).

FIGURE A2.9 Cropped Areas in Chókwè Irrigation System, 2004-10 Seasons



Source: Veldwisch 2015.
Note: CIS = Chókwè Irrigation System.

Roles and Responsibilities in I&D Management from Five Perspectives

Perspective 1: Farmers

- Small farmers versus associated producers.
- Small farmers were moved off their land without much process, but likely not losing in total area of land.
- Most of the associated producers made good profits, but were also taking big risks, with some incurring debts.
- For associated producers, a strong reduction of room for management decisions.

Perspective 2: WUA

Leaders and other local elite used the WUA to gain access to the deals with the investor and oust small farmers from the prime land.

Perspective 3: Irrigation agency

- Increase of irrigated area and production appreciated.
- Reliable partner in the investor, with a large number of emerging farmers.
- Increase in amount of water fees paid.
- Struggle to adequately supply water and keep drainage in good condition.

Perspective 4: Line ministries and regulatory bodies

- Increase of irrigated area and production appreciated.
- "Breadbasket of the nation."

Perspective 5: Private sector

The investor took on a large share of the risks

Reference

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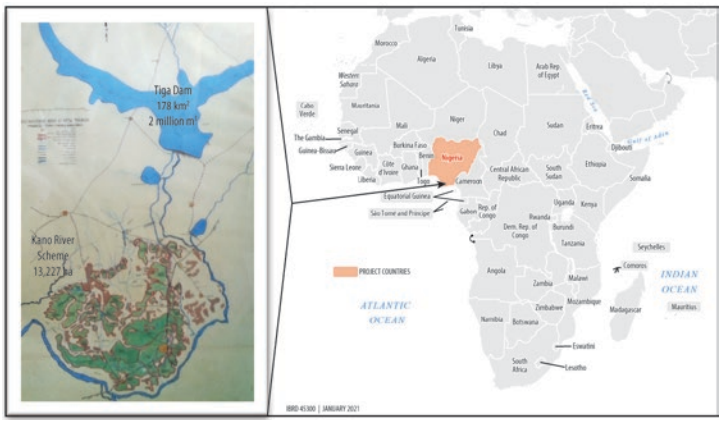
Case 11. Nigeria: IMT and PIM in the Kano Irrigation Scheme

MAP A2.11 Tiga Dam and Kano River Scheme, Nigeria



Scheme Overview

The Kano River Irrigation Scheme (KRIP) is located in Northern Nigeria in Kano State, approximately 30 kilometers outside of the state capital, Kano City (map A2.11). Kano is the second-largest city in Nigeria with a population of 3.6 million. KRIP development started in the early 1970s with a planned area of 22,000 hectares in phase 1, of which 13,227 hectares was implemented in various stages until 2008. Rainfall is 697 millimeters per annum, falling in four months of the year (June to September). Dry season cropping is fully irrigation-dependent while wet season irrigation is supplementary. The main crops grown are rice and horticultural crops (tomatoes in particular), supplying local urban and distant markets.

Scheme OMM, up to the time of the project intervention, was the responsibility of the government I&D agency, the Hadejia Jamare River Basin Development Authority (HJRBDA), which operated the main supply from Tiga Dam to the scheme since its establishment in 1976. The authority had a mixed water service provision and agricultural support mandate prior to the institutional reform process, including agro-mechanization, ad hoc fertilizer, and seed distribution.

Water Management Arrangement

- Irrigation and drainage (I&D) agency supplies bulk water
- Private sector contracted for heavy-duty maintenance services
- Water user associations (WUAs) at secondary level

Farmer Profiles

- Average plot size: 0.8 ha
- Size range: 0.1 ha to 20 ha
- No. of farmers: 18,000
- Women farmers: 10%
- Business and cash-income orientation

Value Chains

- Rice
- Tomatoes
- Grains
- Vegetables

To cannery and urban and distant markets

Key Problems and Challenges

Water Infrastructure

- 1970s' gravity canal scheme
- 14,000 ha of modernization
- Tiga multipurpose dam supplying irrigation scheme and Kano City

The dominant problems were that farmers were not getting an adequate and reliable supply of water *despite* the available resource in Tiga Dam, and the scheme condition was in perpetual decline. There were serious issues of top-end and tail-end inequity, and farmer representation was nominal through weakly established WUAs. Despite these major challenges and aided by proximity to a major city and related markets, KRIP retained a distinctly commercial farming character, and was viewed as one of Nigeria's better-functioning large-scale schemes. The main causes of poor performance were attributed to the following.

Dilapidated infrastructure over 30 years old with limited maintenance since inception. While the concrete-lined canals were still reasonably functional, drains and control structures were dilapidated. The original Begeman gates for flow control were in poor condition or inoperable.

The I&D agency had a mixed agricultural and water supply mandate, was top-down, administratively weak, and under resourced. Funds received from government were not earmarked for OMM and were used for various purposes (including subsidized agricultural inputs) subject to influence by political campaigns. Maintenance was limited to crisis responses of canal breaches or flood damage, and routine maintenance was absent.

ISFs were not ring-fenced. By law, all revenue collected from activities on state-owned assets had to be remitted to central treasury. A return flow of operational funds was meant to follow annual OMM budgeting but was typically a fraction of the amount that was requested, and late in arriving.

Low ISF collection rates and low incentive to pay, given poor service to farmers. Farmers paid a nominal ISF, equivalent to approximately US$15 per hectare per season, less than a quarter of the estimated amount required for adequate OMM. Fee collection rates of approximately 30 percent to 40 percent were reported.

Inadequate legislation for robust water management institutional arrangements. Water law was antiquated with no provision for decentralized water management, participatory irrigation management (PIM), IMT, compulsory membership, water user representation, or fee retention. A draft Water Resources Bill to modernize water management nationally, including IWRM provisions, was under debate for more than 10 years, but at the time of the intervention the bill had not progressed. The draft included no specific enabling provisions for improved *irrigation water* management.

Heavy infestation of typha grass in canals and drains. Dense stands of typha grass reduced canal flows, blocked drains, increased sedimentation, and provided ideal nesting sites for quelea, a major cause of crop losses. Removal required heavy machinery at high costs.

Approach and Solutions

The Government of Nigeria identified the strategic and economic importance of irrigation development across the country, particularly in the more arid, less economically developed northern states. Scoping studies were conducted by the Food and Agriculture Organization of the United Nations in 2004.

Some years later the government, represented by the Federal Ministry of Water Resources, requested the World Bank to provide technical and planning support. This led to an extended collaboration over five years, during which a set of strategic areas for intervention were identified, leading to the Transforming Irrigation Management in Nigeria (TRIMING) program, which included KRIP. The main strategic interventions that led to the modernization and reform plan for KRIP are first summarized and then expanded below.

- Reform of the role of the River Basin Development Authority (RBDA) (I&D agency).
- IMT to WUAs at secondary canal level and PIM in the form of WUGs at tertiary level.
- Institutional reform opportunistically included in the new Water Resources Bill (passed by the House of Representatives in 2018 and awaiting Senate approval at time of publishing).
- Substantial investment in organizational development.
- Private sector contracted for supply and main canal maintenance and desilting.
- Agricultural services separated from water supply services.
- Scheme infrastructure modernization, with attention to revised hydraulic and organizational boundaries.

PHOTO A2.10 Kano River Irrigation Scheme (KRIP)

PHOTO A2.11 Beneficiaries of the Kano River Irrigation Scheme

Transformation Strategy

The strategy for scheme operational and financial sustainability was based on the following:

- **Institutional realignment and definition of new functional roles,** with the RBDA taking on the role of bulk supplier and operator, providing water to 26 new sector-level WUAs located at secondary canal level.
- **New laws and regulations** at federal level to ensure a legal basis for WUA establishment (including compulsory membership) and to provide a legal basis for fee retention at WUA and scheme level to finance ongoing OMM.
- **Organizational capacity development for OMM** at the scheme in support of the RBDA (I&D agency) as the operator for the bulk system, multiple WUAs at secondary level (700-1,400 hectares), and WUGs at tertiary level (30-100 hectares).
- **Private sector contracted for maintenance** of the supply and main canal and drainage system, requiring heavy machinery for removal of typha grass, canal works, and desilting activities.
- **Explicit and legally supported operator and WUA service agreements** established through service delivery contracts between the RBDA and the WUAs, and the RBDA and the maintenance contractor.
- **Investments in the agricultural complex** through private sector support to ensure increased productivity and profitability to generate income and thereby ensure that the irrigation service fees were both sufficient for the OMM needs, and affordable for the farmers. This also supported the attitudinal shift needed among farmers from the mixed (agricultural and water) mandate of the prior organizational functions to the RBDA and the newly established WUAs responsible for irrigation service provision only.

- **Infrastructure redesign and modernization** to ensure technical and organizational alignment of the secondary-level hydraulic units. This included canal and control structure modernization, and, importantly, the installation of measuring points at which the new bulk water supply entity would deliver to the newly established secondary-level WUAs. These hydraulic units were designed for between 700 and 1400 hectares, to ensure sufficient size to employ full-time administration and technical personnel, but remain small enough for meaningful representation and farmer access to the WUA office and personnel.

- **Annual OMM budgets were based on asset and personnel assessments,** and **affordability to pay** was assessed on realistic anticipated yields and market evaluations. ISFs were expected to increase from US$15 to US$45 to US$60 per cropping season, which was evaluated as affordable in discussions with farmer representative groups, given wider agricultural and organizational support to the scheme organizations (water service security and reduced risk) and production and marketing support to the farmers through private sector mobilization.

Attitudinal Change through Consultation and Information Exchange

The RBDAs are powerful regional organizations in Nigeria with a long history of water-related development, playing a central role in planning and managing investments in relation to dams and irrigation, as well as in operations, including revenue collection. Proposed changes to institutional arrangements required a shift in the wider understanding of their role, and inevitably a change in power relations and the financial control of resources. Key elements of the process leading to attitudinal change at all levels included:

- **Mobilization of ministerial support**, through two consecutive governments, by the Nigerian lead personnel, supported by the World Bank project leadership.

- **Selection of capable senior Nigerian personnel** on the counterpart team.

- **Multiple workshops at federal, regional, and scheme levels**, led by the Nigerian counterpart team over a period of two years in all participating states and schemes. This was supported by a range of technical specialists, thereby introducing other African experiences from further afield, leading to the collaborative assessment of problems and development of solutions.

- **Visits to other African countries where irrigation reform had been carried out,** such as Mali, Senegal, and South Africa.

- **Repeated engagement with farmer representatives and RBDA personnel** at scheme level, defining new roles and functions in an iterative process of refinement.

- **Mobilization and support to dynamic counterpart staff,** to address resistance to change and achieve attitudinal shifts in support of the transformation agenda.

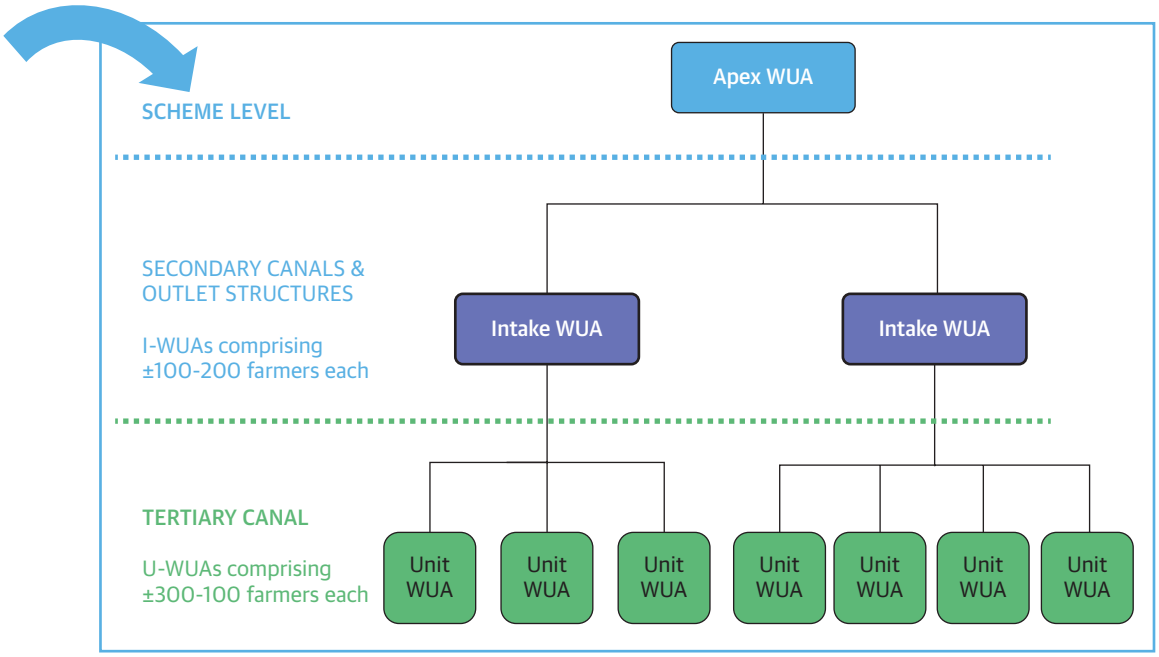
Building on Existing Institutional Arrangements

WUA organizational development interventions were initiated in 2006-07 by the Federal Ministry of Water Resources (FMWR), Irrigation Department (figure A2.10). A three-tiered WUA structure was introduced using cooperative legislation at:

- **Unit level** (30-50-hectare WUGs). PIM arrangements were nominally introduced at the tertiary-level WUA, responsible for maintenance of the earthen canal hydraulic unit.
- **Secondary-level blocks** (200-2,000 hectares, later resized organizationally and in the engineering design to 700-1,400 hectares).
- **Scheme level**, represented by an Apex WUA.

While these initial attempts (prior to the transformation initiative) at institutional reorganization achieved relatively little in terms of improved irrigation water services at farm level, they were valuable in introducing ideas about new ways of organizing and operating. The RBDA irrigation personnel and farmers were aware of fundamental principles of PIM, providing an important platform for the reform process.

FIGURE A2.10 Institutional Arrangement for WUA



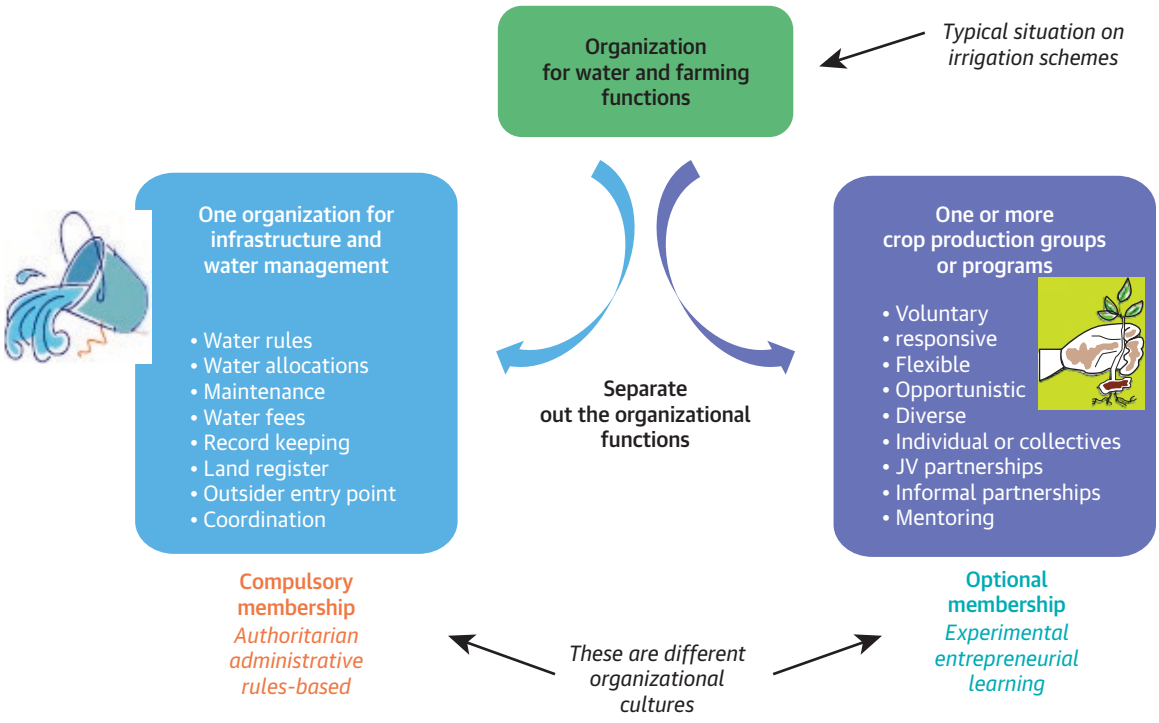
Source: Original compilation.
Note: WUA = water user association.

Changing the Dual Agro-Water Mandate to an Irrigation Water Services Mandate

The RBDA and the WUAs previously had the dual mandate of being responsible for water service issues and for facilitating agricultural support. This included the organization of subsidized seed and fertilizer, input warehousing, and the coordination of marketing. The Apex WUA acted mainly in a liaison and conflict resolution capacity for lower-tier WUAs, and operational involvement was limited to seasonal allocation decisions with the RBDA. The tertiary-level WUAs were responsible for ad hoc maintenance and water-sharing activities at tertiary level.

The modernized arrangement mandate was limited to irrigation water functions only, shown in the blue box in figure A2.11. The prior three-tier WUA structure was maintained in principle, but new responsibilities were defined with government teams, farmer representatives, and RBDA personnel over 18 months. In principle, water responsibilities were viewed is an input to the agricultural enterprise and were facilitated by the RBDA, maintenance contract, WUA, and the WUG. The agricultural functions (in the green box in figure A2.11) were separately assigned to cooperative structures based on crop type. PIM and IMT were key principles included in the institutional setup at secondary canal level, reflecting devolution to the lowest practical, and financially sustainable, level.

FIGURE A2.11 Organizational Mandates

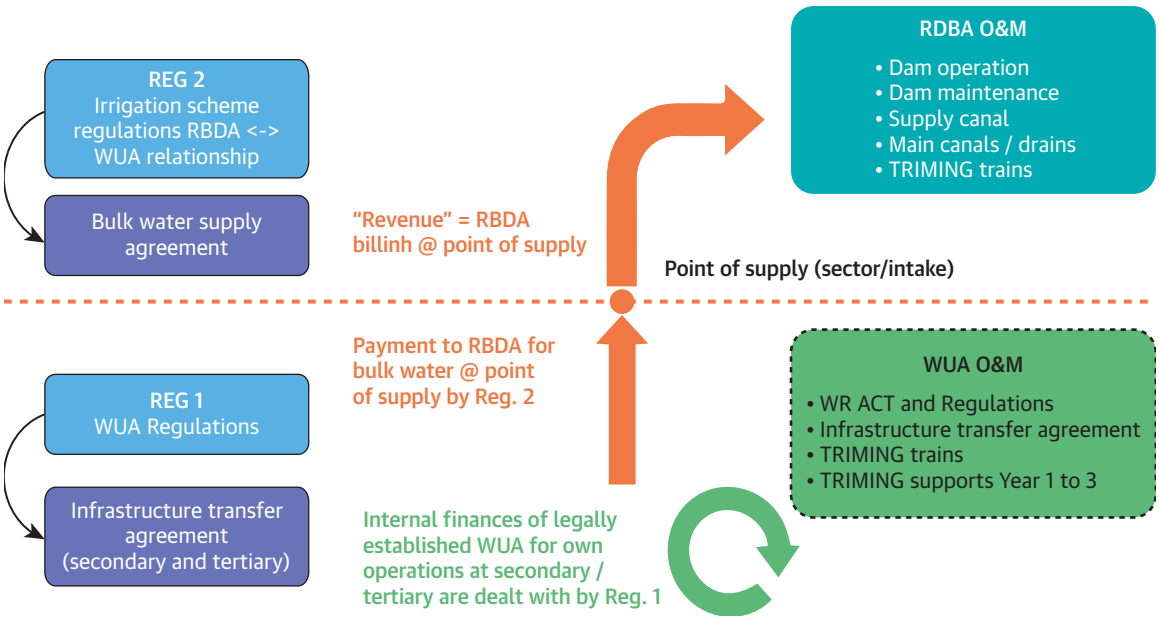


Source: Original compilation.
Note: JV = joint venture.

Redefinition of Key Roles: Legal Reform and Institutional Bricolage

A legislative intervention was made to the draft Water Resources Bill, including two new regulations (WUA and irrigation scheme regulations). These were included in the bill at the project's initiative to enable a sound legal basis for effective scheme management in future, by properly enabling IMT and PIM. This process was facilitated by engagement with and active support from the minister. The bill was passed by the House of Representatives in 2018 and was pending final Senate approval at the time of publishing. While this legislative intervention is expected to have longer-term impact, the project had to rely on interim measures to enable immediate action. This was achieved through facilitating (a) a Statement of Sector Policy by the minister; and (b) a Delegation of Authority for Transfer of Irrigation and Drainage Facilities to Water User Associations, both based on the extant legislation. These interim measures established rights of use of infrastructure by WUAs, devolution of financial control to the scheme, and the right to collect and hold a significant portion of the water use fees at WUA level. The interim legal interventions, particularly financial ring-fencing at scheme level, were imperfect, but were all that could be achieved within the project cycle. They enabled the transformation process to make a significant step to a modernized management arrangement. The project proceeded with the interim legal measures that enabled the same approach, albeit with lesser legal specificity and clarity, and in anticipation of the bill being promulgated into law in future (final arrangement shown in figure A2.12, facilitated by interim legal provisions during the project). The modernized arrangement included a revised role for the RBDA, from operator of all levels of the

FIGURE A2.12 Revised Institutional Arrangements for WUAs and Irrigation Scheme Regulations



Source: Original compilation.
Note: RBDA = River Basin Development Authority; HJRBDA = Hadejia Jamare River Basin Development Authorit; TRIMING = Transforming Irrigation Management in Nigeria; WUA = water users' association.

scheme, to one focused on reservoir operations, and OMM of the supply and branch canals (figure A2.12). Water was delivered to the secondary-level WUAs, which were bulk water purchasers responsible for internal distribution. This facilitated the WUA entities to be legally established, retain fees, engage in contractual agreements with the RBDA as bulk services provider, and enforce nonpayment of ISFs by farmers. The revised arrangement led to the WUAs being sized to be financially viable (700-1400 hectares), yet remain decentralized enough for meaningful local participation, sufficient degree of farmer control over decision making, and the employment of permanent administrative and technical staff for operations.

Engineering Redesign in Support of Organizational Functions

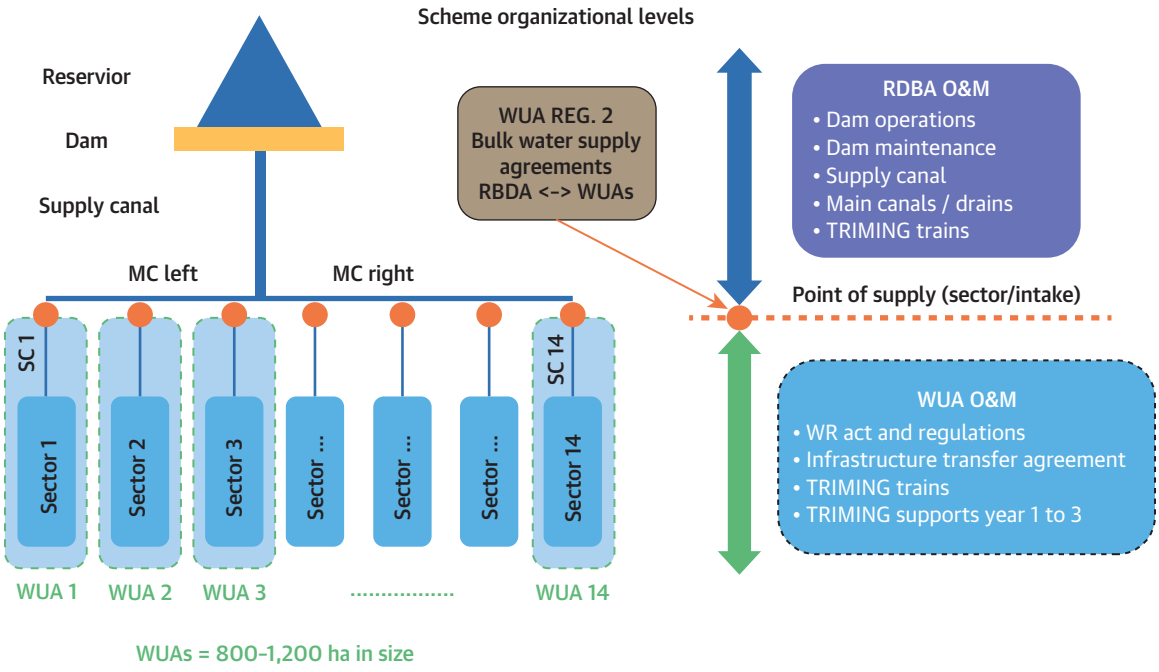
The engineering design was revised interactively so that sectors were combined or divided to arrive at WUAs of approximately 700-1,400 hectares.

Legal agreements were structured at the point of supply (red dot) between the RBDA (bulk operator) and the WUA responsible for OMM within the resized sectors (irrigation blocks). See figure A2.13.

Summary of Key Functions from Six Perspectives

The roles of the stakeholders are outlined in relation to six viewpoints on water management.

FIGURE A2.13 Scheme Organizational Levels

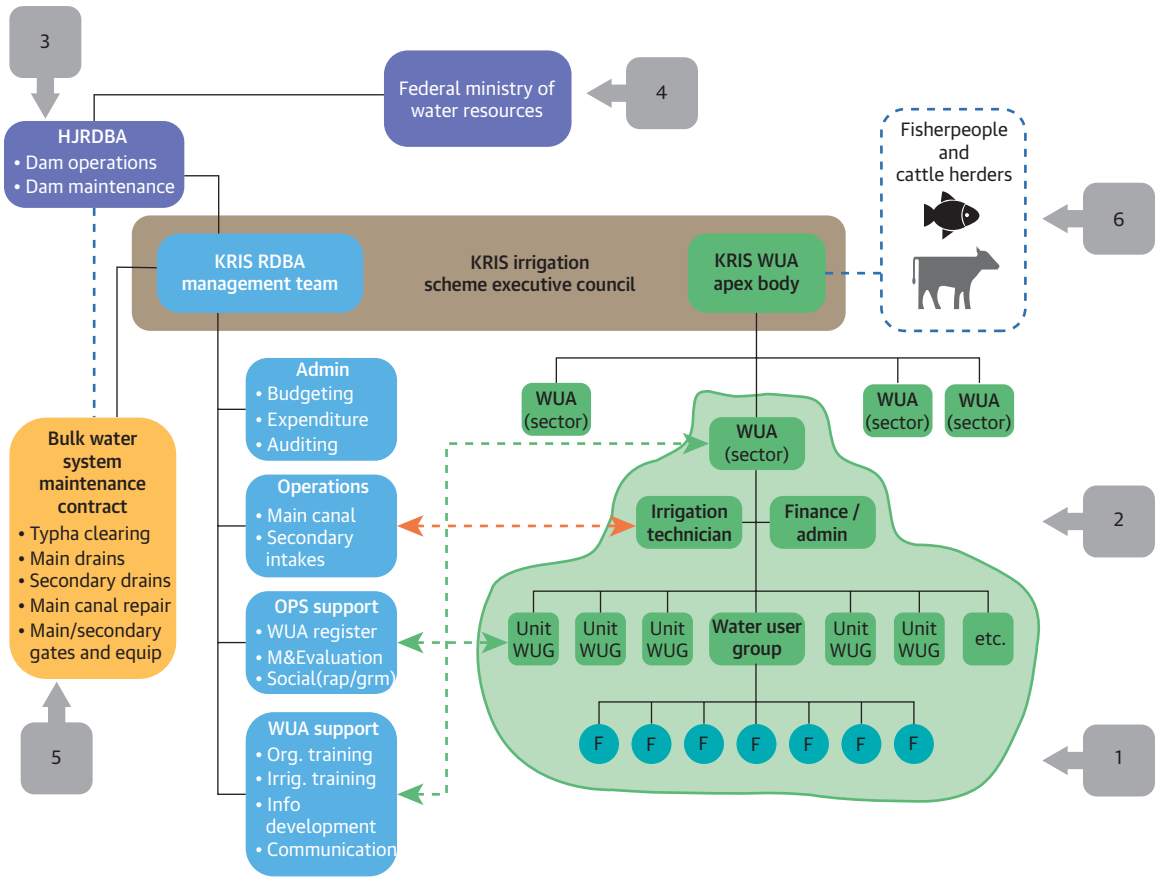


Source: Original compilation.
Note: RBDA = River Basin Development Authority; TRIMING = Transforming Irrigation Management in Nigeria; WUA = water user association.

These are listed and shown in figure A2.14.

1. Farmers (both in schemes and individually).
2. WUOs who framing boundaries and systemic linkages (roles, responsibilities, legal-financial flows) at the levels of WUGs, WUOs, and apex bodies.
3. State irrigation agencies (such as HJRBDA).
4. Line ministries and regulatory bodies (FMWR).
5. Private sector (PPPs, service providers for water and agriculture, value-chain entities).
6. Non-irrigation users (fisher people and cattle herders).

FIGURE A2.14 Functions of the Different Stakeholders



Source: Original compilation.

Note: GRM = Grievance Redress Mechanism; HJRDBA = Hadejia Jamare River Basin Development Authority; KRIS = Kano River Irrigation Scheme; RAP = Resettlement Action Plan; RBDA = River Basin Development Authority; TRIMING = Transforming Irrigation Management in Nigeria; WUA = water users association.

Perspective 1: Farmer involvement in WUGs

- Formulate the water register of the farmers served by the tertiary canal(s) under their responsibility and update it every year at the (sector-level) WUA.
- Distribute water to users in accordance with the scheme's operational manual.
- Collect the fees from the farmers before the irrigation season starts (fees approved by the executive council of the scheme) and deposit them at the WUA at the sector level.
- Organize, involve the farmers, and implement the maintenance of the canals and drains at the tertiary level before each irrigation season starts.
- Keep a record of the days involved in the maintenance of canals and drains voluntarily provided by the farmers.
- Intervene in any water service conflict that could arise in the WUA at the unit level.
- Report at sector level on the grievances and conflict resolution presented by the farmers.
- Coordinate and distribute the compensation grants provided by the project, derived from damages in the construction of the infrastructure as established in the approved Resettlement Action Plan.

Perspective 2: WUA (sector level, 700–1,400 hectares)

- Collate the **unit water register** of the farmers served by the sector and update it every year. The sector WUAs need to include any farmers who are served directly by the distributary canal under their responsibility.
- **Distribute water to the WUAs** at the unit level in accordance with the operational manual of the scheme.
- Open a **bank account** following the agreed specifications approved by the PMU, and **collect the fees from the unit WUAs**.
- Prepare the **irrigation scheduling** before the irrigation season starts.
- **Organize** and involve the farmers and implement the **maintenance of the distributary canals** and drains at sector level before each irrigation season starts.
- Intervene in any unresolved **water service conflict** in the WUA at the unit level.
- **Report to the apex WUAs** at scheme level about the conflict resolution and grievances presented by the farmers in their sector.
- Review the implementation by the WUAs at unit level of the compensation grants provided by the project (derived from damages in the construction of the infrastructure, as established in the Resettlement Action Plan).
- Implement the **grievance redress mechanism** at their sector.

- Organize, **facilitate,** and conduct the **training session with the WUAs** at the unit level to improve the efficiency of the system.
- **Organize meetings** of the WUAs at the unit level, using the facilities of the sector-level offices.
- Participate at the **general assembly**.
- Prepare monthly financial statements of the sector (balance between collections and the expenses).
- Respond to the observations made by external auditors of the accounts presented and resolve issues.

The apex WUA would contribute to the scheme executive council in relation to the following:

- Formulate the **irrigation plan** of the scheme (with sector WUAs).
- Participate in the process and approve the I&D **service fees**.
- Manage the contractual arrangements with the **maintenance contractor.**
- Approve the **irrigation program** of the sectors and RBDA scheme team.
- Review **progress monthly** and address issues.
- Review the **progress information** presented by the WUAs.
- Review the **general audit** of the WUAs and report to the HJRBDA.
- Act as an **entry point for outside stakeholders** and disseminate information to farmers and stakeholders**.**

Perspective 3: Government irrigation agency (HJRBDA)

- **Operate the dams** and distribute water to the **main canals** and sector WUAs.
- Participate in the negotiations of the **ISF** of the scheme and obtain approvals from regulatory and oversight bodies (to be decided and formulated).
- Support the scheme executive council (SEC) and the (sector-level) WUAs in their routine OMM activities, including ongoing training for O&M, financial, and other administration.

Perspective 4: Line ministries (FMWR)

- Regulatory review and knowledge dissemination of the WUA establishment processes, including awareness-raising media and structured training approaches.
- Support in relation to the formalization of water rights at scheme level.

Perspective 5: Private sector

The private sector plays an important role in the water management functions. The modernization of Kano WUA requires the contracting of a maintenance contractor by the scheme executive council. The contractor would undertake heavy-duty maintenance activities including:

- Clearing of typha grass from waterways with a fleet of swamp boats.
- Clearing of main and secondary drains.
- Undertaking main and secondary canal repair on an ongoing basis.
- Maintaining infrastructure and equipment (including gates) on main and secondary canals

Perspective 6: Nonirrigation Users

The needs of fisher people and cattle herders were accommodated in the overall technical design by ensuring water provision to key locations, and cattle transit paths inside the scheme. Organizationally, interaction and conflict resolution between irrigators and herders (a major social and political issue in Nigeria) was facilitated at the Apex WUA level.

Summary of Key Learnings

The Kano case highlights a participative and transformative planning process that led to a jointly formulated and completely restructured water management arrangement and a major shift in functional roles of all key players. While the construction aspect of the modernization was still being implemented at the time of writing this report (2018), the attitudinal change, participative redesign, and legal transformations reported here were established, and contributed to the reform of the irrigation sector at national level.

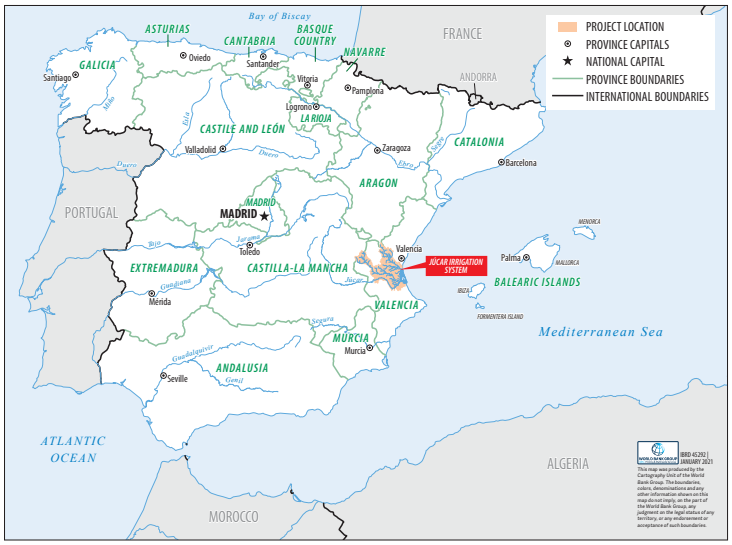
It is expected that these institutional and organizational transformations will lead to key outcomes of improved performance in terms of sufficiency, equity, and reliability; strengthen representation and fairness; and lead to long-term financial sustainability through systematic infrastructure maintenance.

Key lessons emerging:

- The **power of inclusive consultations over time in facilitating attitudinal shifts *despite* substantial initial resistance to change.** Extended engagement with all stakeholders over three years and the use of preexisting and familiar structures (such as the three-tier WUA arrangement) as building blocks for future arrangements, led to change.
- The **importance of in-country political and technical leadership**, and close collaboration with funding agency planners. In the Kano case, this involved two ministers of Water Resources, the Department of Irrigation project coordinator, and World Bank project and country leadership.

- The **need for quick responses to opportunities**, such as those afforded by the unexpected movement of the Water Resources Bill after two years of being stalled. This prompted new WUA clauses to be inserted into the bill, and subsequent regulations drafted by the combined project planning team in a short window of time. The quick response substantially strengthened the regulatory environment.
- The importance of **aligning hydraulic and organizational boundaries and functions**, and the need for harmonizing engineering design with water management organizational design (Apex WUA at scheme level, operational WUAs at secondary level, and WUGs at tertiary level).
- The importance of a viable and affordable **financial feedback loop (ISFs supporting OMM)** based on realistic cropping plans and yields, and ring-fencing of ISFs for future use only in OMM. These were central to planning for financial sustainability into the long term.

Case 12. Spain: Modernization of an Ancient Flood System—New Governance Challenges



System Overview

The La Acequia Real del Júcar irrigation system in Valencia, Spain, is ancient: its main canal was constructed in the 13th century under the reign of King Jaime I. Over 750 years the system was expanded to now cover some 20,000 hectares, supplying irrigation water to approximately 29,400 smallholders. The system is collectively managed by the Junta de Gobierno (elected board of directors) of the Comisión de Regantes (WUA). This is one of the most ancient, important, and influential WUAs of Spain (see photo A2.12).

Water is taken from the Jucar River through the Antella intake works. The water from the Jucar River is also used by groundwater users in the upper part of the river basin, several other large and smaller irrigation systems in the downstream part of the river basin (such as the Júcar-Turia irrigation system), and the city of Valencia. The Jucar river basin is a closed river basin, implying that in most years, most of the time no water reaches the Mediterranean Sea. The irrigated area presently is about 20,000 hectares. In 2018 approximately 29,400 users had water rights.

Water Management Arrangement

- Construction started in the 13th century
- Water user associations (WUAs) at two levels: main system and 21 *términos* (villages)
- WUA is one of the most important in Spain

Farmer Profiles

- Average plot size: 0.7 ha
- Size range: 0.1–10 Ha
- No. of farmers: 29,400
- Many farmers over 60 years old
- Oranges are sold to cooperatives (but hardly profitable)

Value Chains

- Fruit (mainly citrus)
- Vegetables
- Rice

Oranges to national and Northern European markets; rice for local and national paella

Governance

The governance has two tiers: at the level of the 21 *términos* (villages) all users elect a board of seven members (*junta local*). The junta locales employ a *celedor* (ditch rider) and various *regadores* to distribute the water and irrigate the fields. They also appoint a water judge (*jurado de riego*) to mediate in conflicts. All users can join the annual general assembly meeting for discussion with the board.

The users in the términos also elect one or two representatives of deputies (*delegados*) to form the general assembly of the Comisión de Regantes at main system level. See figure A2.17. These 30 members of the general assembly elect a daily board (*junta de gobierno*) for the governance at main system level. This board has 10 members who elect a chairperson (*presidente*) from their midst. They have a meeting once a month. The junta de gobierno employs engineers and administrative personal to manage the irrigation system. They also employ an *acequiero mayor,* who oversees the water distribution at main system level, and various *guardas,* who distribute the water along the secondary canals.

Water Infrastructure

- Irrigation system more than 750 years old
- 20,000 ha of irrigated land
- 54 km of main canal
- 500 km of distribution canals

PHOTO A2.12 Acequia Real del Júcar

Reservoirs

Two reservoirs in the Jucar River store water that is released in the summer for irrigation: the Alarcón Reservoir (1,112 cubic megameter capacity) and the Contreras Reservoir (300 cubic megameters of useful capacity).

Groundwater

Little groundwater is used in the system, due to its salinity and because the small net returns for crops such as oranges and rice do not support pumping costs.

Water allocation

Water is allocated according to the water rights tied to a landholding and the crop planted.

Water allocation and distribution

Water allocation and distribution to each of the términos is arranged by the acequiero mayor and executed by guardas (ditch riders). Inside each término the celador distributes the water. The regadores make sure each field is irrigated.

Farmers request water turns, and these turns follow the order along the canal. This system has been changed to automated delivery in the more modernized areas.

The main field application method remains basin irrigation, in which bordered fields with fruit trees are inundated. Vegetables are irrigated with furrow irrigation. In the modernized sectors, drip irrigation is installed. Rice is cultivated in permanently flooded paddy fields.

Water is conveyed in open, mainly lined canals, and regulated with electrically or manually operated vertical sliding gates. Discharges are measured at the entrance of the secondary canals. This infrastructure is now replaced by a piped system, which has automated regulation and flow meters.

Albufera estuary

An important part of the system's run-off and drainage water ends up in the Albufera estuary (2,800 hectares), situated at the tail of the main canal. The Albufera is a freshwater lagoon and estuary on the Gulf of Valencia coast, south of the city of Valencia. It is a nature reserve and visited by many tourists. The shores of the lagoon are used for cultivating paddy rice. Traditionally fishing was important, but due to bad water quality, fishing has stopped.

The Jucar River Basin and Irrigation Modernization Plans

The river basin authority (Confederación Hidrográfica de Jucar, CHJ) that forms part of the Ministry of Environment allocates the water from the Jucar River and reservoirs to the various irrigation systems. It coordinates the water allocation with the Federation of the Groundwater Users in the upper basin, and the Federation of the Irrigation Systems in the downstream part of the basin.

At the end of the 20th century, increased water use in the upper part of the Júcar basin (and the plan to transfer water to the Vinalopó watershed in the south) put pressure on the water allocation in the Jucar basin. The 1998 River Basin Management Plan of the CHJ planned the modernization of irrigation systems in the lower part of the basin to maintain the balance between supply and demand. The water "saved" through the installation of drip irrigation in the modernized irrigation systems was allocated for other agricultural uses. The government provided subsidies of 60 percent for the installation of the piped distribution system and hydrants. The farmers had to pay for the drip installation in their fields. Their main motivation for installing drip irrigation was for its convenience and the time it saves (and not for the reduction of water use).

The river basin plans made in the context of the European Water Framework Directive (2000-15 and 2015-30) also addressed the need to save water, not so much for reallocation to other agricultural uses, but because the increased valorization of ecological river flows and the Albufera Lake (in the tail-end) required a shift in emphasis from irrigation to ecological flow.

Role of the WUAs

The board of the WUAs approved the plan to shift to drip irrigation; however, the water users did not participate in that decision. When asked why they shifted to drip irrigation, 50 percent of the farmers replied that they were obliged to do so by the board of the WUA, 16 percent responded that they wanted to increase production (with fertigation), and 9 percent said water saving was their goal (Ortega-Reig et al. 2017).

Execution of the Modernization Plan

The first modernization plan with installation of drip irrigation was approved in 1998. This plan was followed by several more plans by the river basin authority. The irrigated areas are converted one by one, and the process goes very slowly. In the La Acequia Real del Jucar irrigation system, as of 2018, only three irrigation sectors had been converted (sectors 14, 15, and 23), and three more are under construction (sectors 10, 18, and 19; 717 hectares in total, with 2,575 farmers) out of the total of 43.

When an irrigation sector is converted to drip irrigation, a distribution system of buried pipes is installed. Each field gets a hydrant that can be opened and closed by remote control. The operation and monitoring of the piped system and the distribution to the fields is done from a central command center. At the head of each irrigation sector, the water is mixed with fertilizers.

Not all farmers in the irrigation sectors with pipes have installed drip irrigation in their fields, with about 5 percent of the farmers refusing to convert to drip irrigation. One reason is because the old citrus trees adapt poorly to the conversion from basin to drip irrigation because their root systems are too deep and wide, so localized shallow drip irrigation results in reduced yields.

In many parts of the irrigation sectors that have been converted to drip irrigation, the farmers want to maintain the open canal system as a backup system. The canals are used once a year to give extra water to leach salts. In case of heavy rainfall, the canals serve as drains for storm water. The maintenance of the canal system forms an extra financial burden.

Environmental Effects of Water Saving

One major objective of the modernization program was to save water, which could then be allocated from the Júcar River directly to the Albufera lagoon to increase water quality. It is calculated that the drip irrigation in the La Acequia Real del Júcar saves about 10 million cubic meters of water per year (out of the 180 cubic megameters of annual allocation). However, before the installation of the drip irrigation, the extra water applied to the fields drained mostly to the Albufera lagoon. Thus, the saving can be considered a "dry water saving," with no net positive result for the Albufera region (Mondría 2010).

The water allocated directly from the river might have higher quality compared with the drainage water from the irrigation system. However, the risk is that the "saved" water will be allocated for other uses (or stored in the Alarcon or Contreras reservoirs) and not to the Albufera. This demonstrates how water allocation from a reservoir to a natural park can be changed easily by a political decision.

Socialeconomic Effects of Modernization for Users

The conversion to drip irrigation has four main social and economic effects in the converted areas. With the conversion to drip irrigation, water distribution is regulated and monitored by a central remote center, meaning that the local WUA (at the level of the 21 términos) no longer has a function. This places the democratic functioning of the scheme at risk despite the board of the main irrigation system still being elected by the farmers of the 21 WUAs of the términos.

Because the farmers do not need to request water turns to the celedores, and the regadores are no longer needed to irrigate the fields, the centuries-old collective irrigation organization that supported the social fabric of the rural areas in the converted términos is affected.

Yields of older orange plantations have decreased as a result of drip irrigation while water fees have increased, and farmers have to invest in drip installations that need regular maintenance and repair. One main problem is the theft of equipment in the field (such as water meters), which increases the costs of the infrastructure. The irrigation water is mixed with fertilizers, making it impossible for a farmer to produce organic crops. Additionally, the fertilizers are the same for all farmers in an irrigation sector, irrespective of the crops grown. This problem is now being solved by connecting organic farmers directly to the main distribution pipes, before the sector heads where the fertilizers are mixed.

Suggestion for Improvement

Allow decentralized management of the drip system. This will enable users to have direct involvement in the management of their irrigation sector and will allow for more flexible water distribution and fertilizer use.

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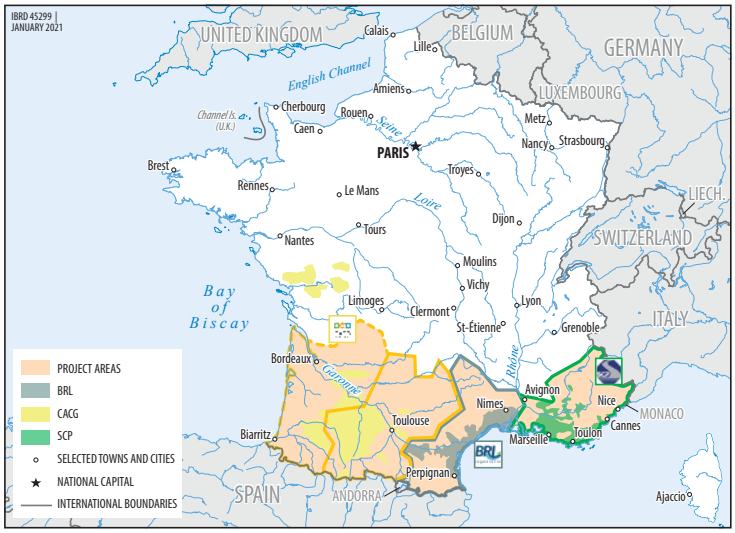
Case 13. France: Evolution of Regional (Water) Development Companies

MAP A2.12 Regional Development Companies with Public and Private Shareholders as Water Service Providers



Scheme Overview

Three regional development companies (Société d'Aménagement Régional, SARs) managed the three largest irrigation schemes in southern France, where irrigation is needed to supplement rainfall. These companies manage large hydraulic assets with the main purpose of delivering I&D services to farmers. In addition, and according to regional specificities, the companies provide water services for other uses (such as water supply and sanitation, hydropower, industry), contributing to the water security of the three regions. The three companies are BRL, operating in the Languedoc-Roussillon region; Société Canal de Provence (SCP), operating in the Provence region; and Compagnie d'Aménagement des Côteaux de Gascogne (CACG), operating in the Sud-Ouest region.

Key Problems and Challenges

The three SARs were created in the 1950s, after the Second World War, in order to boost the economy of these three deprived regions, where agriculture (wheat, vineyards, and olive trees) was mainly rainfed (in the Languedoc Roussillon) or irrigated

Water Management Arrangement

- Initially created in the 50s as Regional Development Companies with multiple functions
- Now with 75 years concession contract specialized in multipurpose water delivery services

Farmer Profiles

- Size range: 5 – 50 Ha
- No. of farmers: 20,000
- Commercial orientation

Value Chains

- Fruit trees, cereals, orchards, vineyards, etc.

Water Infrastructure

- 350,000 ha equipped with pressurized system (hydrants)
- 85 dams, 70 pumping stations, more than 10,000 km of pipe
- Urban water for 3.9 million people in the 3 schemes and water for industries (400 customers)

through precarious small-scale irrigation schemes in the Provence (eastern and southwestern parts of France).

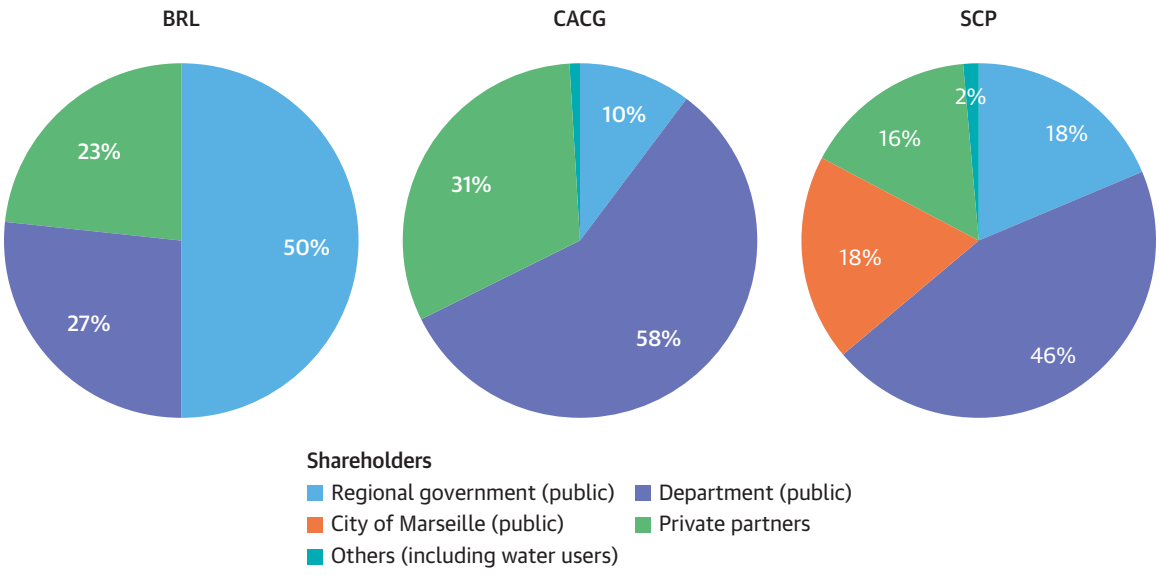
Approach and Solutions

The SAR were created as public development tools to foster regional and multisectoral development: diversified and intensive agriculture; industrial expansion; urban expansion; and tourism development on the coast.

A specific legal and institutional personality was developed for the newly created companies (SARs) that fall under the French Société d'Economie Mixte (a publicly owned and privately managed company, with a majority of public shareholders). During the creation of the companies, the concessionary (asset owner) was the central government, represented by the Ministry of Agriculture. This function of concessionary has been transferred to the regional government as part as the process of decentralization. Figure A2.15 shows the current breakdown of shareholders for the three SARs. The institutional design also includes a public service concession for 75 years granted from the state to the SARs; and the granting of water rights issuance by the river basin agency (especially for the main water withdrawal in the Rhône River).

PHOTO A2.13 SAR Managed Irrigation Schemes

FIGURE A2.15 Shareholders of the Société d'Aménagement Régional



Source: Daurensan et. al 2015.
Note: BRL = Bas-Rhône Languedoc; CACG = Compagnie d'Aménagement des Côteaux de Gascogne; SCP = Société Canal de Provence.

The two main missions to fulfill for the SARs were the development of water storage, transfer, and distribution infrastructure, and the provision of support for irrigated agriculture development (incuding extensions services, research, and land management). Some SARs also have specific complementary missions, such as tourism promotion.

The objective was to create regional companies with local governance and a comprehensive mandate covering the design, construction, and operation of the hydraulic assets over a long period of time, as well as complementary functions that will ensure productive agricultural use of public investments (agricultural research, extension, development of multipurpose water uses allowing to increase the revenues for the SAR).

Transformation Strategy

The long history of the SARs can be divided into three different periods.

1955–85: 30 years of development

During this period, the SARs (a) planned, designed, and carried out works and hydraulic multipurpose infrastructure; (b) mobilized the necessary funding; and (c) were involved in land restructuring, research and technical support to producers, and post-harvest and marketing processes for agricultural products. Starting in the 1970s, the SARs exported their knowledge by developing consulting activities, especially in Francophone countries such as Morocco, Tunisia, Mali, and Senegal.

1985–2000: Crisis, reorganization, and specialization around water service delivery

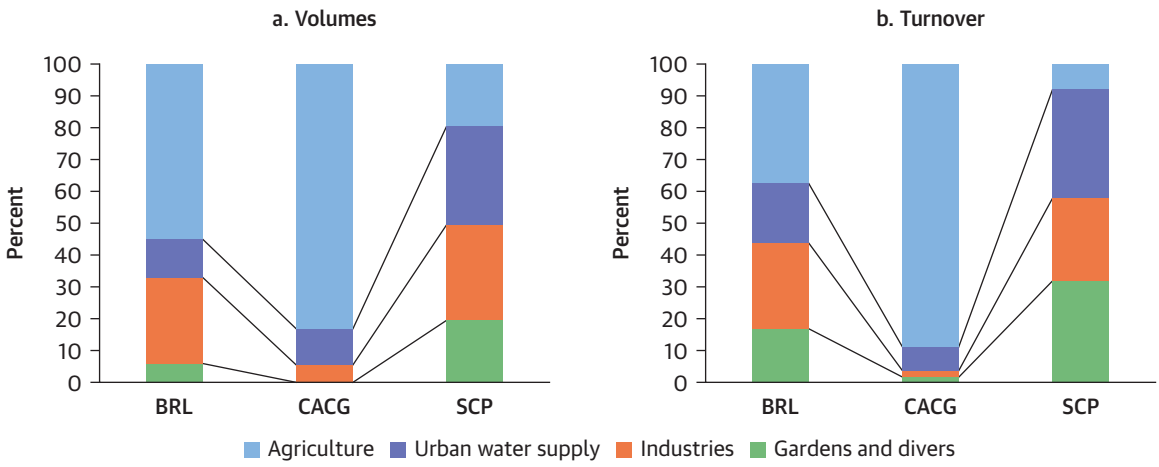
This period corresponded with the reduction of the investment phase as the main hydraulic assets were completed. The three SARs also disengaged from some complementary missions (such as land management, tourism promotion) and transferred these functions to specialized entities. The companies also faced the reduction of state financial support, which obliged them to restructure their organization significantly (including reduction of staffing, creation of subsidiaries, optimization of operation costs, and update of tariffs), and look for new financial partners (local authorities, private companies, and banks).

Even if the SARs represent a majority of public shareholders, they are not entitled to subsidies for O&M. They operate under private management with private accounting, tax liabilities, and the obligation to ensure a constant balance between charges and income. Important investment of asset renewal may be co-financed by the concessionary (regional government), the SARs, and the river basin agency (the latter if the renewal includes a modernization of the infrastructures leading to water economy or positive externalities on environment).

SARs in the 21th century

The SARs are consolidating their business model by diversifying their sources of revenue for water sales, as showed in figure A2.16, panels a and b. Even though the volumes of water delivered to the customers are still predominantly for agriculture (except for SCP), the revenues generated from the irrigation fees are decreasing, and for two of them represent only 10 percent (SCP) and 40 percent (BRL).

FIGURE A2.16 Sources of Revenue for Water Sales



Source: Daurensan et. al 2015.
Note: BRL = Bas-Rhône Languedoc; CACG = Compagnie d'Aménagement des Côteaux de Gascogne; SCP = Société Canal de Provence.

A new generation of regional projects is strengthening SARs' position as key stakeholders contributing to water security and resilience of the regional economy to climate changes and climate variability (including flood management, thanks to the multipurpose dams managed by the SARs). These projects are Aqua Domitia (for BRL); Poitevin Lowlands (for CACG); and Verdon Saint-Cassien Transfer (for SCP).

Summary of Key Functions from Six Perspectives

Perspective 1: Farmer involvement

Farmers are customers of an on-demand, individual, and pressurized irrigation service (hydrant on the plot). They pay the irrigation fee using a binomial formula based on volume and on flow available at the hydrant. A contract is signed between the farmer and the SAR that stipulates duties and rights for each party (including the continuity of service for the farmer, and the right to interrupt service if the farmer is failing to pay the irrigation fee).

Perspective 2: WUA

In the public concession (the hydraulic assets built by the SARs), the WUA has no functions in O&M. Outside the public concession (small and medium schemes built before the SARs, but receiving some services from the SAR), the traditional forms of collective water management in France applies, the Association Syndicales Autorisées (ASAs). These ASAs are WUAs, based on a strong and old legal framework. They are created based on the principle of compulsory membership (for any landowner within the perimeter). They are in charge of O&M of hydraulic assets, collect irrigation fees, and operate under the public oversight (local government) for their financial management.

Perspective 3: Agency (SAR)

The SAR (concessionaire) (a) invests and operates—acts on behalf of the concessionary (asset owner); (b) receives remuneration from the users (water tariffs); (c) bears investment and operation risks; and (d) ensures the renewal of infrastructure (with the support of the concessionary).

Perspective 4: Line ministry (Ministry of Agriculture)

The Ministry of Agriculture was the first concessionary until this function was transferred to the regional government under the framework of the decentralization policy of France.

Perspective 5: Private sector

Some private companies are stakeholders of the SARs, especially commercial and development banks, water supply and sanitation service providers, and water users.

Perspective 6: Nonirrigation users

In addition to I&D services, the SARs provide water service delivery to other customers for uses such as:

- Water supply and sanitation (bulk water to treatment plants, and in some cases treated water to customers).
- Water for electricity generation (especially SCP).
- Water for industry (especially SCP).
- Nontreated water for individual households (usually for recreational uses such as garden and swimming pools).
- Ecological flows in the public interest, to provide water for the environment (such as securing minimal environmental flows).

Summary of Key Learnings from SARs Case

The SAR model is quite unique in the world, not only because of its legal and institutional personality but also because of its capacity to evolve, over more than 60 years, from a typical public entity concentrating multiple functions to ensure a coordinated regional development, to a mixed company (public and private shareholding) that combines a *specialized water service provider* (function of water service provision) operating under private management rules for a large spectrum of customers and water uses, with a *key stakeholder in regional development* (function of asset development), especially toward water security. The reasons for success are multiple and include:

- The existence of a long-term territorial vision (concession contract of 75 years), including socioeconomic and environmental challenges.
- The participation of public stakeholders in financing the CAPEX aspects of the scheme. The regional development was decentralized with a clear vision of how to use the SARs to catalyze regional development.

- The private law statutes and the operating autonomy that allow for O&M without public subsidies under a customer-provider relationship (with rights and duties for each party).
- The integration of all human skills in the SAR, from design to operation, which is useful for the O&M of the schemes in France but also for the export of knowledge (consulting firms within the SARs).
- The multipurpose infrastructure (agricultural, urban, industrial, environment) that allows for limiting demand risks (such as a reduction of volumes for irrigation) by diversifying customers and revenues.
- A clear and sustainable tariff policy, and commercial management that includes (a) transparent contracting between the contractor and final user; (b) solidarity between uses and territories (a water user at the tail-end of the system pays the same as those upstream); (c) the adaptation of tariffs to the needs of the water users (such as the possibility of selecting different flows and range of total volume for farmers), and for every use (including agriculture and urban).

Reference

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