

Governance in Irrigation and Drainage

Concepts, Cases, and Action-Oriented Approaches—A Practitioner’s Resource

Pieter Waalewijn, Remi Trier, Jonathan Denison, Yasmin Siddiqi, Jeroen Vos, Eman Amjad, and Mik Schulte

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This publication received the support of the Global Water Security & Sanitation Partnership (GWSP). GWSP is a multidonor trust fund administered by the World Bank's Water Global Practice and supported by Australia's Department of Foreign Affairs and Trade, the Bill & Melinda Gates Foundation, the Netherlands' Ministry of Foreign Affairs, the Rockefeller Foundation, the Swedish International Development Cooperation Agency, Switzerland's State Secretariat for Economic Affairs, the Swiss Agency for Development and Cooperation, the U.K. Department for International Development, and the U.S. Agency for International Development.

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1818 H Street NW, Washington, DC 20433

Telephone: 202-473-1000; Internet: www.worldbank.org

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Please cite the work as follows: Waalewijn, Pieter, Remi Trier, Jonathan Denison, Yasmin Siddiqi, Jeroen Vos, Eeman Amjad, and Mik Schulte. 2020. "Governance in Irrigation and Drainage: Concepts, Cases, and Action-Oriented Approaches—A Practitioner's Resource." World Bank, Washington, DC.

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Cover and report design: Owen Design Co.

Cover photos (left to right): John Wambugu/USAID, Ben Barber/USAID, Jacob Burke, Alfredo Carrasco/World Bank

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Foreword

This resource book explores how irrigation governance can help address rural poverty, mitigate climate-change impacts, and feed the planet. It addresses the various performance areas that shape irrigation to better understand what we mean by improving irrigation performance and “fixing the institutions,” and acknowledges that where one sits determines one’s priorities, needs, and actions. It then provides practical process guidance to identify core problems, build alliances, and take incremental steps towards reform.

The central message of this resource book is that functions, processes, and related capabilities must be the priority focus of all interventions in irrigation institutions. Acknowledging the tremendous diversity and history in culture, practice, and guidelines, it does not attempt to replace or provide a blueprint. Rather, it presents an overarching vision and approach and a common language to address day-to-day performance problems in reaching ever-evolving local and global demands.

We hope the analysis and proposed action presented here will help us better articulate, support, and monitor key challenges, as well as to start recording diverse successes in making the sector more effective in feeding people, sustaining the planet, and providing decent livelihoods for farmers.



Jennifer J. Sara
Global Director, Water
World Bank

Acknowledgments

This work was led by Pieter Waalewijn (Global Lead for Water in Agriculture) and Remi Trier (Co-Global Lead for Water in Agriculture) of the World Bank. Additional World Bank colleagues, who are members of the World Bank Water in Agriculture Global Solutions Group, including Joop Stoutjesdijk, Francois Onimus, David Casanova, Gabriella Izzi, Craig Kullman, Kazuhiro Yoshida, Abdulhamid Azad, Vivek Srivastava, Pierrick Fraval, IJsbrand de Jong, Erwin de Nys, Lucy Lytton Steven Schonberger, and Richard Damania, provided detailed comments and experienced advice throughout the process. Stephen Hodgson contributed to the section on water user organizations, and Bill Garthwaite contributed to the section on catalyzing change through legal reform. Andres Duque Salazar contributed to graphic design. The administrative support of Carolina Delgadillo, Alona Nesterova, and Isabel Duarte Junior is also graciously acknowledged.

The authoring team comprised a group of independent consultants: Jonathan Denison (Lead Consultant), Yasmin Siddiqi, Jeroen Vos, and Eeman Amjad; and Pieter Waalewijn, Remi Trier, and Mik Schulte from the World Bank.

Executive Summary

i The Irrigation Governance Challenge

Irrigated farming is central to meeting the world’s food and fodder needs and will be even more important in delivering on food security and water sustainability development priorities in the future. High population growth, climate change, increasing socio-economic growth, and water stress are key drivers of change. Although irrigation covers only 6.5 percent of the total land used for agriculture, it supports production of 40 percent of the world’s food and fodder output, with a gross value of 55 percent of global agricultural produce. Improving irrigation performance is a priority strategy in addressing rural poverty and in mitigating climate-change impacts, especially for the most vulnerable. Investment in irrigation has seen renewed interest in the past decade, and irrigation and drainage (I&D) governance has emerged as a key focus to achieve improved performance.

Institutional failures and poor irrigation performance have been blamed on low capacity, perverse incentives, misdirected policies, and weak implementation – but these are only contributing factors. Investments in institutions of the past have aimed to “fix the institutions,” with a focus on form and on organizational structure.

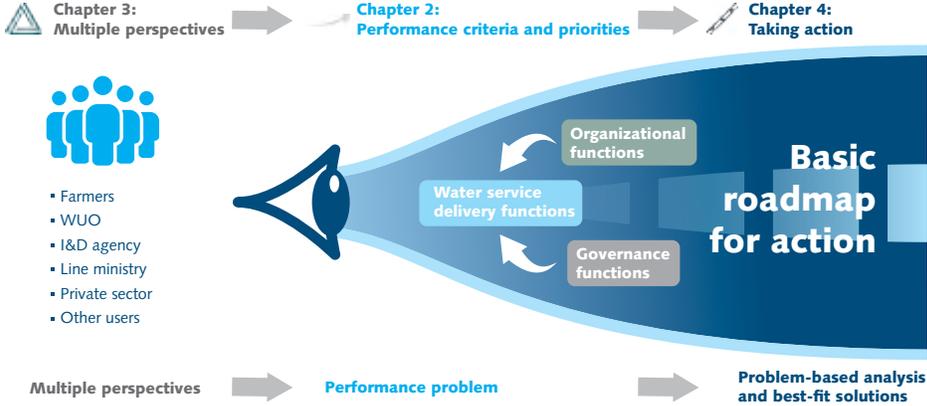
The central message of this resource book is that functions, processes, and related capabilities must be the priority focus of all irrigation institutional interventions.

Audience and Purpose

The resource book is written by practitioners for practitioners. It is aimed at task team leaders and team members who are involved in irrigation and drainage investment projects. It is also expected to be helpful to other readers, including government personnel, consultants, Water User Organization (WUO) leadership, Non-Governmental Organizations (NGOs), and research academics.

The approach is “systems-type agnostic” and is applicable to groups of independent small-scale irrigators pumping water individually from shared shallow aquifers, to tens of thousands of farmers and multiple organizations involved in mega-schemes that cover hundreds of thousands of hectares. The approach can be used for scheme-level diagnosis, organizational restructuring and evaluation and monitoring. The thinking can also be applied to national and scheme-level strategic planning processes, and in the implementation stages of I&D investment projects.

FIGURE E.1. The Resource Book Approach: Perspectives on Functional Performance Approach



Note: I&D = irrigation and drainage; WUO = water user organization.



The Approach: Multiple Perspectives on Functional Performance

The book lays out an approach based on two main working concepts: the first is that there are *multiple actors in irrigation governance*; and the second is that each of these actors has service-delivery expectations and responsibilities, as defined through a *focus on three sets of performance functions*. The approach enables practical institutional analysis, and the design of best-fit responses using a problem-based approach, outlined and shown in Figure E.1.

- **Take account of multiple perspectives:** Identification and appreciation of the motivations of all actors who are linked to the hydraulic system
- **Define functional performance criteria:** A detailed set of indicators facilitates the definition of each actor’s water-service delivery performance expectations
- **Engage in problem-based inquiry:** A problem-based approach ensures that collaborative effort in diagnosing problems is focused on root causes and leads into collaborative planning and action-oriented responses

The resource book emphasizes functions over form: The water service-delivery functions are the primary outcome and are enabled by the organizational and governance group of functions. These groups of functions, or functional themes, are expanded in detail into a set of performance areas that enable and guide deeper interrogation, as shown in Table E.1. Questions of enquiry are then posed around each performance area to identify the specific problems of each actor. Performance problems identified in this way can then be solved.

TABLE E.1. Summary of Functional Themes and the Main Performance Areas

Functional themes	Features	Summary of performance areas
1. Water service delivery	<ul style="list-style-type: none"> • Typically describe performance at system level, often relating to physical infrastructure • Technical, well-defined, and documented parameters (for example, Bos, Burton, and Molden [2005] and Malano and Burton [2001]) • Numerical and finite indicators (for example, ratios, percentages, finite numbers) • Attributed as a performance measure for project outputs (for example, increased equity caused by introduction of command area channels) • Linked to a pricing policy (or tariff) that reflects the performance of service 	<ul style="list-style-type: none"> • Adequacy • Reliability • Equity • Flexibility • Quality • Multiple-use services • Productivity
2. Organizational Resources	<ul style="list-style-type: none"> • Overall service provider ability to deliver quality and sustainable I&D services • Service provider human resources (skills, capacities, diversity, and so on), financial resources (cost recovery and effectiveness), management, process, and sustainability • Communication and ways of executing processes, including systems operations • Service provider accountability in providing suitable services and in infrastructure-related MOM and the recovery of service fees 	<ul style="list-style-type: none"> • Financial sustainability • Asset management • Internal and external accountability • Process management • Cost-effectiveness
3. Governance	<ul style="list-style-type: none"> • Covers core elements of what constitutes good governance within the context of an organization • Includes service provider responsibility toward stakeholders and transparency of operations and actions • Presence of procedures, goals, and associated legal instruments for service delivery • Service provider core values and organizational responsibilities • Interstakeholder relationships and communication • Diversity and inclusiveness of service provider 	<ul style="list-style-type: none"> • Responsiveness and transparency • Accountability • Policy and legal frameworks • Strategy, mission, and vision • Organizational coherence and representation

Note: I&D = irrigation and drainage; MOM = management, operation, and maintenance.

FIGURE E.2. Three Groups of Performance Functions



Note: capex = capital expenditure; MOM = management, operation, and maintenance.

Key Features of the Perspectives on Performance Approach

PRACTICAL FIRST PRINCIPLES: The resource book describes *practical ways of engaging with irrigation-related water management processes*. It includes detailed performance criteria for water-services delivery and describes working concepts and foundational principles that are needed to achieve these. The many examples that are given are inspirational and intentionally non-prescriptive, and can be drawn upon as needed in program design or evaluation activities.

A FUNCTIONAL FOCUS: Techniques for problem analysis and developing best-fit solutions revolve around the three areas of performance: *water service delivery, organizational resources, and governance*. The multiple actors whose performance needs are key to problem identification are farmers, WUOs, I&D agencies, private sector, line ministries, and then a range of other water users and interests (including fisherpeople, herders, domestic users, IWRM entities, navigation, hydro-power, ecological needs, among others). The roles and issues of key players, and their incentives, are described with an emphasis on performance expectation and on

Work with options, not prescriptions.

Function always goes before form!

Think six-plus actors, and identify their diverse performance needs.

MSPs support analysis and catalyze collaboration.

Use principled pragmatism to get real.

Define the problems and get best-fit solutions.

Build learning organizations that plan, act, review, strategize and re-plan.

functions. This understanding of performance needs, and user-motivations, informs the institutional design and strategic planning processes that follow.

MULTI-STAKEHOLDER PARTNERSHIPS: The institutional design process depends on active participation from the multiple actors involved in I&D governance. The use of *multi-stakeholder partnerships (MSPs)* provides a dynamic collaborative space for diverse groupings to engage around conflicting needs, jointly define problems, and develop solutions. The farmers' and other water-users' perspectives are a top priority in the desired shift to a service-oriented culture. MSPs are a strategic way of mobilizing people and ideas and are integrated with the overarching problem-driven approach to developing solutions.

PROBLEM-CENTERED THINKING: *Problem definition is a critical step in crafting institutional solutions.* Ways of deconstructing problems, leading to new solutions are outlined in the book. A process of discovery, by working with MSPs, using legal and regulatory analysis and other irrigation diagnostic models and tools, are expected to lead to fresh insights into causal problems, and inform the development of locally appropriate governance solutions.

INCLUSIVE ACTION-LEARNING: The process of *collaborative analysis and solution development is guided by a 'search' framework that is based on an action-learning cycle.* Adopting "principled pragmatism" (Authority, Ability, Acceptability) will enable practitioners to be more realistic about what can be achieved in a given political and administrative context.

— — — Main Milestones on the Road Map for Action

The general plan is to collaboratively identify the underlying core problems and establish new service-delivery performance targets for water users and service-providers. Functions and responsibilities need to be defined and assigned to different actors. The reflexive search framework facilitates practical solutions to be systematically developed in response to interim outcomes along the way. The suggested stages of engagement can be summarized as follows:

Understand the context and reflect on expectations:

The starting point of I&D governance interventions involves the collection of general information, the identification of stakeholders and water-users, followed by an initial exploration into their performance needs. The process includes the following actions:

- Conduct interviews, gather reports and information, and importantly, get into the field to listen to irrigation farmers, operators, and water-users.
- List the responsibilities and functions for I&D service-delivery as anticipated in policy and in law. Map out the organizational structures of government as it impacts I&D services delivery.
- Identify stakeholders within the framework of actors (the six-plus perspectives) that are described in Chapter 3 and analyze their level of involvement in the process.
- Establish multi-stakeholder partnerships (MSPs) to take forward collaborative enquiry into problems and set the stage for the collaborative development of solutions.
- Explore and get insight into the roles, functions and performance expectations of all actors, within the performance framework described in Chapter 2.
- Summarize key elements of the historical and political context with an emphasis on understanding the Triple A's (Authority, Acceptance and Ability) to ensure realism and build alliances for credible reform.

Define problems and set objectives:

The next stage involves a more-targeted enquiry of performance problems by working with groups of stakeholders, most likely in MSPs. The sequence of activities would include:

- Describe the de-facto characteristics of the current service-delivery arrangements using insights from literature, documents, MSPs, field observations, and irrigation system modelling and/or audits (using tools such as MASSCOTE and MUSSMAS) as appropriate.
- Use participatory problem identification methods (such as the Ishikawa diagram), and work with various MSPs to define the performance delivery problems (Chapter 2) from the perspectives of the six-plus actors (Chapter 3).
- Identify and drill down into the sector performance problems and explore causality in relation to poor development outcomes. Assess if these problems are widely acknowledged as being important.
- Agree on general objectives for the reform among actors and set performance objectives, and then define the functions needed to achieve these. Allocate responsibilities to the different actors.

Plan and implement the action:

- Develop and agree on an action plan to achieve key targets informed by the consultations, reflections and problem analysis of the previous stages. In defining the action plan, the Triple-A viewpoint will bring realism and pragmatism as to what can be achieved.
- Actions can cover a wide range of interventions independently, or in parallel, including: institutional re-design and shifting of functions and responsibilities; participatory irrigation management or irrigation management transfer; skills and capability development; changes to technical elements (modernization, system re-design, or simplifications); socio-technical interventions to make management easier or more effective; unlocking specific legal obstacles through new legislation or regulatory changes; financial support interventions or fee-structure changes; public private partnerships in various forms; and policy interventions.
- A key working concept in action-planning is to build from what is available by adopting an approach of “bricolage” informed by “principled pragmatism.” A bricolage approach enables immediate short-term steps to be taken towards longer-term goals. A search frame approach facilitates a reflexive action and re-planning process leading to the ongoing improvement of strategies and plans. The use of MSPs in the process facilitates locally informed refinements and catalyzes action in the ongoing process of organizational learning and institutional strengthening.

The Way Forward

Irrigation schemes are, in most cases, de-facto multiple-use systems serving diverse groups of users, with competing interests. A service-oriented culture with the aim of providing reliable and cost-efficient water to these groups calls for a much broader understanding of functionality. Irrigation departments that largely carry this responsibility are often old, firmly established, protective, and habit-based institutions. They are characterized by heavy path-dependency and are slow in changing course. In the face of fast-modernizing socio-technical shifts in society, service provision flexibility needs to be accommodated in a different way to be fully relevant to the diverse users.

The approaches that are set out in the resource book provide context to institutional responses and define a process of engagement where pathways of action are usually unclear. The intention is to inform new and pragmatic frames of understanding and initiate action towards the resolution of long-standing and

difficult governance challenges. Problem-driven approaches as set out in this book, that focus on functionality rather than on conformation with pre-set rules and policies, are essential for confronting the dynamic and persistent challenges. While great care is needed in specifying what the outcomes of such processes should look like, it is possible, and even imperative, to define the concepts and principles to be used in achieving them.

Abbreviations

AAA	authority, acceptance, and ability
ADB	Asian Development Bank
AFD	Agence Française de Développement
AWM	agricultural water management
BOT	build-operate-transfer
capex	capital expenditure
CCA	cultivable command area
CEO	chief executive officer
CGIAR	Consultative Group on International Agricultural Research
CSA	climate smart agriculture
EE	executive engineer
EIRR	economic internal rate of return
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FLID	farmer-led irrigation development
FFS	farmer field school
GDP	gross domestic product
GHG	green house gases
GIS	geographic information system
GNI	gross national income
GPS	global positioning system
GSM	global system for mobile
HR	human resources
IA	irrigation agency
ID	irrigation department
I&D	irrigation and drainage
IBRD	International Bank for Reconstruction and Development
ICID	International Commission on Irrigation and Drainage
ICRR	Implementation Completion and Results Report
ICT	information communication technology
IDA	International Development Agency
IEG	Independent Evaluation Group (World Bank)
IFI	International Financial Institution
IFPRI	International Food Policy Research Institute
IIMI	International Irrigation Management Institute
IMT	irrigation management transfer

IO	irrigation organization
IPCC	Intergovernmental Panel on Climate Change (World Bank)
IRRI	International Rice Research Institute
IWMI	International Water Management Institute
IWRM	integrated water resources management
ISF	irrigation service fee
JICA	Japanese International Cooperation Agency
KfW	Kreditanstalt für Wiederaufbau (German Development Bank)
LoS	level of service
MASSCOTE	Mapping System and Services for Canal Operation Techniques
MDG	Millennium Development Goal
M&E	monitoring and evaluation
M&L	monitoring and learning
MIS	management information systems
MOM	management, operation, and maintenance
MPA	multiphase programmatic approach (World Bank)
MSP	multistakeholder partnership
MUS	multiple-use systems
MUSMASS	Mapping System and Services for Multiple Uses of Water Services
NGO	nongovernmental organization
NIA	National Irrigation Agency
OECD	Organisation for Economic Co-operation and Development
O&M	operation and maintenance
opex	operating expenditure
PAD	project appraisal document
PDIA	problem-driven iterative adaptation
PDO	project development objective
PforR	Program-for-Results (World Bank)
PIM	participatory irrigation management
PMU	project management unit
PIU	project implementation unit
PPP	public-private partnership
PRA	participatory rural appraisal
RBM	river basin management
RRA	rapid rural appraisal
SCADA	supervisory control and data acquisition
SDC	Swiss Development Corporation
SDG	Sustainable Development Goal
SMS	short message service



SRI	System of Rice Intensification
SSA	Sub-Saharan Africa
TA	technical assistance
ToR	terms of reference
UN	United Nations
WBG	World Bank Group
WRM	water resources management
WUA	water user association
WUG	water user group
WUO	water user organization



CHAPTER 1.

A Fresh Take on Governance



This chapter provides information on context and an analytical framework for practical problem solving.

1.1 Introduction

The Context

Irrigated agriculture is central to meeting the world's food and fodder needs and will be even more important in ensuring global food security in future. As more basins reach full exploitation status, water use in every sector faces increasing competition. Maximizing the social and economic returns from irrigation infrastructure and limited water resources has become important almost everywhere. Irrigation governance holds much potential to strengthen scheme performance and has been emphasized in research and practice since the 1980s. It is now widely appreciated that an “infrastructure-only” approach to irrigation development has resulted in problems of poor irrigation service-delivery, and contributed to a cycle of infrastructure decline and operational unsustainability. Yet, working examples of good governance have been difficult to replicate and success across the irrigation sector has remained elusive (Meinzen-Dick 2007).

In trying to address the identified governance gap, practitioners have often replicated approaches that worked well when designing the concrete-and-steel engineered works and have relied on formulaic solutions with ideas of “design-norms” and “best practice.” These blueprint-style solutions were usually poorly-adapted to the diverse contexts where they were applied and lacked flexibility to respond to evolving realities on schemes. The resource book brings a fresh approach to tackling the governance challenge.

Why Another Book?

The resource book is aligned with the World Bank Water Global Practice Strategic Action Plan to sustain water resources, deliver services, and build resilience. There are many detailed texts that address specific institutional, organizational, and socio-technical elements of governance, but a simple and flexible overarching framework is missing. The resource book aims to bring clarity to an often-cluttered reality on schemes through a focus on *performance expectations* from *multiple perspectives*. The content is geared for action and includes a set of approaches for collaborative problem definition and for the formulation of locally-appropriate solutions that we believe will help resolve diverse problems.

Governance is defined as “the process through which state and non-state actors interact to design and implement policies within a given set of formal and informal rules that shape and are shaped by power” (World Bank 2017, 3). I&D governance interventions are a high priority because of the large functional deficit that typically prevails on irrigation schemes (Meinzen-Dick 2007; Lankford et al. 2016; Obertreis et al. 2016). Investment costs in governance are a small fraction of infrastructure costs and present an opportunity to achieve quantum leaps in water-service delivery. Meaningful outcomes can be achieved, as is shown in the case studies, but result from evolutionary and iterative processes that take time. They unfold in iterations of learning, requiring shifts in attitude from farmers to policy makers, changes to rigid organizational norms, and sometimes need legislative reform.

Irrigation schemes have great diversity in their history, scale, climate, purpose, technology type, cropping patterns, and modes of governance. They are dynamic and complex systems with ecological, technical, social, financial, and political dimensions that are in constant flux (Lankford et al. 2016; Obertreis et al. 2016; van Rooyen et al. 2017). Institutional and organizational solutions that are appropriate for one irrigation scheme are not easily replicated elsewhere—both within and across countries. While attractive in simplicity, imposing formulaic solutions has not found much success; and a wide range of external and local factors need to be considered in each situation (Meinzen-Dick 2007). That usually means going back to first principles and building from foundational concepts.

Scope of Application

Understanding the service-delivery expectations from the different perspectives of multiple actors is key to the approach. These actors could include groups of independent small-scale irrigators pumping water individually from shared shallow aquifers, to tens of thousands of farmers and multiple organizations involved in mega-schemes



Meaningful outcomes can be achieved, as is shown in the case studies, but result from evolutionary and iterative processes that take time.



that cover hundreds of thousands of hectares. The content can be applied to national and scheme-level strategic planning processes, and to the implementation stages of I&D investment projects. The approach can also be used for scheme-level diagnosis, organizational restructuring and evaluation and monitoring.

It is also important to recognize the limitations to what can be achieved by governance interventions alone. Institutional and organizational factors represent a few “pixels in the picture.” Governance interventions can only be successful when water resource availability and hydraulic infrastructure functionality, at the very least, are above critical thresholds. It is essential to consider how these and other factors, such as water-legislation, socio-politics, market access, agro-finance, land-tenure, etc. will influence, and be influenced by governance responses. While centrally important to achieving successful irrigation-performance outcomes, these other domains are not addressed in detail in the book, except where they overlap with governance analysis and solution-building processes.



Likely Users

The resource book is written by practitioners for practitioners. It is aimed at task-leaders and team-members who are involved in irrigation and drainage investment projects. It is also expected to be helpful to other readers, including government personnel, consultants, WUO leadership, NGOs, and research academics.



Organizations and Institutions—A Definition

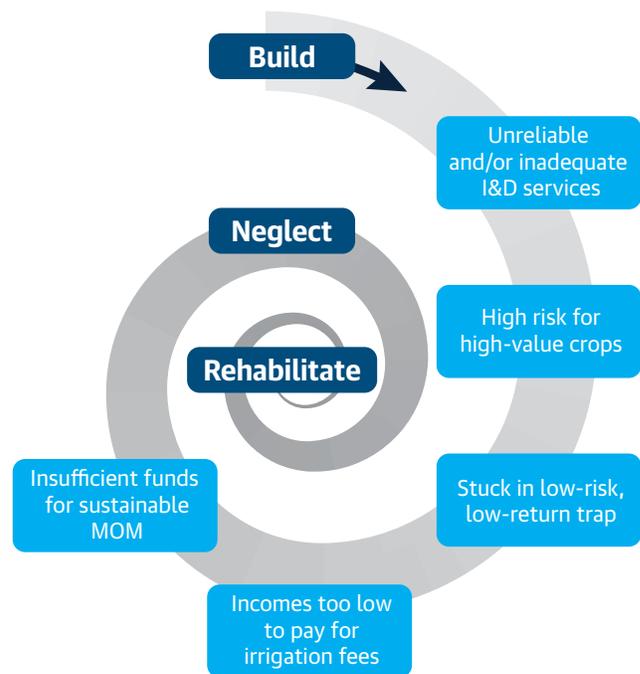
We have adopted the sports analogy definition for organizations and institutions (North 1990). **Organizations are the players of the game**; the actors, or agents who can be individuals, groups, companies, government entities etc. **Institutions are defined as the rules of the game** comprising the laws, regulations, contracts and agreements etc., which can be formal or informal in nature. This distinction is important as the two descriptors are often used interchangeably in governance discussions, but here, have different meanings.

1.2 A Persistent I&D Governance Problem

The Build-Neglect-Rehabilitate Cycle

The well-recognized downward spiral of build-neglect-rehabilitate, shown in the schematic below, is an old management problem and continues to be a major reason for institutional re-design and modernization. The high prevalence and persistence of the downward spiral of management, operation, and maintenance (MOM) neglect can be explained to some extent by the history of irrigation expansion (see online Appendix 1 [World Bank 2020a] for more detail). Large-scale schemes proliferated quickly and globally in the past century, driven mainly by national I&D agencies and funded by public coffers and international banks. These agencies pursued the engineering-centered “hydraulic mission” of driving economic development through big-water infrastructure development (Obertreis et al. 2016). After construction, the agencies took on the role of irrigation MOM yet maintained their engineering character. They emphasized technical rehabilitation (Suhardiman and Giordano 2014) rather than shift expertise and their core mission to management and service delivery. Problems were viewed as technical in nature, with little focus on the organizational, institutional, and social dynamics. Service-delivery quality declined, and the costs of operating and maintaining public irrigation schemes became an unbearable fiscal burden (Darghouth et al. 2007).

Since the 1990s, governments-initiated policies aiming for full cost-recovery from farmers (Meinzen-Dick 2007). This was difficult or



Note: I&D = irrigation and drainage; MOM = management, operation, and maintenance.

impossible in practice because schemes were already locked in a cycle of decay. Lack of funds at the scheme level, old infrastructure, and inadequate management capability undermined service delivery. The subsequent water insecurity presented high risk to farmers, disincentivizing investment in high-value crops; they were stuck in a low-risk farming system with low cash returns; and then they were unable to generate income to pay fees for adequate MOM—this led to infrastructure neglect and dependence on new construction-rehabilitation investments. Breaking the cycle clearly requires efforts across the whole system, and the critical aspect of irrigation governance is the focus here.

IMT AND PIM

Irrigation and management transfer (IMT) is where management, operational and maintenance responsibilities on public schemes are handed over to irrigator groups.

Participatory irrigation management (PIM) is where irrigators take a central role in the management, operations and maintenance.

Evolutions in Scheme Management Thinking

In the 1980s, an initial response to the observed build-neglect-rebuild cycle was investment in the management skills of technical irrigation personnel. In countries like India and Pakistan, engineers in large irrigation agencies went through management training, but this approach had limited success in addressing the fundamental problems of degrading infrastructure, poor service delivery, and a lack of cost recovery (Meinzen-Dick 2007). About the same time, farmer-managed systems in the Philippines and Nepal on small hillside schemes were observed to have successful collective management arrangements. The strength of self-organized arrangements was even observed at sublevels of large state-run schemes in Asia (Suhardiman and Giordano 2014). This led to enthusiasm for water user associations (WUAs) and the power of collective action to transform irrigation performance. A trend of irrigation management transfer (IMT) followed in the late 1980s and 1990s as governments attempted to withdraw from the direct funding of scheme MOM because of the increasing fiscal load. The idea was that farmers should take control of, and finance, scheme operations as far as possible.

Success with WUAs and IMT, was varied. Irrigation institutions remained resistant to fundamental change. Practitioners became more aware of the wide diversity of types and situations on irrigation schemes, such as farm scale, technology type, and local history. Lack of success is also explained by path dependency, where institutional practices of the past have “persistence” that influences future possible trajectories (North 1990). I&D agencies on large public schemes had an engineering mission with a focus on construction and maintenance. Their historical purpose, and dominant mind-set, was not centered on service delivery (Meinzen-Dick 2007). Since the late 1990s, water markets, water trading, and the role of the private sector and PPPs



became important. As with prior trends, this development emphasis showed varied, unpredictable, and sometimes even destructive outcomes (Obertreis et al. 2016).

Ostrom (1992) provided insight by highlighting diversity as a factor, identifying 40 main elements (including social, economic, political, resource-governance, user type, and ecosystem) that were found to impact institutional functioning. This emphasis on diversity drove home the need for nuanced responses because schemes are so varied and they need tailored solutions. Successful I&D management interventions were those responsive to the specific context, often combining the strengths of actors in the main intervention arenas of natural resources management (land, water, and agroecosystems); service delivery and inclusiveness; and agrosocioeconomic development. More on these themes of inquiry can be found in the theoretical sections in Appendix 1 (World Bank 2020a).

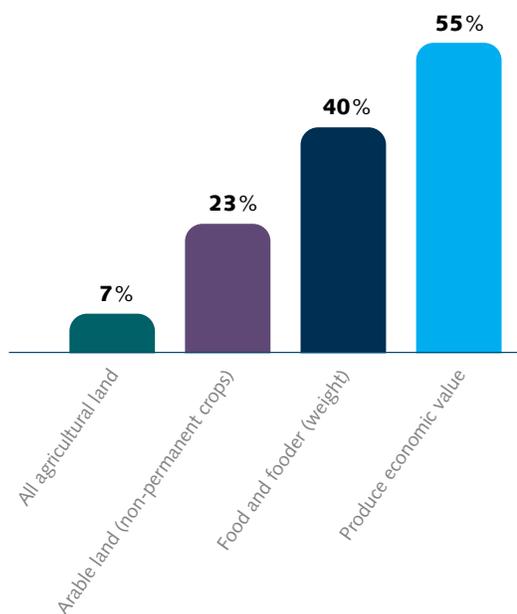
1.3 Global Irrigated Agriculture: A Few Facts and Trends

Selected Statistics

Based on 2009 data, the worldwide area equipped for irrigation is now about 320 million hectares (Lankford et al. 2016), of which about 85 percent is actually irrigated (Food and Agricultural Organization [FAO] 2017a). This is double the amount equipped in 1960 (160 million hectares). Globally, irrigated lands cover only 6.5 percent of the total land used for agriculture (all crops) and 22.7 percent of the arable land (nonpermanent crops)² (Lankford et al. 2016). On this relatively small footprint, irrigated agriculture produces 40 percent of the world's food and fodder output, estimated at 55 percent of the global produce value because irrigation is associated with higher-value crops (Molden, Frenken, et al. 2007).

Irrigation is responsible for an estimated 70 percent of global water withdrawals,³ yet the consumptive fraction attributed to irrigation is often misunderstood. It is useful to view irrigation water use from the perspective of evapotranspiration in relation to total global agricultural production. Green water—water from rainfall that is held in the soil—is estimated to be responsible for 80 percent of global agricultural evapotranspiration, whereas blue water—water supplied by irrigation from rivers, reservoirs, and groundwater—is responsible for the remaining 20 percent (Molden, Frenken, et al. 2007). The varied definitions of agricultural land, arable land, irrigation, and agricultural water-managed areas in relation to water withdrawals make direct

The contribution of irrigated agriculture to global total



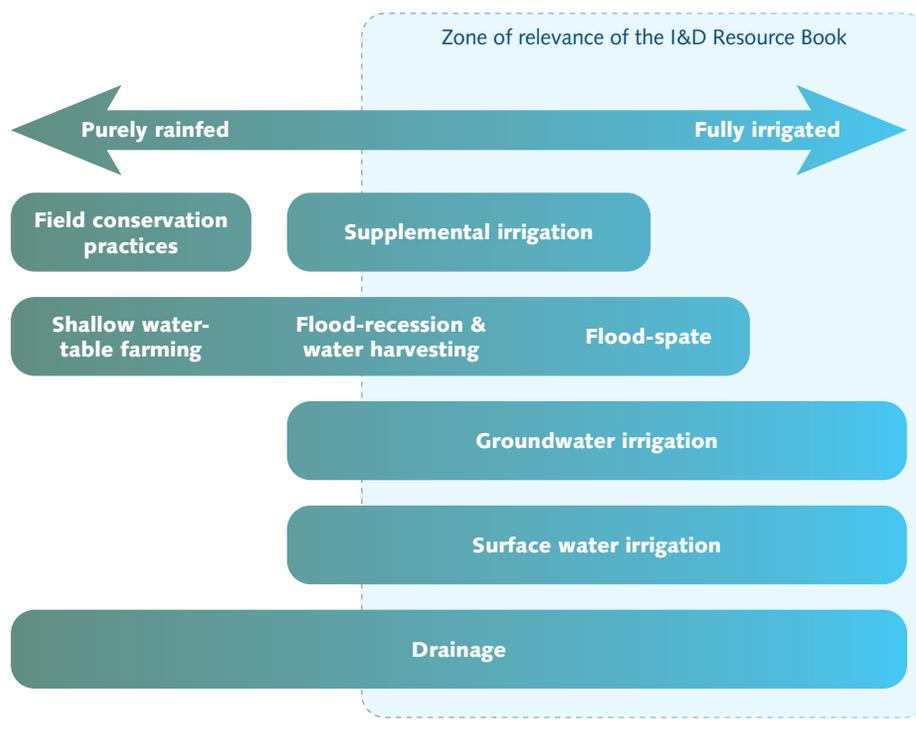
comparisons difficult. This inspires many debates on irrigation “consumption” in relation to future global food and fodder production. What is undisputed is that irrigation is a pillar of the global food system and is more effective than rainfed agriculture in producing “crop per drop” because of associated intensity. Investment in irrigation development, and in governance, will be of central importance to generating the world’s food and in addressing poverty into the future.

Irrigation and the Agricultural Water Management Spectrum

The FAO (2016) has adopted a simple irrigation typology⁴ to describe irrigation systems in the AQUASTAT database:

- **Area equipped for irrigation:** Area equipped for full control irrigation *plus* equipped lowlands area *plus* flood-spate irrigation (Oweis, Hachum, and Bruggeman 2004) area (full control irrigation technologies defined by AQUASTAT include surface irrigation, sprinkler irrigation, and localized irrigation such as drip, trickle, and microsprinkler)
- **Agricultural water-managed area:** Area equipped for irrigation as above *plus* cultivated non-equipped lowlands area *plus* cultivated non-equipped flood-recession area

FIGURE 1.1. Agricultural Water Spectrum



Note: I&D = irrigation and drainage.

This classification reflects the view that agricultural water management is best considered a spectrum of practices, from water harvesting for rainfed agriculture on the one end to highly sophisticated precision-managed drip irrigation on the other. The range of practices includes shallow aquifer use (dambos and so on), flood-recession farming, spate irrigation, and supplementary and full irrigation (Molden, Faures et al. 2007; Rockstrom et al. 2007). This book examines organizational and institutional development across the agricultural water spectrum (Figure 1.1) with a focus on “schemes” and, to some degree, collective groundwater management.

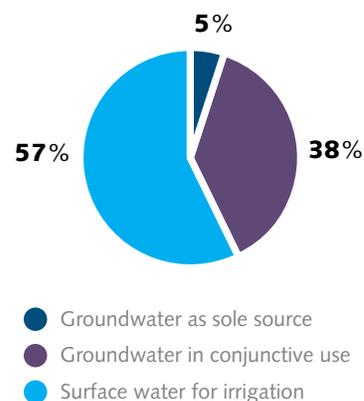
In tackling performance and service provision, rapidly changing global trends will impact organizational design and action planning. Water management in I&D is evolving rapidly because of increased food demands. Key drivers of irrigation evolution include population growth, competing sectoral demands, limited resource availability, ongoing technical revolutions, modified diets, and climate change uncertainties, all of which have reframed the multiple challenges of water use in food production.

Groundwater and Irrigation Management

Groundwater is a major source of irrigation water and supplies an estimated 38 percent of the total equipped irrigated area globally, providing 43 percent of the total consumptive water used for irrigation. In volumetric terms, this is equal to 545 km³ yr⁻¹ of the estimated 1,277 km³ yr⁻¹ used for irrigation (Siebert et al. 2010). Groundwater is a reliable source and brings flexibility to irrigation operations that cannot easily be matched by canal irrigation systems (Siebert et al. 2010).

Conjunctive use: Groundwater is most often used conjunctively with surface water, estimated to comprise 89 percent of all groundwater use in irrigation (Siebert et al. 2010; Thenkabail et al. 2009).⁵ The combination of surface water and groundwater brings additional water security for irrigators by providing an alternative when surface water is inadequate. Conjunctive use has been observed to be an increasing reality on established large-scale irrigation schemes. Shah (2018) highlights how farmers are investing in their own shallow wells and pumps in India and Pakistan, where the large-scale canal distribution systems are functionally less effective than farmers require. The investment in shallow-well pumps facilitates an independent and more secure water supply albeit at a significant direct cost to farmers, but they willingly carry it for the greater reliability of supply and the flexibility it allows in their on-farm irrigation operations (Shah 2018). The canal networks in these large-scale irrigation systems then have the de facto function of serving as the recharge

Sources of irrigation water





mechanism—a fundamental shift from the original design intention. Although groundwater quality is typically better than surface water (Siebert et al. 2010), irrigators using shallow wells on schemes, and downstream of irrigation schemes, risk water quality because of higher nitrate, agrochemical, and salination levels.

Sustainability crisis: Irrigation based on groundwater is facing a global sustainability crisis as abstractions exceed recharge rates, leading to groundwater depletion. Wada et al. (2012) show that *nonrenewable* groundwater comprises nearly 20 percent of the gross irrigation water demand (based on data from 2000). This is approximately 47 percent of all groundwater use in irrigation and is growing steadily. Non-sustainable use is most evident in the semiarid regions with low rainfall, such as North Africa, the Middle, and the Near East. The crisis of over-abstraction is likely to increase with food demand and will be most severe in countries with emerging economies (Wada et al. 2012). The high contribution of groundwater to irrigated agriculture in the light of these unsustainability trends emphasizes the need for new governance responses to achieve a sustainable irrigation supply into the future.

Local aquifers and integrated water resources management (IWRM): Groundwater use in irrigation presents unique management challenges that are very different from governance on irrigation schemes. Monitoring, sharing, regulating, and coordinating aquifer use has organizational challenges that are more aligned to IWRM than



I&D governance, given the typical scale of aquifers and many types of users across sectors. Hydraulic interconnectedness, aquifer performance, recharge dynamics, and sectoral allocations are complex. The source itself is less visible, requiring groundwater-monitoring processes, suitable technology, and different collaborative arrangements between users. Aquifers often stretch beyond the boundaries of the irrigated area or the catchment, adding complexity. IWRM is of high importance to ensure effective assessment and integrated management of surface water, groundwater, and wastewater resources and for rationalizing competing demands within catchments and river basins. Although of great importance in addressing wider water governance challenges, IWRM is well-documented elsewhere and is not addressed in detail in the resource book.

Small-scale groundwater use explosion: Another groundwater phenomenon is the rapid expansion of independent, market-oriented irrigators using small, motorized pumps or bucket-and-rope systems drawing from shallow aquifers. Growth in Asia and across Sub-Saharan Africa (SSA) has been rapid in the past 20 years (Shah 2014; Woodhouse et al. 2017).⁶ In India and Pakistan, Shah (2014) points to the crisis of rapidly declining groundwater levels from the massive growth of independent shallow-well irrigators whose proliferation has been driven by electricity subsidies (in India) and the pull factor of increasing market demand for high-value crops. This subsector brings new governance, environmental, regulation, and coordination challenges. It is fast-growing and entrepreneurial in character and is driving rural economic growth with limited input from governments or development agencies. These small-scale independent groundwater irrigators warrant support in a context of increasing groundwater stress and are a subsector in which the resource book approach is expected to be useful. A case study is included in online Appendix 2 (World Bank 2020b).

Climate Change



Irrigation water availability, crop-water demand, and irrigation practices are being directly affected by climate change, including snow and glacial melt; changing seasonal river flows; higher crop evapotranspiration rates; reduced rainfall; higher frequency, uncertainty, and duration of drought; more variable rainfall; increased flooding; and saline intrusion into coastal aquifers. These factors will increase pressure on available water resources and bring greater uncertainty regarding the timing and availability of water supplies for many existing irrigation systems. In addition to physical changes, there is changing social emphasis such as the enhancement of the value of water and ecosystems in relation to wetlands and rivers. Downstream flow-releases

for ecological purposes (such as in Spain, Australia, and South Africa) or for recreational purposes are an important competing demand. There are also growing concerns about the rapid depletion of natural resources; the need for promotion of low-carbon farming approaches and technologies and for clean production methods such as the reduced use of chemical fertilizers, fossil fuels, and pesticides; and the importance of social equity movements such as fair trade. These will all change the way irrigation farming is practiced. Future technology shifts and evolving social priorities will demand different institutional and governance responses with these changes in mind.



A Global Shift to Market-Oriented Irrigation Farming

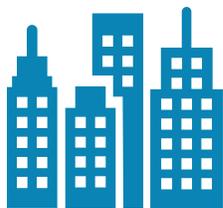
Irrigation farming globally has shifted progressively from projects that had origins in rural stabilization, poverty alleviation, and social benefits or that were driven by political visions and state identity (such as in the former Soviet Union) to now being largely characterized by a sharper-edged market orientation. At a global level, the small potential for irrigation expansion, combined with ever-increasing demand for more, and higher-value, crops means that the trend to business farming translates to an increased need for business-oriented management of irrigation schemes (Burton 2010; Lankford et al. 2016). On large-scale public schemes, one of the key drivers of market-oriented farming is the unwillingness and incapability of the state to continue heavy subsidies for MOM with declining infrastructure condition. The need for scheme financial self-sufficiency demands profitable farming to generate revenue for MOM, leading to market-oriented farming systems. Asset management, audits, financial self-sufficiency for MOM, water pricing, and trading are also important given increased competition for scarce input resources (Burton 2010).

More People and Changing Diets

Future food demand is set to double by 2050, with the population projected to reach 9.7 billion by 2050 (FAO 2017a). The increasing global population is compounded by a shift in diets associated with socioeconomic gains and urbanization, which is associated with higher incomes that lead to changing food preferences. Future diets, driven by rising incomes, will include more livestock products (dairy and meat) and fruits and vegetables, requiring more water than before (Molden, Frenken et al. 2007). The related crops have a higher financial value than cereal and field crops, which, except for rice, demand more water than cereals. The net result on irrigated farming is that



urbanization and socioeconomic growth are pull factors to higher-value, market-oriented farming.



Urbanization and the Rural Exodus

A little more than half of the world's population currently lives in urban or periurban environments, a percentage that is expected to reach 66 percent by 2050. The political focus (from rural to urban problems and opportunities) followed this widespread trend, resulting in fewer rural agricultural employment opportunities and more opportunities in the cities. In developing countries, the exodus of youth searching for jobs and a modernized life has a potential upside for farming, holding the promise of less competition for land and the opportunity for larger farming units through lease or sale. The downside is that farming is increasingly characterized by older people associated with lower risk-taking and innovation, both of which are key entrepreneurial drivers. Although smallholder farming enterprises can have economies of small scale in some situations (discussed in Chapter 3), economies of scale are typically associated with larger farm sizes. Larger farms and enterprises tend to have lower input costs, reduced transaction costs, and higher bargaining power in output markets. Urbanization is also linked with increased socioeconomic growth and changes in food preferences.

Tech Revolutions and Artificial Intelligence

Agricultural biotechnology has been a dominant driver of increasing yields and falling food prices since the Green Revolution. Improved crop varieties and genetic engineering, precision agriculture, farming decision making supported by artificial intelligence, autonomous farm machinery, and remote sensing for real-time crop management are already established and evolving quickly. Technical support services, drones, open-access satellite imagery, evapotranspiration datasets, and integrated expert diagnostic systems for irrigation management are now expanding from developed to developing countries. On a water-related front, global system for mobile (GSM)-enabled supervisory control and data acquisition (SCADA) systems are rapidly becoming cheaper and simpler. These can be easily installed for flow measurement and monitoring in canal and groundwater systems, prompting rapid changes in management thinking. Although performance has been disappointingly weak in practice (Lankford et al. 2016), a new generation of tech-savvy practitioners offers reason for optimism. Collaboration between planners, engineers, managers, and farmers—with increased Internet access via cheaper smartphones—will be a prominent feature of



the future. These fast-moving technology trends present new and radical opportunities for innovation in organizational design.

Financial Technology and Digital Solutions—Fintech



Financial technology, or fintech, is the use of digital technologies to improve financial services across all sectors. GSM communications and mobile money are rapidly expanding options to finance and technology. The main advantages of fintech are reduced costs; reduced time engaging in transactions and increased speed in finalizing them; increased access to a wide range of users via user-friendly interfaces; added value through new and more types of services in support of small, micro-, and medium enterprises; and administrative options for financial transactions and management for microsaving, agricultural, and water user organizations (Arner, Barberis, and Buckley 2015). Rapid growth of fintech has been enabled by high uptake of smartphones. In 2017, mobile phones dominated mobile connections in the world at 57 percent and will reach 77 percent by 2025 (Ikeda and Liffiton 2019). Use of Fintech is a major opportunity to leapfrog the historical constraints of access to financial services for the poor. The technologies are made accessible to farmers who are distant from regular banks and have limited finances, literacy and numeracy, and/or insufficient certification to hold regular bank accounts.

One example is the case of GSM-enabled solar-powered pumps for small-scale farmers in Africa. These have integrated, supplier-based financing arrangements (hire purchase or pay as you go). Pumps are activated through the GSM link and paid by the farmer using mobile money when cash is available. These kinds of solutions can be extended to land preparation, postharvesting, and other agritech services.

1.4 Irrigation Groupings from a Governance Viewpoint

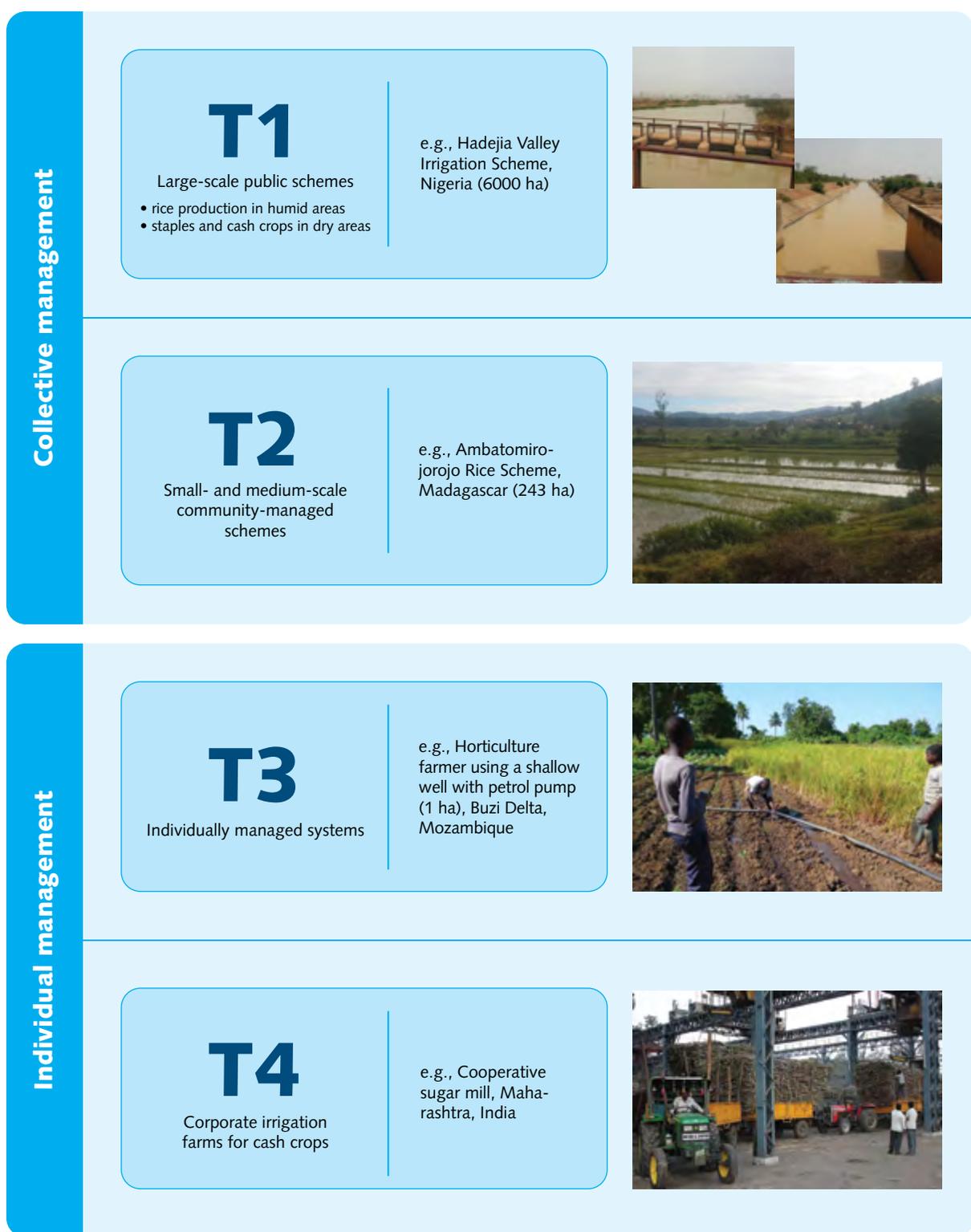
On schemes, water conveyance and distribution can be pumped or use gravity, and the institutional setup can be public, private, community-based, or a combination. The resource book's focus on governance aligns well with the simple scheme categorization of Molden (2007), illustrated in Figure 1.2. These are grouped under two management modes:

Collectively Managed Irrigation Schemes

Collective irrigation management occurs when a group of irrigators share the hydraulic infrastructure, thus fitting the definition of a scheme. These include large-scale public schemes (Type 1) and small- and medium-scale community-managed schemes (Type 2). Collectively managed schemes represent



FIGURE 1.2. Modes of Irrigation Management and Types of Schemes



the main governance context to which the resource book will apply. They can be managed autonomously or co-managed with agencies or operators as follows:

- **Autonomous management** takes many forms, from village-owned schemes operated by voluntary farmer labor to private sector service organizations owned or contracted by the irrigators. The many variations are characterized by the absence of a government irrigation agency involved in the operation and maintenance of the infrastructure or water resource (at the point of abstraction). These fit the definition of small irrigation schemes (Lankford et al. 2016).
- **Co-managed schemes** are mostly the result of the transfer of management responsibilities for part of the irrigation infrastructure from the public-sector irrigation agency to WUOs. These have been the focus of PIM or IMT programs in medium- to large-scale government-managed schemes and are considered large-scale schemes (Lankford et al. 2016).

Individually Managed Irrigation Schemes

Individual irrigation management occurs when farmers have independent control over their irrigation system but share a source (river, reservoir, or aquifer) with other adjacent irrigators. These can be individually owned (Type 3) or company-owned (Type 4). Water governance in this context falls more into the realm of IWRM, which is beyond the scope of the resource book. The resource book content will, however, be relevant to a subgroup of individually managed schemes in which smallholder irrigators share a localized shallow aquifer. In Appendix 2, a case study on shallow-groundwater management in India provides practical insight into how governance in this context can be achieved



LARGE DEFINED

Large-scale schemes are any system where there is a formal, usually a Government Irrigation Agency, that is responsible for MOM in the main supply system. Size, in hectares, is indicative, but does not define the categorisation of “large” (Lankford et al. 2016).

Type 1: Large-Scale Irrigation Schemes Have High Importance Globally

Large-scale schemes providing water to smallholder farmers are found all over the world in diverse contexts including China, India, Pakistan, Uzbekistan, Kazakhstan, Iran, Turkey, Morocco, Argentina, Mexico, Swaziland, Nigeria, and Sudan. They comprise approximately 40 percent of the total equipped global irrigation area (approximately 130 million hectares of 320 million hectares) and are typically gravity-fed canal schemes (Lankford et al. 2016). In developing and transition countries, the estimated area is 115 million hectares, 45 percent of the 225 million hectares total irrigated area in such countries. Usually larger than 1,000 hectares, large schemes extend to hundreds of thousands, or in cases, millions of hectares in size.





Large-scale schemes share a similar technical history as they were mostly developed with a water-infrastructure focus during the colonial era of the first half the 1900s and later in the modernization era of the 1960s to the 1980s. These were typically established in a top-down fashion, dominated by powerful centralized irrigation bureaucracies, that sheds light on some of the institutional reform challenges of today. They are old, are often in poor physical condition, and have a distinct, multitiered hydraulic and institutional character. Across all regions, they are similarly plagued with issues of low performance and low water productivity. I&D agencies are, in most cases, responsible for some or all of the MOM of large-scale schemes, often in tandem with WUOs of some form and typically at secondary or tertiary levels of the scheme. Rarely, the private sector carries the role of bulk-water-supply operator, a role that has drawn increasing interest as a way of improving service delivery and leveraging private sector competencies and investment into large schemes. In all cases, the hydraulic complexity, with its scale and being compounded by varied land and development history, presents a unique set of challenges for irrigation reform.

Modernization of both infrastructure and management arrangements is a pressing need. Large-scale schemes have major potential for improved economic returns through modernization. There are massive benefits that would transpire from large-scheme modernization in increased water availability. Lankford et al. (2016) show that a 10 percent decrease in total irrigation consumption (beneficial and nonbeneficial) on the 130 million hectares of large-scale schemes would equate to the increased availability to other sectors of approximately 50 liters per person per day for each one of the 9.7 billion people on the planet.

Type 2: Different Institutional Challenges at Smaller Scales

In the case of small-scale irrigation, the institutional development challenge is more localized and relates to working with scheme participants—mainly farmers (in the absence of an operator or agency). Activities include the training of technical and administrative personnel on the technical and administrative functions of MOM. On large schemes, the challenge is across the board, involving farmers, water user groups (WUGs), WUOs, operators, and agency personnel. Thus, working on a single small-scale scheme is generally easier—the actions needed are more readily defined, and timelines are shorter.

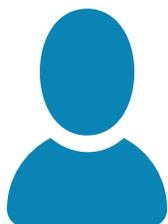
Studies of irrigation performance and scheme sustainability show a significantly higher success rate for smaller schemes compared with larger ones. Based on their assessment of 314 schemes, Inocencio et al. (2007) found that large programs aiming



for investment in many small irrigation schemes are more likely to be successful than a few large-scale irrigation systems. This was explained by several factors, including the relatively technical simplicity at any one site and the stronger social cohesion in smaller groups of irrigators (Lankford et al. 2016; Shah 2018). In all cases, irrigation governance on new and existing schemes, small or large, must be a priority in the design, implementation, and operational stages to ensure long-term irrigation success.

It would, however, be short-sighted to oversimplify the implementation and organizational challenge based on scale alone. Implementing 10 schemes of 5,000 hectares may well be simpler in many developing countries than implementing 500 schemes of 100 hectares. Although the research points to the latter having greater chances of long-term success, the implementation challenges would be different, as would the organizational-development focus. The reality is that policy, the geography of the distribution of resource availability, and regional political priorities require irrigation developments of different scales to be pursued where expansion is still taking place (Svendsen, Ewing, and Msangi 2009; You et al. 2011).

Type 3: Individual Irrigation Systems



Individual systems are the second main grouping: These systems serve a single farming enterprise, and the entire system—from the water source to application in the field—is managed by one entity, whether a farmer or a company. Examples of these range in scale and technology type, from temporary diversion structures with simple canals to farmers pumping groundwater from shallow aquifers, rivers, or ponds.

Individual smallholders sharing an aquifer are a group for which the resource book can have governance application. This group has increased rapidly across Asia and Africa the past few decades and have become a dominant subsector as a result (Shah, Burke, and Villholth 2007; Woodhouse et al. 2017). They are characterized by individuals on small farms, typically 0.5 to 2 hectares in size, farming almost exclusively for higher-value markets. High-value horticultural crops predominate, with rice also being important. Pumped systems drawing from shallow aquifers using flood irrigation are most common, but diverse technologies such as bucket-and-rope and gravity-canal supply, as well as drip and sprinklers, are also prevalent. The underreported growth of small individual irrigators has been described in India, Bangladesh, and China (Shah, Burke, and Villholth 2007) and in SSA (Woodhouse et al. 2017). Although independent irrigators manage their own irrigation systems, they need organizational support regarding the depletion of shared aquifers or shared watersheds.



Type 4: Corporate Irrigation Farms



Corporate farms are not addressed in the resource book because they are independent in their irrigation management. Corporate agribusiness entities do, however, have potential for involvement in smallholder schemes as operators, as agricultural service providers, in outgrower roles, or in other strategic alliances. In terms of governance, the involvement of corporate agribusiness presents numerous partnership options with a community-farmed dimension. These can take various forms such as consolidation of land (van Koppen, Tapela, and Mapedza 2018) and technical, outgrower, or financial services relationships. Public financing for infrastructure can be obtained from the government, whereas private financing can provide MOM services. The private sector can also provide agricultural support, financial, extension or financial services, and/or irrigation operational support in exchange for secure access to irrigated land or produce (for example, for processing facilities).

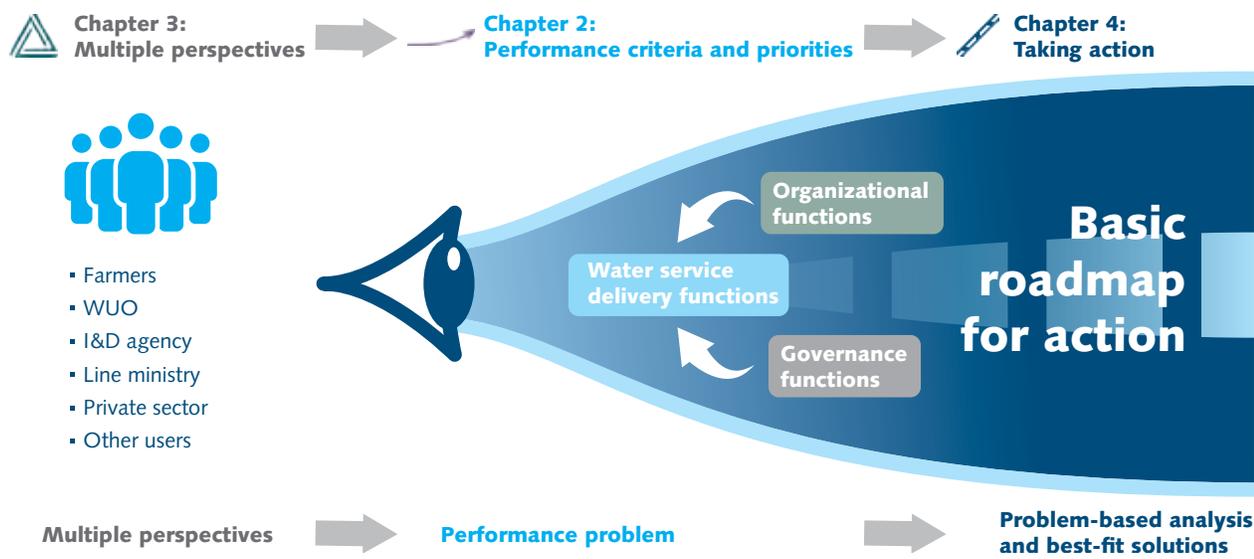
There is limited long-term experience of such mixed relationships with an operational role in water service provision, though different models are being implemented under World Bank programs, such as in Zambia and Malawi. van Koppen, Tapela, and Mapedza (2018), in documenting the outcomes of similar joint venture arrangements in South Africa, have highlighted the critical aspect of contract detail, clarity of understanding by the community members of contract implications, and the need for a regulator to ensure a balance of power between the private sector partners and the community group. These kinds of solutions will hold promise in certain contexts and are essentially a mix of types 1, 2, and 4.

This brief discussion of the various forms of schemes from an irrigation management perspective (Types 1 to 4) highlight the complexity and diversity of the organizational development challenge. It also explains why structured organizational solutions not developed from the specific needs of the various stakeholders are highly unlikely to be functionally responsive or to improve irrigation governance or irrigation farming outcomes. The resource book aims to provide the principles and frameworks for suitable institutional and organizational responses in this diverse, dynamic, and often chaotic real-world environment.

1.5 The Perspectives-on-Performance Approach

The institutional analysis and design process that is described in the resource book is enabled by taking a binocular view of reality: multiple perspectives and functional performance. This allows water service-delivery performance problems to be identified from different viewpoints, which leads to collaborative action to resolve the problems. The resource book approach can be summarized as follows:

FIGURE 1.3. The Resource Book Approach: Viewing Performance Problems from Multiple Perspectives to Develop Action-Oriented Solutions



Note: I&D = irrigation and drainage; WUO = water user organization.

- **Take account of multiple perspectives:** The approach requires identification and appreciation of the motivations of all actors who are linked to the hydraulic system.
- **Define functional performance criteria:** The resource book includes a detailed set of indicators that facilitates the water service-delivery performance expectations of each actor to be clearly defined.
- **Engage in problem-based inquiry:** A problem-based approach ensures that collaborative effort in diagnosing problems is focused on the actual priority problems, thereby avoiding simple replication based on “best-practice organizational forms.” This leads to collaborative planning and action-oriented responses.

Figure 1.3 shows how the three main working concepts are integrated to achieve best-fit solutions.

Multiple Actors with Different Perspectives

There are many actors that must be considered when identifying problems and crafting best-fit institutional responses. These actors have distinct needs and responsibilities in addressing problems.

Not all of the actors will be present in each situation, but all need to be initially considered, and then those who are relevant must be included in processes as they evolve. Viewing performance needs and

MULTIPLE ACTORS WITH DIFFERENT PERSPECTIVES

IRRIGATION	<ul style="list-style-type: none"> • Farmers • WUOs • I&D agencies • Line ministries • Private sector
OTHER	<ul style="list-style-type: none"> • Domestic users • Water supply utilities • Hydropower users • Fisherpeople • Stock farmers



problems from multiple perspectives provides a way of understanding specific needs and a basis for rationalizing competing interests.

Three Groups of Performance Functions

Performance is needed across three kinds of I&D functional groupings, or themes, as outlined in Figure 1.4. Each of these has a more detailed set of performance areas that are described in detail in Chapter 2. The organizational and governance functions on the right of Figure 1.4 contribute to the higher-priority water service-delivery functions.

FIGURE 1.4. Three Groups of Performance Functions



Note: capex = capital expenditure; MOM = management, operation, and maintenance.

Making Sense of Organizational Forms That Provide Irrigation Functions

Different countries have a variety of organizations carrying out irrigation and drainage services for the different parts of the hydraulic landscape. In most cases, a single organization can have multiple roles and functions (Svendsen 2005). The responsibility for providing the functions and achieving performance can be carried out by varied individuals or combinations of organizational groups. Organizations providing irrigation functions are not always simple to categorize, but an indicative grouping is listed in Table 1.1.

TABLE 1.1. Forms of Irrigation Service Providers on a Public-Private Continuum

	Form	Description
Irrigation agencies	Irrigation department	The ID is the conventional form of irrigation agency, and it can fall under the mandate of the national, state, or local government. Most IDs are accountable to their parent government branch and carry out the government's mandate rather than operate for profit.
	Government or user board	These differ from IDs in that they earn some of their revenue from the provision of services. The governance structure is through a mixed board consisting of government officials from different departments, line ministries, and the private sector (for example, Murray-Darling Basin Authority).
	Public utility	Utilities (SOEs) that provide irrigation services subject to regulation. They earn revenue through the provision of services and are governed by corporate owners and public agencies (for example, irrigation companies in central Asia). This type of organizational form is more common in municipal water supply and electricity supply than in irrigation service provision.
Water user organizations	Communal irrigation management	These systems are developed and operated by communities, and the communities own the water infrastructure. Such systems are found across the world, but the most well-known are in Nepal, Philippines, and Malaysia. Members pay a fee and/or contribute labor and materials for construction and maintenance.
	Water user associations	WUAs are a more formal version of community-based irrigation organizations and are established under a variety of legal forms (specific WUA law, trusts, co-ops, and so on).
	District	Irrigation districts, similar to WUAs, are governed by the client but are usually larger. They differ from IDs and user boards in that top-level control rests with the client and not an outside group. Their operations rely on earned revenue, and they are nonprofit entities.
(Semi-) private sector	Canal company	These are nonprofit entities under corporation law. The company builds and operates the canal by borrowing money, and the board of directors hires a manager and staff to run the daily operations (for example, Société du Canal de Provence in France). Although it has some characteristics of a public utility, this kind of company has public and private shareholders and operates on a market and cost-recovery basis.
	Contractor	Contractors are family-owned or private sector companies that provide irrigation services for a fee. A specific form of these are joint ventures involving farming estates with outgrower arrangements and, potentially, operator functions.

Sources: Svendsen (2005) and de Fraiture et al. (2007), amended by the authors.

Note: ID = irrigation department; SOEs = State-owned enterprise; WUAs = water user associations.

A Problem-Based Approach

A problem-based approach is adopted because (a) there is need for nuance in response to diversity and (b) it facilitates selectivity to address only what is truly problematic and nonfunctional. It is important to avoid modifying or replacing organizational



elements simply because there is opportunity or power to do so. The idea is to work towards best-fit solutions and avoid the practice of translating what is thought to be “best practice” in one situation and apply it to another. This is known as isomorphic mimicry, or a blueprint approach, and is the exact opposite of what is proposed here.

The reality of path dependency, expanded in Appendix 1 (World Bank 2020a), is that organizations and institutions are heavily dependent on their history, with the characteristic of persistence, or the tendency to continue past practices and norms (North 1990). The concept of bricolage, expanded in Appendix, is a pragmatic approach of building new solutions based on the organizational and institutional elements that are readily available. The wholesale revision of legal frameworks and organizational structures—and completely changing the way people do things based on history and experience—may be preferable at times; however, it is more often the case that realism and pragmatism in relation to time, budget, and sociopolitical context will call for building on what exists to achieve adequate, if not perfect, levels of functionality.

Problem diagnosis and responsive solutions must consider the fact that organizations are, by nature, political entities with diverse internal views, tensions, and motivations (Suhardiman and Giordano 2014). Failed institutional interventions are associated with the tendency to ignore heterogeneity within any group of actors, particularly in bureaucracies. An irrigation agency, for example, with the designated mission of ensuring effective and efficient water delivery, will inevitably be driven internally by other considerations such as access to financial resources, continued survival, and power to influence political change at higher levels. The use of performance areas and multiple perspectives allows nuanced organizational and institutional responses to be developed with a focus on both the actors and institutions (agreements or rules) attentive to their particular priorities.

Case Studies for Inspiration and Illustration

The resource book expands on each of these main elements in turn and includes a set of inspirational case studies in Appendix 2. The cases are presented in detail, and extracts are used to illustrate processes described in the resource book. In addition, innovations and successful ways of working are highlighted. Key agents of change are identified, and their organizational forms and functions are also described.

EFFECTIVE GOVERNANCE SOLUTIONS

- Must be fit-for-purpose, not one-size-fits-all
- Lie in a locally responsive mix of interventions that involve different actors on the irrigation stage
- Must respond to the diverse perspectives and the real functional performance needs

THE EXTERNAL ENVIRONMENT

The external environment is also critically important. This is not only for setting general boundaries on effectiveness, but also for sensing and understanding opportunities for fundamental reforms that will allow the I&D entity to jump up to the next level of organizational effectiveness.

FOCUS ON FUNCTIONS AND ON PROCESS

Make a shift from solutions that focus on organizational structure, to ones that emphasize functions, inclusive processes, and collaborative ways of working.

1.6 Structure of the Resource Book

The content of the resource book is summarized below; the chapters move progressively from working concepts and ways of viewing the problems to practical, action-oriented steps.

Chapter 2 explains what is meant by I&D performance. Service delivery, which is the foremost objective, is defined first, followed by a list and detailed description of performance indicators in relation to the key irrigation and drainage functions. Different types of performance assessment are outlined, and two other performance auditing and modeling tools that can be used with the resource book approach are briefly described.

Chapter 3 describes each of the multiple actors and their various motivations pertaining to the three main groups of irrigation functions: water delivery services, organizational resources, and governance. Together, Chapter 2 (performance areas) and Chapter 3 (multiple perspectives) provide the necessary elements that institutional responses need to address. The chapter concludes with a description of



multi-stakeholder partnerships (MSPs) as a strategic tool for mobilizing and working with stakeholders as part of an action-oriented problem-driven approach in Chapter 4.

Chapter 4 is an action-oriented chapter that is framed around a problem definition and collaborative solution development. It describes key governance principles that must inform action planning, outlines how targeted legal interventions can unlock opportunities, and describes PDIA, a reflexive analysis and planning technique. The chapter aims to provide a practical road map that will enable practitioners to take steps toward mobilizing multiple stakeholders, identifying core problems, and developing locally appropriate solutions.

Appendix 1 (World Bank 2020a) describes important theoretical and conceptual tools that give insight into and aid understanding of the governance challenge in irrigation and drainage. It is valuable to inform the analysis and design of organizational and institutional solutions.

Appendix 2 (World Bank 2020b) includes a range of case studies covering the developing regions of the world and provides valuable practical insights into what has and has not worked elsewhere.

Notes

1. The idea of a “wicked” problem was first put forward by Horst Rittel in the 1960s. It is one that is very difficult to solve and, in some cases, does not have a “solution” at all. As initial solutions are found, they often reveal other apparently insolvable problems; thus, the solution to one problem is another problem (Buchanan 1992).
2. For more information, see the FAO website at <http://www.fao.org/faostat/en/>. AQUASTAT is the FAO global information system on water resources and agricultural water management. It collects, analyses and provides free access to over 180 variables and indicators by country from 1960.
3. As above.
4. In practice, there is a form of schemes that combines these two groups in the monsoon- and cyclone-dependent rice-growing areas in Africa and Asia. They control floodwater during the monsoon season through a system of flood embankments and drain excess flood water in drainage canals. In the dry season, they provide traditional I&D services. They fall under Group 1.

5. Data on the sources of irrigation water are based on the ratios of groundwater-only and conjunctive use from Thenkabail et al. (2009) applied to the updated assessment of total groundwater use in irrigation by Siebert et al. (2010).
6. Woodhouse et al. (2017) write about farmer-led irrigation development (FLID), which should not be conflated with a single technology such as small pumps. FLID is a farmer-led process of irrigation development, and although small petrol and diesel pumps are a feature, it involves many different technologies such as small-gravity schemes, bucket-and-rope systems, and hand-watering, among others.







CHAPTER 2.

Irrigation and Drainage Performance



This chapter explains what is meant by I&D performance. Improving service delivery is explored in a range of performance indicators for key irrigation and drainage functions.

Irrigation and drainage (I&D) performance assessment is an important management tool for providing irrigation and drainage services. I&D **performance management** can be defined as “...*the systematic observation, documentation and interpretation of activities related to irrigated agriculture with the objective of continuous improvement*” (Molden, Burton, and Bos 2007, 307). **Performance assessment**, on the other hand, is the process by which the level of service in a **performance area**, defined by the measurable **performance indicator**, is evaluated. The term performance area describes a specific subject of interest, whereas performance indicator refers to a measurable descriptor for an area of interest. Performance indicators tend to be case-specific and are not addressed in detail but require special attention by irrigation practitioners with support from monitoring and evaluation experts.

The introductory part of this chapter defines irrigation service delivery and follows with a description of the main irrigation functions that must be met to achieve successful irrigation farming on schemes. The main part of the chapter includes a detailed matrix of performance areas, followed by a description of each. As performance assessment can be undertaken for different reasons, various motivations for doing so are also outlined. These perspectives on performance will vary on any one scheme and, quite obviously, between different schemes, which calls for a willingness to explore, understand, and engage with diverse situations and views. The descriptions of the various aspects of service-delivery performance is key complementary information to the six perspectives described in Chapter 3.

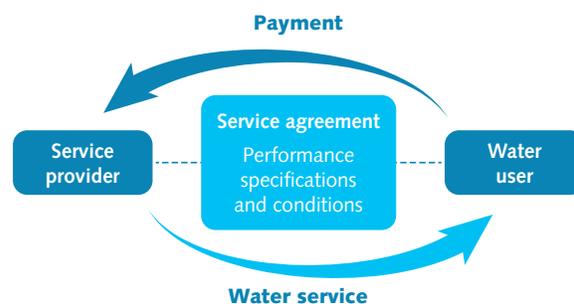
2.1 A Focus on Service Delivery

Water can be used for different purposes such as domestic use, irrigation, watering livestock, hydroelectricity, tourism, or industrial use, thus involving multiple actors in the service-delivery chain (Renault, Wahaj, and Smits 2013). The process of irrigation management on schemes has multiple dimensions. At face value, it is about service delivery for crop production. At a social level, however, irrigation is about collective action and is subject to power struggles and local and national politics. In defining performance, however, the resource book takes a relatively narrow perspective and is focused on water service delivery and system operational performance. In this chapter, the type of service delivery is specified, and expectations on standards are explained.

Services generally involve the provision of adequate, reliable, and equitable water and, in the case of drainage, the removal thereof. The quantity, quality, accessibility, reliability, and cost of the services are the most common performance measures (ADB 2017), but these need to be further segmented into detailed parameters, which is the subject of this chapter.

A Trio of Performance Areas

Robust and functioning management structures are fundamental to the provision of any product or service. It is, therefore, important to understand management structures and processes and how they impact the organization's ability to deliver services. In developing the performance matrix for service delivery, three main themes are identified (after Bos et al. 1994): **operational service delivery, organizational resources, and governance**. To deliver services, an organization requires adequate resources and effective governance at local and higher levels.





Level of Service

On larger schemes, it is usually an agency (government or private) that provides water to water user associations (WUAs), individual farmers, and other water users for a fee. On smaller schemes and on subsystems of larger schemes, collective management (water user organizations [WUOs] or similar) can be effective service provision entities.

In all situations, the level of service must evolve from consultations with users themselves and not be unilaterally imposed by a higher-level irrigation agency or operator. The level of service (LoS) of an irrigation system is one key determinant impacting the efficient use of water and productivity on irrigation schemes. An appropriate and clearly established LoS contributes significantly to improved water delivery outcomes in relation to flexibility, reliability, and equitability throughout the irrigation area. There is also evidence that a clearly stated and agreed-on LoS between operators and users contributes to intensification (increased agricultural output) and increased water productivity (ADB 2017). A good understanding of LoS is thus essential, so the concept, as defined by the World Bank (2018), is presented in Box 2.1.

BOX 2.1. Level of Irrigation Service Defined

The level of irrigation service must:

- be consistent with the goals and objectives identified for the final users, the organization and the irrigation scheme(s);
- evolve from extensive consultations with the organization providing the services and the users (and those potentially impacted);
- contain a series of norms (targets) against which operational performance can be measured;
- encompass a series of performance indicators to measure the degree of attainment of the objectives and targets;
- be revised on an ongoing basis in order to respond to changes related to irrigated agriculture; and
- consider and take account of the cost of providing a stated or desired level of service.

Diversity and Context-Appropriate Expectations of Performance

It is important to acknowledge that when targets for a level of service are set, they do not necessarily have to improve on a current situation. In many instances, physical, institutional, and social

realities place boundaries on what is possible. The ambitions of different users are diverse and technical, and financial and historical factors have to be carefully considered. Path dependency means that future actions are, to some extent, predetermined by earlier decisions and events—technically, socially, or institutionally. An old, small, and simple gravity-fed rice scheme in a medium rainfall area, for example, will have completely different limitations on improvement options than a high-value horticultural scheme in an arid setting. Defining aspirations, and setting performance and service-delivery targets, is thus a highly site- and user-specific process.

2.2 Analytical Framework

All performance assessment programs require a framework to define and guide the work, several of which have been proposed in the past. Some were specific to a particular scheme, whereas others were more generic. Key players in the formulation of generic frameworks have been Bottrall (1981), Abernethy (1984), Oad and McCornick (1989), Small and Svendsen (1990), and Murray-Rust and Snellen (1993). The framework described herein builds on this previous work, as well as work by Burton and Mututwa (2002), Mututwa (2002), and more recently, Lankford et al. (2016). The framework serves to define why the performance assessment is needed; what data are required; what methods of analysis will be used; and who will use the information provided. Without a suitable framework, the performance assessment program may fail to collect all the necessary data and may not provide the required information and understanding.

From Whose Perspective?

The assessment may be carried out on behalf of one stakeholder or stakeholder group but might look at performance assessment from the perspective of another. For example, the government may commission a research institute to conduct a performance assessment to study the impact of system performance on farmer livelihoods or farmers might commission a study of the irrigation service provider to ascertain whether they are receiving an adequate level of service for fees paid.



Over Which System?

This refers to spatial context—in this case, the areas are linked predominantly by the extent of the I&D system and its associated command area and beneficiaries. System impacts can be upstream and downstream; for example, when improving water quality, there are direct benefits to the river ecology downstream. Performance is measured using indicators, for which data are collected and recorded. The analysis of the indicators then informs on the levels of performance.

Thematic Boundaries

Developing a suitable analytical framework that focuses beyond infrastructure or technical performance-specific areas is necessary for undertaking institutional-strengthening actions. Such a framework builds on the work of Bos et al. (1994), who consider the role of all actors in the irrigation system and include satisfying specific conditions:

- A framework that *service providers and users* can use to assess performance (with suitable baseline indicators against which to benchmark performance)
- A set of practical *performance indicators* that can be easily measured and used to assess performance
- An *incentive and reward system* to encourage periodic performance review and hold accountability when standards are not met

With these conditions in mind and drawing on Ostrom (1993 and 2005) and Merrey et al. (2007), a framework based on a more practical set of performance areas of interest has been developed. It considers **three thematic areas comprising groups of functions**, presented in Table 2.1. These cover the physical and technical aspects of water service delivery, the organization, and the governance boundaries related to irrigation scheme management, operation, and maintenance.

2.3 Performance Areas



Irrigation service delivery requires water resource availability and infrastructure adequacy above minimum thresholds, along with enabling institutional arrangements and sufficient human capital, to ensure its success. Performance areas have been grouped into three domains, in which the first, water service delivery, is the result of a process that depends on the second domain of effective organizational resources and management capability, which in turn is enabled by the third domain of good governance. The performance areas and more detailed descriptions are listed in Table 2.2.



The focus of the resource book is on irrigation and drainage service provision, though successful irrigation farming depends on many other key agricultural development support functions. These include financing, agricultural knowledge, access to input and output markets, labor availability, and primary natural resources. Most agencies will be responsible for functions beyond water service delivery, sometimes including these wider agricultural functions and often including other scheme infrastructure such as main- and field-access roads within the scheme. Facilitating road access

TABLE 2.1. Summary of Thematic Boundaries and Features

Functional themes	Features	Summary of performance areas
1. Water service delivery	<ul style="list-style-type: none"> • Typically describe performance at the system level, often relating to physical infrastructure • Technical and well-defined and documented parameters (for example, Bos, Burton, and Molden [2005], and Malano and Burton [2001]) • Numerical and finite indicators (for example, ratios, percentages, finite numbers) • Attributed as a performance measure for project outputs (for example, increased equity caused by introduction of command area channels) • Linked to a pricing policy (or tariff) that reflects the performance of service 	<ul style="list-style-type: none"> • Adequacy • Reliability • Equity • Flexibility • Quality • Multiple-use services • Productivity
2. Organizational resources	<ul style="list-style-type: none"> • Overall service provider ability to deliver quality and sustainable I&D services • Service provider human resources, (skills, capacities, diversity, and so on), financial resources (cost recovery and effectiveness), management, process and sustainability • Communication and ways of executing processes, including systems operations • Service provider accountability in MOM and the recovery of service fees 	<ul style="list-style-type: none"> • Financial sustainability • Asset management • Internal and external accountability • Process management • Cost-effectiveness
3. Governance	<ul style="list-style-type: none"> • Covers core elements of what constitutes good governance within the context of an organization • Includes service provider responsibility toward stakeholders and transparency of operations and actions • Presence of procedures, goals, and associated legal instruments for service delivery • Service provider core values and organizational responsibilities • Interstakeholder relationships and communication • Diversity and inclusiveness of service provider 	<ul style="list-style-type: none"> • Responsiveness and transparency • Accountability • Policy and legal frameworks • Strategy, mission, and vision • Organizational coherence and representation

Note: I&D = irrigation and drainage; MOM = management, operation, and maintenance.



is an important service provided by scheme operators, and although not addressed here in detail, it needs to be included in scheme-level performance planning and assessment, as appropriate to each situation. Agricultural services are increasingly devolved from irrigation and drainage agencies to other arms of government and/or to private sector entities, allowing agencies to focus on water service delivery.

The full set of performance areas will have different levels of importance to different actors involved in the irrigation process. These relationships are discussed further in Chapter 3, where the six perspectives are expounded. The list of performance areas are intended to:

- prompt consideration of which performance areas are applicable to the reader's context; and
- provide a starting point for considering the causes that affect performance (that is, to initiate the deconstruction of the performance problem at any scheme or location).

BOX 2.2. Conduct Scoping Exercises with the Full Set of Indicators in Mind, and Then Select Them as the Situation Requires

- The list of performance areas is **neither exhaustive nor completely definitive**; it will be necessary in some contexts to add or revise them as needed.
- It is important, **at the start, to consider all the performance areas** in any given situation, noting they will have different levels of relevance. In some cases, financial, technical, or political realities may dictate that addressing a performance area is simply not possible, and plans must be made accordingly.
- The **aim is to tailor and prioritize** these according to the individual situation and to understand their importance from the viewpoints of all key actors involved in the service-delivery chain.

TABLE 2.2. Irrigation and Drainage Water Management Performance Areas

Functional themes	Performance area	Description
1. Water service delivery	1.1. Adequacy	<ul style="list-style-type: none"> Do the farmers receive enough flow, pressure (if applicable), and total quantity to meet their crop-water requirements and timeliness? Is excess irrigation water suitably drained from farmers' plots without damaging soil and crops? Is the biological and chemical quality of irrigation water supplied safe for users, crops, the environment, and livestock?
	1.2. Reliability	<ul style="list-style-type: none"> For irrigation services based on irrigation scheduling: Does the farmer receive water according to the agreed-on schedule and with predictability? For on-demand service: Does the service provider ensure continuity of service at the delivery point (for example, hydrants or other)? For proportional distribution or spate irrigation: Does the farmer receive water per agreement? For flood protection: Are the fields and other conveyance infrastructure protected against the design flood (of the relevant return period—for example, one in 50 years)?
	1.3. Equity	<ul style="list-style-type: none"> Is irrigation water distributed fairly across all users of the system? Are drainage and flood protection services comparable across all users? Are irrigation service parameters (adequacy, reliability, flexibility, quality) built into infrastructure that enables equitable distribution to all users? If service varies within the irrigation scheme, are variations reflected in the pricing policy?
	1.4. Flexibility	<ul style="list-style-type: none"> Does the system allow farmers to vary their demand in response to changing needs at the farm level during the cropping cycle and over the seasons? To what extent can farm decisions on cropping and irrigation methods be made independent of others in the same system, within the overall service agreement? Can farmers make choices in relation to the services, which are then reflected in the price they pay (for example, increased flow rates at a higher price or formal and informal water trading between irrigators)?
	1.5. Multiple-use services	<ul style="list-style-type: none"> Are the needs of other groups of water users or services recognized by I&D and other agencies (watershed management, flood protection, environment, ecological flow, hygiene, livestock, fisheries, domestic water, washing, tourism, recreation, groundwater recharge, and so on)? Is there a pricing policy for other users adapted to their use?
	1.6. Productivity	<ul style="list-style-type: none"> Is the irrigation service attuned to enabling sustainably maximized and diversified production (in terms of yield or return per unit of water, labor, inputs, and so on)? Is the cost of service affordable compared to productivity gains, and is the invoicing done in relation to farmers' expected cash flow?
	1.7. Operability	<ul style="list-style-type: none"> Is the physical design of the infrastructure (density of network, type of control structure, measurement capability) fit to deliver the required level of service required by farmers? How sensitive is the service to flow fluctuations, breakdowns, and other variations and anomalies, and can service be maintained without high deployment of water, energy, and personal resources?

table continues next page

TABLE 2.2. Irrigation and Drainage Water Management Performance Areas *(continued)*

Functional themes	Performance area	Description
2. Organizational resources	2.1 Financial Sustainability	<ul style="list-style-type: none"> • Are sufficient resources budgeted for and mobilized to manage, operate, maintain, and replace irrigation infrastructure to deliver quality irrigation and drainage services now and in future? • Do water users pay for irrigation services? (Is there effective fee-setting, and are fee collection mechanisms enforced?) • Is there access to finance for scheme management from commercial sources such as private financial institutions (for example, banks), technology suppliers, and so on?
	2.2 Asset Management	<ul style="list-style-type: none"> • Is there an asset management plan to maintain the condition of I&D assets and an optimum operating standard and to provide a level of service to farmers that is consistent with cost-effectiveness and sustainability objectives? • Is there an appropriate operation plan that rationalizes the type and costs of various operational requirements (to provide a suitable level of service to farmers consistent with cost-effectiveness and sustainability objectives)?
	2.3 Technical Operations Management	<ul style="list-style-type: none"> • Is the organizational structure and decision making clear and functional in terms of inclusiveness, hierarchy, functions, and reporting? • Is there a suitable inventory on main system and service parameters (users, land owners, irrigation network, irrigation rights, geography, crops) to support decisions? • Are there internal service standards and process workflows for common MOM functions, and are records on service levels maintained?
	2.4 Organizational Management (Including HR)	<ul style="list-style-type: none"> • Is the staffing composition adequate to fulfill the mission in terms of technical, financial, social, and management positions, skills, and capacities? • Is there an effective staffing plan, including training and development, performance management, adequate compensation, and learning opportunities? • Is there a transparent and merit-based staff performance and reward system in place to incentivize employees? • Are there outsourcing policies and practices for specific functions?
	2.5 Fiduciary Management	<ul style="list-style-type: none"> • Is there effective expense control and cash flow management of the I&D agency based on accurate forecasting? • Are there performance standards for I&D services that are used as the basis for fund allocations, prioritization of activities, and monitoring improvements in service delivery?
	2.6 Strategy and Processes	<ul style="list-style-type: none"> • Is the institutional vision, mission, and sector road map to support change management and improved service-delivery performance by the I&D agency aligned to water and agricultural policy? • Is there an appropriate investment strategy for development and sustainability of I&D infrastructure and services? • Is there appropriate due diligence on decision making, including attention to issues of inclusiveness and to decision meetings with due process and record-keeping?

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TABLE 2.2. Irrigation and Drainage Water Management Performance Areas *(continued)*

Functional themes	Performance area	Description
3. Governance enforcement and Conflict Management	3.1 Transparency and Customer Orientation	<ul style="list-style-type: none"> • Is management accountable to users, owners, and stakeholders, and are there performance assessment mechanisms? • Does management include staff and users in institutional improvement processes, and is there an effective communication strategy? • Is information on scheme operation and service delivery routinely and effectively measured (metered) and documented? • Is there an effective and responsive information management system to provide agency-related information on structure, people, and processes? • Are conflict management mechanisms in place to enable debate and resolve conflict regarding the service (either between users or between service providers and users)? • Is there adequate tracking of conflicts and analysis to overcome structural problems?
	3.2 Enabling Policies and Associated Legal Instruments in Place	<ul style="list-style-type: none"> • Are there adequate policy and legal frameworks (including suitable legal instruments in place) to strengthen performance of irrigation service delivery? • Do the water and other relevant sectors demonstrate compatibility between policies?
	3.3 Institutional/Organizational Coherence	<ul style="list-style-type: none"> • Does the I&D agency have organizational autonomy (financial, political, and so on)? • Are there suitable mechanisms defined for inter- and intra-agency coordination? • Is there clarification of tasks and responsibilities (spatially, functionally, hierarchically, and hydraulically) of the various agencies regarding delivery of irrigation and drainage services? • Is the I&D service provider considered credible by the people it serves, financiers, and other stakeholders?

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TABLE 2.2. Irrigation and Drainage Water Management Performance Areas (continued)

Functional themes	Performance area	Description
3. Governance enforcement and Conflict Management	3.4 Accountability	<ul style="list-style-type: none"> • Is provision of irrigation water regulated and licensed, and are these suitably enforced? • Are there service agreements (formal or informal) between parties for the provision of services, and are these agreements enforced? • Are there process management and performance monitoring systems within the organization that ensure adequate accountability to the management and to members, users, and customers? • Are farmers and water users of I&D services engaged in the accountability of the agency and other stakeholders responsible for service delivery? • Is there effective communication within the organization and with its clients on the formulation, execution, and evaluation of service-delivery activities?
	3.5 Inclusive Representation	<ul style="list-style-type: none"> • Is there transparency, equity, and inclusiveness in the stakeholders associated with services delivery, including women, youth, and other marginalized groups, as well as the I&D agency? • Is the level of representation of various stakeholders, including women, youth, and marginalized groups, suitably reflected in the composition of water user groups and the I&D agency? • Are stakeholders, including women, youth, and marginalized groups, suitably empowered, included in dialogue, and involved in decision making, including setting their agenda?

Note: HR = human resources; I&D = irrigation and drainage; MOM = management, operation, and maintenance.

2.4 Performance Descriptions: (1) Water Service Delivery

The indicators linked to the first category of water service delivery are technical in nature and, in this sense, are familiar to many irrigation practitioners, particularly engineers. The indicators are linked to the physical aspects of providing water and drainage services. There is extensive published work on specific parameters and relevant definitions, albeit with varied detail; definitions adopted here follow from leading irrigation practitioners (Bos, Burton, and Molden 2005; Murray-Rust and Snellen 1993) and provide a simple but comprehensive list that defines irrigation service delivery to users. Increasingly modern technology, including Earth observation, makes monitoring of these types of performance indicators much more precise and allows actual monitoring of impact, rather than adherence to “norms.”

Adequacy: Is There Enough?

Adequacy is traditionally measured with a clear formula, such as relative water supply, which is the ratio of water supply (irrigation plus rainfall) to crop-water demand. In this case, we consider delivery from the end user’s perspective of

receiving sufficient (quantum) and timely irrigation supplies to meet crop-water requirements and to avoid excess water standing in the field for too long. Adequacy of supply and drainage affects farmers' decisions on cropping patterns and can negatively impact yields through plant-water stress (when less than the optimum amount is available) or waterlogging (when there is excess). Drainage requires the provision of drainage ditches for the release of unused water in an environmentally acceptable manner. When farmers do not receive adequate water, this triggers alternative strategies including upgrading on-farm irrigation systems; water theft; informal trade with neighbors; reduction of the irrigated area; use of alternative sources (usually groundwater); on-farm storage; and night irrigation.

Adequacy measures whether the water is delivered to the right place, at the right discharge, and at the correct pressure to enable productive on-farm use. It thus also addresses "fitness for purpose." If there is no need for a highly sophisticated delivery mechanism for the intended use, a simple supply system can also be adequate or fit for purpose. The performance area further entails providing water of suitable biological and chemical quality to support crop production and avoid detrimental impacts on the ecosystem.

Adequacy is a highly specific indicator for each scheme and is not possible to capture in one metric. It depends on the physical circumstances and how these are optimized through infrastructure, seasonal planning, scheduling, and the day-to-day distribution of water. This interplay of infrastructure, operational management regimes, and day-to-day decisions thus requires a scheme-specific definition and measures of the LoS.

Reliability: Can I Depend on It?

Irrigation service reliability is conventionally defined as the extent to which the irrigation system, and the related delivery of water, conforms to what users expect from the system (Renault and Vehmeyer 1999). From the water user's perspective, this is a critical parameter to plan cropping patterns and input requirements. Knowing when water supply will be received enables crop-production planning and can help farmers irrigate more efficiently by being prepared at the time water arrives. In defining and describing the performance area, the farmer's understanding of when he or she will receive water must be considered. Defining service levels for reliability must take account of how dependable the system is for timely delivery, per the agreed-on schedule.

Different kinds of scheduling can be used:

- **Fixed schedules** like 'warabandi' in South Asia, where a time per unit area is provided each week, regardless of crops and flow in the outlet, or proportional use (fixed water shares, rather than schedules).

- **A defined order**, with each farmer taking water in turn on a predetermined basis (according to availability), or as negotiated between individual farmers, or flood-spate (where there are often traditional agreements on the first user taking the entire share until land is sufficiently irrigated).
- **On demand (or restricted on-demand)** – such as in pressurized or downstream controlled irrigation systems, where farmers can take water based on their needs (with certain restrictions to timing/discharge/pressure).

The expectation from the farmer on the “adequacy” (1.1) of the service will be different for each situation, and the question of reliability pertains to the extent to which these expectations are met consistently. When considering drainage, reliability also relates to the frequency at which excess rainfall or floods affect a farmer’s field, with a related risk of crop damage. Farmers respond to unreliable supply with similar measures as listed under inadequate supply, including developing groundwater sources, creating buffer storage, informal water trading, and switching to less-sensitive crops.

Equity: Is It Provided Equally among All?

Equity is a measure of how fairly irrigation water is supplied (Fan et al. 2018). Inequity is one of the common issues of irrigation system performance. Often the head reaches of the system take a greater share of supply, leaving less available for the mid- and tail reaches. The consequences are generally higher production at the top end of the system, inequitable wealth distribution, and power asymmetries between farmers in the command area.

Equity is considered from two perspectives:

- **Horizontal equity.** The equality of irrigation water distribution, which may not always be uniform, can impact crop performance. It can be defined as spatial uniformity of the ratio of supply and demand. Standard indexes that quantify irrigation distribution include Christiansen’s coefficient of uniformity (1942) and Abernethy’s modified interquartile ratio (1986).
- **Vertical equity.** This applies to irrigation water distribution between individual water users with different needs, such as surface and conjunctive water; different land-holding sizes; cropping patterns; alternate water sources; and so on. Vertical equity may need additional measures to include marginalized groups, extra investments, or operation and maintenance (O&M) costs to support difficult-to-reach locations. If there is one unique type of farmer, there might be a specific service-delivery arrangement that is costed and managed (fairly) to account for the difference.

The performance areas developed for equity give equal importance to drainage provision across the system. The extent to which infrastructure is responsive to equitable distribution; ensuring that the right type and size of structure is located at all points on the scheme; the installation of proportional offtakes, or time-division structures that provide water in proportion to the area to be irrigated; and the time taken to irrigate are all technical determinants to be considered.

It is important to note that equity considerations do not necessarily mean equality in service levels. There can be users who have higher, or different, demands compared to others using the same system, and these can be accommodated if well-discussed in terms of mutual expectations and the sharing of costs and risks (vertical equity). Differences in service quality can also be compensated for by an appropriately tiered pricing policy.

Flexibility: Can It Accommodate Changes?

Flexibility of irrigation delivery infrastructure may be viewed as operational or strategic. The main difference between the two types is the time scale for which flexibility is designed:

- Operational flexibility is on a fine-time scale—that is, irrigation events in an irrigation season or over a few seasons.
- Strategic flexibility seeks to provide for potential long-term changes in irrigation needs—that is, over a period of 10 years or longer.

A flexible irrigation supply allows farmers to optimize use of resources (land, water, labor, and so on). The System of Rice Intensification (SRI), for example, requires higher levels of both flexibility and reliability and is associated with greatly improved yields and profitability. Unless the system can provide suitably high levels of service, improved production systems such as SRI cannot be used.

Flexible systems are those that can deliver water with varied frequency, supply rate, and/or duration as required by different farmers on the system. With more lucrative returns on diversified cropping, some irrigators on a scheme may be keen to shift to high-value crops, requiring different delivery criteria to others. Both irrigation water management and technical aspects must be considered, as both have inherent limits in being able to accommodate changes.

In considering this performance, the extent to which the farmer has management control of the frequency, rate, and duration of irrigation water delivery is important. When infrastructure modernization is justified, particularly for switching to higher-value crops, it is necessary to explore conceptual design changes (such as replacing canals with pipes or installing buffer storage), rather than simple

BOX 2.3. Flexibility: The Case of the System of Rice Intensifications

The System of Rice Intensification (SRI) is an agroecological, climate-smart, and low-input methodology for increasing rice productivity and can play a crucial role in increasing rice production in the world. SRI was developed in Madagascar and is practiced in more than 55 countries (with increasing global uptake). The SRI methodology is based on the principles of early plant establishment, reduced competition among plants, creating soils that are rich in organic matter, intermittent drying to promote tillering, with reduced overall water use. By using the SRI, farmers can derive more benefit from the genetic potential of rice compared with conventional approaches. Key outcomes are:

- increased yields, often by 50 percent or more;
- 90 percent less seed use and 30 to 50 percent less water; and
- lower use of agrochemicals and lower farmer health and pollution risks.

The SRI was initially viewed as a rigid technology, but farmers who have been trained in the guiding principles have successfully adapted their rice-production practices, developed innovations, and achieved substantive improvements on their previous methods of growing rice. One of the key challenges in the SRI is irrigation water control. Unlike conventional paddy rice production, the SRI requires alternate wetting and drying cycles during the period of vegetative growth and careful avoidance of deep flooding thereafter. **The introduction and success of the SRI thus requires higher performance with regard to water supply flexibility and reliability.**

rehabilitation of the existing design and layout. Specific areas of introducing strategic system flexibility in a main distribution system include the following:

- Replacing canal structures that are at the end of their serviceable lives with new canals with additional capacity (or allowing for stepped capacity increases and flexible water control in the future)
- Allowing channels to operate at higher supply levels (less freeboard) than has been the operational practice, thereby providing buffer storage
- Constructing supplementary delivery systems (pump and pipeline systems), with or without the conjunctive use of groundwater
- Constructing off-channel storage dams
- Laying down flat pipes to directly abstract water from distribution channels

Flexibility can also be provided to the farmers through the pricing policy by giving choices in terms of service performance that are reflected in the tariff. For example,

farmers can subscribe for a higher flow at a higher price. This would allow them to irrigate their field in a shorter time, assuming suitable on-farm irrigation systems and/or land management practices (such as land levelling) have been undertaken.

Multiple-Use Services: Are Other Water Users' Requirements Also Met?

Within an irrigation command area, and more broadly within a river basin, are several water users with water needs and performance requirements not relating to irrigation. These users, when dependent on the irrigation scheme or impacted by the I&D system downstream, must also be considered. Aquaculture in I&D systems, livestock, environmental base flows for downstream ecosystems, domestic water requirements, and conjunctive management of groundwater are key areas to consider as part of a performance assessment. For example, domestic water supply requires a much higher level of service than irrigation (that is, continuous service throughout the year, which creates additional demands on the technical and management, operation, and maintenance [MOM] modalities on the scheme). Similarly, tail-end releases back into the environment have potentially serious implications for downstream flow and water quality.

In addition to physical aspects, the institutional arrangements between various users must also be highlighted. These are often overlooked but can be a crucial link in overall system performance improvement. One example is that of shallow tube-well operators within, or downstream of, irrigation systems directly affected by groundwater levels, who may not be part of a WUA and could thus be omitted in the consultation process when developing solutions. Pricing needs to be addressed when considering these other water uses.



Productivity: Is the Service Attuned to Agricultural Production Trends?

The economic value of water in agriculture is much lower than in other sectors, including manufacturing. This is leading to increased competition for finite fresh-water resources, increasing water prices, and driving improvements in water-use productivity (Barker et al. 2003; Niewoudt and Backeberg 2011). Productivity may be considered an overall outcome of several factors, assessed as the economic value of production, tonnage of crop, or labor, per unit of water. It is not the farmers' output that is measured but rather whether the I&D service enables optimal resource use (primarily water and pumping energy) to achieve optimum productivity. Water-use productivity is scale-dependent and can be analyzed at the crop, field, system, or basin level.

Crop-water productivity cannot be considered in isolation and is affected by control over water delivery, reliability, and adequacy. In terms of water control, the amount of water reaching the root zone can be increased with on-farm water management improvements (land leveling, furrows, drip irrigation, and so on). Irrigation reliability and adequacy (described earlier) are key determinants in assessing productivity. Productivity may also be considered intricately linked to pricing policy. The whole point of the irrigation system is to increase productivity and resilience to climate variability (especially in the case of supplementary irrigation) so that farmers make more money. They can then use part of their additional income to contribute to the MOM cost. How the tariff relates to productivity gains (which themselves vary according to LoS) is another important issue to consider.



Conventional approaches to measuring performance (using empirical engineering indicators) have transformed with technological advancements. Satellite remote sensing enables rapid measurement of crop-water productivity over large areas. The outputs may be measured in terms of crop yield (kg), economic value (\$), labor days, and so on, per unit of water. Such information can lead to further analysis of system attributes. For example, visual representation of the variation in crop-water productivity can help identify champion farmers, who may provide insights into why their production is higher with the same volume of water applied. Such farmers may be the true catalysts of irrigation performance improvements. The other powerful use of remote sensing for water-productivity measurements is in presenting stark facts to relevant agencies, using a consistent approach across all irrigation systems. It can facilitate planning improvements in operation and maintenance, provide a better understanding of system limitations, show the extent of

BOX 2.4. A River Basin Perspective on Irrigation Efficiency

Modernization to increase irrigation efficiency and improve water control and scheme-management are important to enable more effective and precise use of a limited abstracted resource. Reduced scheme demand will also reduce energy costs when water is pumped. In most cases however, improvement at scheme level does not result in more water being available in the basin for other sectors (Batchelor and Schnetzer 2018; Lankford 2012; Perry 2007). There are two main reasons for this. First is that the “losses” incurred from inefficient irrigation systems are mostly recoverable downstream of the scheme through tailwater flows and groundwater recharge and were thus available for other users anyway. The second is that improvements at scheme level tend to prompt farmers to intensify and expand their irrigation activity, thus taking up the “saved” water locally (Perry and Steduto 2017). The basin view of irrigation efficiency, underpinned by an approach of water accounting at a wider scale than the scheme, provides a more realistic perspective of the agricultural fraction of water use in a basin, and has been officially adopted by the International Commission on Irrigation and Drainage (ICID).

Instead of a sole focus on irrigation technology to reduce agricultural water abstractions, albeit important, attention also needs to be placed on agronomic strategies at farm-level that increase water-use productivity. These include effective weed control, early crop establishment for ground cover, improved cultivar selection, contour planting, mulching, conservation agriculture and improved crop husbandry generally. To achieve “savings” in the wider boundary of the basin, the reality is that irrigation technology changes alone will have a limited impact. Changes in crop type, agronomic strategies, and/or a net reduction in the cropped area is required (Perry 2007, Batchelor and Schnetzer 2018).

DON'T FORGET ABOUT DRAINAGE

In many large-scale irrigation systems, particularly on very flat lowlands with “agriculturally-managed water” infrastructure (see Ch. 1), drainage investments can be key to improving yields. Issues of operability and related management must focus on both aspects of irrigation and drainage to optimize benefits for farmers.

areas of groundwater use, and be used to identify the most enterprising farmers.

Productivity gains also impact affordability of the cost of services, as well as the invoicing process and timing in relation to cash-flow realities on the farm. To the extent possible, the invoice should be sent to the farmer after the harvest, when cash becomes available. Invoices should also be clearly related to the services received.

Operability: Is It in Functioning Condition?

The performance area considers the functional status of the system and its capability in delivering the required level of service (LoS) to farmers. This is a core aspect to consider in performance assessment and is often missed when relying on predetermined solutions to perceived problems. Ultimately, the aim of a performance assessment is to ensure that the LoS is responsive to the needs of the users—thereby supporting increased productivity and higher financial returns. The assessment of operability will

establish whether the desired level of service can be provided by the technical and management systems as they exist or whether they require modifications and improvements. These improvements could require specialist resources, the redesign and reconstruction of elements of the system, additional water control equipment, and measuring equipment, among other things. The question of operability must be considered from both the users’ and the service providers’ perspectives.

2.5 Performance Descriptions: (2) Organizational Resources

The set of performance areas under the organizational resources heading mainly applies to the service provider on the scheme, which could be in the public or private sector and which is responsible for providing I&D services to customers and users. However, organizational resource assessments also apply to WUOs at all levels. It encompasses themes of client orientation, business administration and internal processes and management procedures, asset management, monitoring, and benchmarking for I&D. In essence, this group of performance areas relates to the “business” of delivering services. The performance areas presented cover a broad range of issues, and not all elements will be applicable to each situation at the same level of importance.

The aim is to use the areas described below to deconstruct problems and thereby find best-fit solutions in the context of organizational challenges. Organizational

performance areas need to be assessed using a problem-based approach (Chapter 4) in conjunction with the I&D service-delivery performance areas. The challenges that directly affect service-delivery performance would be the highest priority, while those with more peripheral influence would be afforded lower priority. The latter may well have to be accepted, given practical limitations (finance, time, water-law constraints, and so on) of what can realistically be done in response to the problems, ensuring a focus on the highest-priority challenges.

Financial Sustainability

Financial sustainability is a core issue in I&D service provision. It remains one of the weakest links in terms of sustained operational success and in addressing the historical build-neglect-rebuild cycle. Assessing financial sustainability requires consideration of a range of parameters, including the financial status of the agency; budget analysis for capital and operational expenditures (capex and opex, respectively); revenues generated from service fee collection; and other subsidies and projections on future financial demands and requirements of the I&D system. Issues of future water demand in relation to possible efficiency gains (in water- and energy-efficient crops)—and of infrastructure and equipment upgrading, fee reviews, improvements in measurement and fee collection mechanisms, and collection rates—all require consideration. Maintenance requirements in relation to routine, periodic, and emergency maintenance need to be clearly understood for each irrigation system and related budgets established.

Although yardsticks for setting irrigation service fees (ISFs) can be useful to provide a general indication, they can easily be misleading because schemes are diverse in their age, size, condition, technical complexity, organizational structure, locality, and wider operational context. The ISF required to achieve sustainability in one situation will be different from another. An emphasis on the specifics of the expected costs, based on operational assessments, is therefore essential, as is attention to expense control, cash flow management, and accurate cost forecasting.

Examples of indicative ISFs are listed here and may be useful to provide a general indication, but it is not advisable that they be set on this basis:

- Bangladesh: Small-scale systems, O&M costs based on 3 percent earthwork costs, 1.5 percent structures costs, plus 0.5 percent total development costs.
- India: O&M budgets based on Finance Commission recommendations. The 15th Finance Commission suggests INR 1,500 per hectare for utilized and INR 750 per hectare for major and medium irrigation projects (Malik 2014).

ASSESS MOM FINANCIAL NEEDS BEFORE SETTING FEES

A common mistake is to focus mainly on fee recovery. The first priority should be a detailed assessment on the financing needed, then on how to spend the money well, followed by financing and fee-recovery strategies and targets.

BOX 2.5. Main Types of Water Charges

There are various ways that irrigation water can be established and charged, and selection of the appropriate method depends on the particular conditions on the scheme. Irrigation service fees can be based on any of the following (Molle and Berkoff 2007):

- **Uniform user charge:** It is assumed that users have similar access to water and are charged equally. This method is applicable for situations in which differences either cannot be assessed, or are too costly to, even when the actual level of use varies.
- **Area-based charge:** This is a widely used and simple system based either on the area owned by the irrigator or the area actually cropped in the given season.
- **Crop-based charge:** The irrigation service fee is based on two parameters: both the area and the type of crop that is irrigated. This allows for crops to be prioritized and incentivized according to their irrigation water demand.
- **Volumetric charge:** The fee is linked to actual volumes provided to a farmer or to groups of farmers (such as a group on a tertiary canal with a measurement device). Metering allows for direct volume measurement, but volumes can also be measured by the duration that water is provided to a point in the system.
- **Volumetric block tariffs:** This system is a refinement of the volumetric charge arrangement, in which a tiered fee structure can be established to discourage excessive water consumption.
- **Mixed tariffs:** The irrigation service fees combine a flat rate, usually on an area basis, with a volumetric tariff established as with volumetric block tariffs. The arrangement provides a stable minimum income for the operator or agency when consumption is highly variable.
- **Quotas at fixed charges:** A quota system is where a fixed volume of water, measured volumetrically or by time, is provided to the user for a fixed fee. The quota can be varied for different crops.
- **Market-based price:** In this arrangement, the price of water is determined by the market, facilitated by provisions for water trading. Trading can be regulated, where the regulator sets a price, or sets price limits, or the regulator can serve as a broker between farmers selling and those buying.

- **Pakistan:** The Punjab Irrigation Department uses arbitrary yardsticks. For small canals, this is \$677 per kilometer and \$253 per kilometer for main and distributary canals (ADB 2017).
- **Vietnam:** Budget allocations for O&M are based on the command area served and cropping pattern. An arbitrary 30 percent of production value (per hectare, according to crop type and number of croppings) is requested for annual O&M, and the remainder is for staff salaries. About 50 percent of revenue generated from bulk sales of water for domestic and industrial users is also allocated for O&M.¹

The activity of establishing fees, based on a holistic and long-term outlook, is routine in most highly developed countries but remains one of the most challenging areas to understand and untangle schemes in developing countries. Irrigation operations are rarely isolated from political influence and are complicated by issues of (state) asset ownership, land ownership, and scheme history. Many schemes were established with social objectives rather than financially sustainable, market-oriented ones, and there is path dependency in terms of institutions, farmer attitudes, and management practices.

Political imperatives can heavily distort financial sustainability assessments in the form of subsidies (often ad hoc or election-related) and because of strategic objectives regarding food security and rural stabilization. Political imperatives thus impact long-term capital replacement scenarios and fee-setting. The approach of establishing opex and capex requirements to achieve financial sustainability, which is the norm in highly developed countries, is not always easily applied in practice in developing countries, yet it remains of high importance. The need for sustainability calls for a situation-specific approach based on the experience at each scheme and for detailed technical and financial projections to ensure financial sustainability into the future. Financial sustainability is more important than full cost recovery from water users. Eventually, though, there are only three financing sources: tariffs (ISF), taxes (local or national), or (external) transfers.

Asset Management

Asset management is defined as: *“A plan for creation or acquisition, maintenance, operation, replacement, modernization and disposal of irrigation and drainage assets to provide agreed level of service in the most cost effective and sustainable manner”* (van Hofwegen and Malano 1997).

This is a standard approach adopted by other service providers (for example, highways and road agencies typically maintain asset inventories), but for I&D, sound asset management practices have remained elusive. Whether this is a result of I&D being considered a social good historically, asset inventories and condition assessments remain uncommon in I&D in the developing world. Yet it is vital as a basis for benchmarking performance and for understanding and segmenting I&D infrastructure MOM costs (depending on exposure, durability, risk, and so on). This kind of assessment is fundamental for the development of ISF levels discussed in the previous performance area (that is, financial sustainability) and for providing a business-oriented service. It is highly pertinent from the context of the customer and service provider. Asset management also refers to institutionalized processes for activity planning, procurement, acquisition and maintenance schedules that constitute the sometimes mundane but critical every-day tasks of a large part of a

DECENTRALIZATION CAN LEAD TO OPERATIONAL AGILITY

In Bangladesh, a Participatory Small-Scale Water Resources Sector Project has a highly decentralized I&D service provider. Operational strength is at the sub-district level, while the higher-level agency HQ organizational setup is "slim," only engaging in strategic decisions (ADB 2009).

well-functioning irrigation agency, and its success reflects on state and longevity of the infrastructure. Detailed and practical guidelines on asset management in irrigation are readily available, including Burton (2010).

Technical Operations Management

Understanding the organizational structure of the service provider gives insight into how it is configured to deliver I&D services. The staff contingent is important—this includes an assessment of staff numbers, their skill mix (to improve staffing diversification and avoid a technocentric approach), their gender composition, and the organizational hierarchy. Attention should be given to the extent of organizational formalization and centralization, particularly the degree of decentralization and horizontal management, which should shed light on organizational agility (that is, the ability of the agency to adapt to change). A highly stratified and hierarchical agency with a concentration of authority can seriously limit the speed of decision making and exclude potentially useful solutions to operational management problems.

Organizational Management (Including Human Resources)

The performance area considers the organizational structure, the extent of teamwork and coherence across management and staff, and the processes that are followed in meeting organizational goals and service-delivery expectations. Organizational coherence in an I&D agency could be considered in terms of its core values. An important question is: Does it have a suitable organizational culture, based on the beliefs of individuals employed within the agency, and is there consistency across all ranks?

Organizational performance is influenced by culture, values, and behaviors and by its internal coherence in terms of its mission. Credibility is based on perceptions of an agency's accountability, transparency, fairness, and just actions. Inconsistencies, such as individuals whose values and behaviors do not match those of the organization, open avenues for unfair and/or corrupt practices. Biased treatment that favors influential farmers, the rent-seeking behavior of agency officials, and allowing illegal abstractions are all indications of organizational incoherence because they conflict with the mission of the I&D agency to provide fair and transparent services.

At the service-delivery level, these kinds of conflicting practices could result in users' expectations not being met, particularly when there is an absence of clear service agreements. Inconsistency across the organization could prompt or

entrench corruption, add to staff dissatisfaction, and lead to a spiral of dissent that impacts performance. This leaves a negative perception with water users, who will lose trust in an agency that may have conviction in its mission but does not deliver what it promises.

Professional service providers in the commercial world routinely have clear human resources (HR) policies on recruitment and type of staffing. These are accompanied by detailed job descriptions and usually performance criteria. There will be HR capacity-development plans, clarity on any policies for inclusiveness, details on staffing levels and competencies, and monitoring of positions filled against the total number of positions required. In an irrigation service-delivery context, there would ideally be a similar appreciation of the importance, and establishment, of these aspects in the relevant organizations.

Performance reviews of staff, and reward cultures, are also worth considering to motivate staff. In the case of Madhya Pradesh in India, a staff reward system was established and achieved positive results. Irrigation staff with well-performing schemes are rewarded with cash payments and certificates recognizing their contribution. Schemes in which targets have not been met are discussed and causes are identified, and action is taken to remedy the identified causes (Julaniya et al. 2016). This is considered a good example of a state in which staff motivation has contributed to improvements in service delivery.

Fiduciary Management

This performance area considers the service provider's internal procurement and financial management processes. This includes the transparency and efficiency of procurement processes, with attention given to electronic procurement; dedicated websites to post all procurement processes; tender status monitoring; records of contract awards and values; the reliability and adequacy of fund flows from source to user (for example, from the finance ministry to the irrigation agency); ensuring funds are used for intended purposes; information sharing with public and private agencies and customers on fund utilization and the performance of investments; and transparent and digitized accounting systems, ideally double accounting and using suitable software. This links back to the requirement of asset management plans to inform I&D maintenance budgets, ISF rate setting, and other revenue sources. This will enable better linkages between asset management, sector budgeting, and planning.

Strategy and Processes

The performance area is focused on the strategies and the systematic and regularized processes that increase the operational rigor and thus the likelihood of achieving operational goals. Key to this are due-diligence procedures, such as the

international quality-assurance system, ISO 9001. The performance area considers whether the fundamental requirements of operational decision making are in place, including established and officially documented sequential steps and processes, properly regulated by management. These would apply to routine design, O&M activities, and performance benchmarking. Attention needs to be given to the development of a process document for important associated activities, which carry risks, or when standards of quality are required. These should follow a recorded sequence of actions, including a documented action or design plan; a recorded review activity on the technical and/or contractual aspects; a recorded decision meeting; and a decision-review activity—all to ensure quality, risk, and process control. Such systems are routine in commercial business operations. Having performance standards provides clarity on what is to be delivered, by whom, and what standards are to be met. This is particularly relevant in the context of MOM, benchmarking performance, and ISF collection.

For example, the National Irrigation Agency (NIA) in Philippines is ISO 9001-certified. It has an established quality policy, objectives, and scope, including specifics on the services and standards to be delivered. Its Quality Management System Manual details service processes relating to:

- **management**—for example, meeting customer expectations, planning agency operations, performance assessment and monitoring, leadership, and good governance;
- **core**—for example, project-related, such as preparation, construction, and O&M; and
- **support**—for example, resource management (human, financial), external relations, legal services, audits, and so on.

There is a need for irrigation agencies to move toward a more professionalized role by enhancing and formalizing their core strategies and processes. These are linked to broader governance-related elements and add credibility to the agency in its role as service provider.

2.6 Performance Descriptions: (3) Governance

The third functional category or theme covers core elements of what constitutes good governance within the context of an organization that is delivering services. The aim is to better understand the structure, processes, and relationship between the service provider and water users in the context of policy, as well as the prevailing legal frameworks. More specifically, the following must be considered:

- Service provider's responsibility toward stakeholders, transparency of operations and actions, and participatory processes for decision-making procedures

- Procedures, goals, and associated legal instruments for I&D service delivery and, as applicable, I&D in the context of resource management
- Service provider’s core values and organizational responsibilities
- Institutional architecture and associated processes for delivering services
- Interstakeholder relationships and communication
- Transparency, accountability, and inclusiveness

The performance area primarily considers: (a) the perspective of the agency and its interface with the user and vice versa and (b) the opportunities for water users to be engaged in processes to improve performance of the service provider.

Transparency and Customer Orientation

A theme throughout the resource book is that I&D service provision needs to shift to a business-oriented approach in order to increase levels of service delivery. In this shift, attention to an organizational culture that embeds trust, ensures ease of communication (within and with outside parties), and has effective information exchange will improve staff morale and motivation. A business-oriented perspective also requires alignment with a consumer orientation—one of putting the customer first. This kind of organizational culture involves building networks rather than working in isolation (silos), a culture prevalent in many government departments and transferred to operational agencies. This all too often results in delays, miscommunication, and inefficiencies. Assessing a service provider’s transparency and customer orientation provides insights into its base culture and working styles. This is beneficial when assessing problems within vertically organized and heavily centralized agencies and allows solutions to be informed by knowledge of the broader context and the many implicit constraints that need to be addressed.

Lack of transparency usually leads to conflict, whether between employees of an agency; between the agency and service providers; between the customers (water users); and between various agencies associated with agriculture, irrigation, domestic water supply, and water resources management. If left unresolved, conflict inevitably leads to organizational and personal animosities, with the consequence of weakened service provision and additional costs. A conflict management or grievance redress system is a key element of strong organizations. It includes raising awareness, accessible and appropriate communication mechanisms, and monitoring incidences and their corresponding responses. Conflict management systems, when established and operated effectively, minimize the potentially serious negative effects of tensions and disputes. The performance area considers the extent to which the service provider has established suitable conflict management

systems within the various levels of the organization to quickly address and limit negative impacts on service delivery and agency performance.

Enabling Policies and Legal Instruments in Place

Policies, laws, and regulations are different tools with different uses, different criteria for adequacy, and different contributions to performance. Yet attention must be given to each because they are all potentially critical arenas for action. Policies define the course or principles of action and establish the basis for key issues such as roles, responsibilities, and functions of various actors engaged in service provision and their relationship with end users. Laws provide the legally enforceable basis for the establishment of organizations involved in I&D MOM and the basis for their interaction. Consistent policy and legal and regulatory frameworks create an enabling environment for sustainable resource management, service orientation, and accountability for service provision. In many cases, I&D is characterized by legal pluralism, with multiple agencies engaged in water, often leading to legal contradictions, gaps, and overlaps. Assessing these aspects can lead to a better understanding of the core challenges to improving service-delivery performance. Further guidance on legal strategy and acting in regard to legal and regulatory improvements are provided in Chapter 4.

Institutional/Organizational Coherence

I&D agencies require a degree of autonomy to carry out their MOM mandate. Irrigation schemes impact large numbers of people and involve critical limited resources, particularly land and water. They are, therefore, subject to major political influences and political agendas that are not necessarily in the interests of the schemes and irrigation farmers. Political influence can have a particularly significant impact on the financial autonomy of I&D agencies in two ways. First, political objectives can lead to promises of direct or indirect subsidies that undermine the ability of agencies to generate the revenue needed for sustained operations. Secondly, if agencies lack control over their finances, revenues that are successfully collected can easily be diverted by higher levels of government, either to the central fiscus, or they can be intercepted at scheme level and used for purposes not associated with the core MOM mandate.

Explicit agreements are needed between the agency and external actors, including government, WUOs, and service providers. This will bring clarity to the different roles of involved entities, coordination arrangements, fee structures, and financial management processes. Agreements need to clarify functions and tasks of all the organizational actors involved in water service provision. A high level of credibility and coherence increases leverage and access to scarce public sector resources. An I&D agency that is credible and reputable can make a strong case for

why it should receive increased funding, compared with a less reputable agency. Likewise, a good reputation is premised on a strong connection with end users, who are more likely to engage positively in relation to operational compliance and payment of irrigation service fees when they trust an agency.

Accountability

Accountability refers to the obligation of individuals or the I&D service provider organization to take responsibility for delivering the agreed-on I&D services. Accountability is also required to disclose results transparently to all. Merrey (1997) summarized a decade of International Water Management Institute (IWMI) irrigation management research experiences in the late 1990s and highlighted how difficult it is for large public service agencies to achieve accountability with many different stakeholders. This was explained by the fact that agencies are usually structured hierarchically, with officials' primary accountability upward to their supervisors and to the political level and little accountability to water users. On the other hand, if farmers are shareholders, they may have management that is more directly accountable. In both systems, however, accountability may be compromised through the agency structure, favoritism, a lack of clarity of rules, or asymmetry in the level of understanding of the scheme performance and requirements. In other words, there are issues not only with transparency but also with empowerment of those being held accountable and those who need to be accounted to.

The performance area considers a broad set of parameters pertaining to the accountability of the service provider to water users; the enforcement of agreements and licenses; operational accountability; and the communication of results and information. This is a powerful yet challenging aspect to be considered when deconstructing problems, given that it can often expose corruption.

Inclusive Representation

This performance area considers the extent to which the voices of all are represented in I&D service delivery and its associated benefits. The aim is to consider the service provider, water users, and others who may have direct or indirect benefits from the service. Representation is an important but often overlooked element of governance that can have implications on performance and reaching the needs of all.

An important aspect of inclusiveness relates to the pricing of irrigation services, when involvement in the process both encourages a wider understanding of the issues and establishes a strong platform for the payment of irrigation service fees.

The specific interest is representation and inclusion of all stakeholders, including women, as well as marginalized groups which may otherwise be socially excluded. This includes indigenous peoples, scheduled tribes and castes, absolute poor, and youth, amongst others. In many cases, the interface is through the male head of

households and through formal land ownership only, thereby missing the important perspectives of a substantial set of farmers. The performance area also considers the extent to which these marginalized groups are represented within the service provider (at all levels), and in Water User Groups. The performance area is intended to prompt thinking on how to improve inclusiveness to strengthen the technical and financial performance of scheme irrigation operations.

2.7 Types of Performance Assessment



The performance indicators described in detail in this chapter can be used for different kinds of performance assessments, as outlined in Table 2.3.



Systematic and timely data collection lies at the core of performance assessment in practice. Ideally, such data provide sufficient information to enable managers, decision makers, users, and others to answer these two questions (Murray-Rust and Snellen 1993):

- **Am I doing things right?** This question asks whether the implicit or explicit level of service or operation is being achieved and is the basis for operational performance. The question is of main importance to the daily and seasonal activities and to activities related to the service agreement of the scheme management entity.
- **Am I doing the right thing?** This question seeks to ascertain whether, and to what degree, the wider and longer-term objectives are being fulfilled. This question addresses the strategic performance and will be of interest to scheme managers

TABLE 2.3. Types of Performance Assessment

Operational	Relates to daily and seasonal monitoring and evaluation of a scheme
Accountability	Performance of those responsible for managing a scheme
Intervention	Study the performance of the scheme in preparation for a specific intervention
Sustainability	Longer-term resource use and impacts
Diagnostic	Identify the cause(s) of performance for improvements to be made or performance levels sustained

Source: Modified from Small and Svendsen 1990.



and government in revising long-term goals to meet the changing demands of water users, resource management, and so on.

Important for designing the assessment and ensuring its practicality (from a pragmatic time and capacity perspective) is to identify the performance areas of primary interest and their associated indicators. It is important to consider who will undertake the assessment, how results will be presented, and whether a more detailed diagnostic analysis is required.

2.8 Other Performance Assessment and Planning Tools

There are other useful methods and approaches that have been developed for irrigation performance diagnosis, MOM improvement, and redesign of irrigation schemes. Modeling of irrigation activities, or of the interaction between irrigators and other upstream or downstream users, can be informative and enable more critical discussion between water users on schemes. Two useful tools that can be integrated with the approaches described in the resource book are: the Mapping System and Services for Canal Operation Techniques (MASSCOTE) (Renault, Facon, and Wahaj 2007) and the complementary Mapping System and Services for Multiple Uses of Water Services (MUSMASS) (Renault, Wahaj, and Smits 2013). These were developed by the Food and Agriculture Organization of the United Nations (FAO) and address modernization and management of medium- and large-scale canal irrigation schemes. They describe methods for detailed performance auditing with technical and operational improvements in mind.

The perspectives-on-performance approach in this book provides a higher-level and overarching framework for viewing the governance challenges compared with these two tools. The approaches in the resource book are complementary to

MASSCOTE or MUSMASS, which have substantial value where scheme-specific operational diagnosis is needed. They are described in outline below.

MASSCOTE: FAO Irrigation and Drainage Paper No. 63

The MASSCOTE methodology (Renault, Facon, and Wahaj 2007), was developed to assist technical experts, irrigation managers, and irrigation professionals to audit, modernize, and re-engineer the irrigation management systems of medium to large irrigation canal schemes. It acknowledges that irrigation engineers are mostly trained in the traditional way that prepares them to design and construct canals but not to manage irrigation systems. The entry point of MASSCOTE is canal operation, but the goal is to promote modernized, service-oriented management. The approach consists of a systematic series of steps for diagnosing performance and mapping the way forward to improve the level of service and the cost-effectiveness of canal-operation techniques.

MUSMASS: FAO Irrigation and Drainage Paper No. 67

MUSMASS (Renault, Wahaj, and Smits 2013) is complementary to MASSCOTE and brings a multiple-use services (MUS) emphasis to the auditing and planning process when modernizing medium and large irrigation canal schemes. An important aspect of the MUSMASS approach is the reference to the anticipated benefits associated with each type of service for the different MUS users. Users include irrigation, domestic water, groundwater-recharge, fisheries, livestock, recreational, environmental, and hydropower. The paper presents the basic background for MUS and the progressive steps used in the MUSMASS methodology for the auditing of irrigation systems.

Note

1. Field discussions between authors and relevant government officials of the ministry of agriculture and rural development, Vietnam, March 2016.



CHAPTER 3.

Perspectives on Service Delivery



This chapter describes the multiple, sometimes conflicting and incompatible perspectives from different stakeholders on the meaning of good service delivery, and how to effectively work towards shared objectives.

3.1 Many Diverse Actors

The functions that need to be considered when discussing performance in service delivery were discussed in Chapter 2. This chapter now describes the actors to provide insight into who they are, the realities they face, and why they act like they do in relation to the irrigation and drainage service. The emphasis is on those directly engaged in irrigation and drainage, given the focus of the book.

The chapter concludes with a summary on stakeholder identification and multistakeholder platforms (MSPs). These are practical and strategic ways of ensuring inclusion and collaboration of shared and contested issues. The descriptions lead into Chapter 4, which addresses problem-definition techniques, iterative planning processes, and ways of facilitating collaborative action to achieve service-delivery performance. People are driven by diverse motivations, and their actions are incentivized differently as well. These terms are often confused but are clarified in Box 3.1.

MULTIPLE ACTORS WITH DIFFERENT PERSPECTIVES

- IRRIGATION**
- Farmers
 - WUOs
 - I&D agencies
 - Line ministries

- OTHER**
- Private sector
 - Domestic users
 - Water supply utilities
 - Hydropower users
 - Fisherpeople
 - Stock farmers

3.2 The Irrigation Farmer's Perspective

Smallholders Defined

Agricultural water users include corporate farming entities and individuals farming at various scales: small, medium, and large. Much of the engagement in developing countries will be with smallholders, many of them women. The term *smallholder farmer* is widely used but weakly defined. By name, smallholder recognizes the main characteristic of a relatively small farm size, though the concept is also influenced by the type and intensity of farming. There are more than 570 million farms worldwide. Of these, 84 percent are smaller than 2 hectares in size, but they cover only 12 percent of the world's farmland (Lowder, Skoet, and Raney 2016). In addition to size, smallholders are typified by partially developed links within the larger economic system and tend to rely on more localized input and output markets. This has price and quality disadvantages as a result of factors such as poorer roads and access to transport, limited financial capacity for bulk purchases, and lower technical sophistication, all of which are associated with weak economy of scale (Christen and Anderson



BOX 3.1. A Note on Motivations and Incentives

Motivation is what drives people to take action to achieve personal goals and what inspires them to move forward in life (Ryan and Deci. 2009). Understanding motivation helps in understanding why people behave like they do.

Incentives are related but different. These are the drivers that motivate someone to do something. These “things” include external factors, such as financial gain and social norms, and internal personal factors (Rueda et al. 1994). Human behavior is complex, and external incentives will not alone explain why people act and prioritize the way they do. Personal preferences, habits, and sociocultural factors also come into play.

Incentives, such as more reliable water supply, lower irrigation service fees, farming profitability, and so on, are important to motivate people to engage in improved irrigation and drainage governance. However, sustaining a scheme for future generations—or maintaining a way of life linked to values, cultural identity, or as a place for important rituals—can be equally important (after van der Ploeg 2008). Understanding motivations and creating incentives that prompt or accelerate motivation can strengthen institutional design responses to achieve improved service delivery.



2013; Deininger and Byerlee 2011; Sur et al. 2014). As a result, smallholders tend to operate with looser value chains and greater market uncertainties, leading to higher exposure to risks and increased vulnerability to livelihood shocks (Ellis 1998). There are, however, some comparative advantages to small-scale farming linked to a family labor advantage and proximity to field crops. These facilitate lower production costs and better plant husbandry as observed in widely different contexts such as South Africa and Cambodia (van Rooyen and Nene 1996; World Bank 2015).

SMALLHOLDER PRIORITIES

Risk: Lowering risk is important to most smallholder farmers who are vulnerable. Keep risk in focus.

Water: Water is just one of multiple daily farming challenges faced by smallholder irrigators. Water management is a means to an end, not an achievement in itself.

Transaction costs: Time is money, and they have a lot to do. The transaction costs of collective water management are high for farmers. Keep processes and solutions as simple as possible.

Diversity of Livelihoods

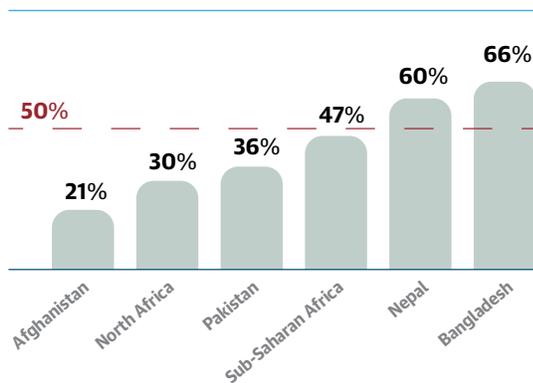
For many smallholders, farming is just one livelihood strategy. Others can include farm labor services, employed jobs (for example, teachers, mechanics, shop owners, local administrators, and so on), and remittances from family members with urban employment. Urban migration, involving mostly men, also has the effect of changing the household gender dynamics and contributing to the feminization of farming (FAO 2017b). Motivation for farming is also different for many smallholder farmers, as reflected by the portion of produce sold increasingly from business-farming for profit and decreasingly from farming for home consumption. These all highlight the diversity within the group of farming actors, which impacts their irrigation service needs and their ability and motivation to be involved in governance and to make irrigation fee payments.

Increased Involvement of Women in Farming

High numbers of women in farming: Aggregate data show that women comprise about 50 percent of the agricultural labor force in developing countries (FAO 2017b). Although there are regional variations, the growth trend is one of increasing involvement of women. Women comprise approximately 21 percent of the agricultural workforce in Afghanistan, 30 percent in North Africa, 36 percent in Pakistan, 47 percent in Sub-Saharan Africa (SSA), 60 percent in Nepal, and 66 percent in Bangladesh. In East and Southeast Asia, more than 46 percent of farmers are women. The most significant growth in women’s involvement in farming has taken place in North Africa, with their involvement doubling in the period from 1990 to 2015 (FAO 2017b).

Less access to resources: Worldwide, females face unequal opportunities, especially if deep cultural traditions influence their roles and mobility in society. This

WOMEN IN THE AGRICULTURAL WORKFORCE IN SELECTED REGIONS AND COUNTRIES



inequality affects food and nutrition security; if female farmers were better supported to reach their full potential, they could produce 20 to 30 percent more food (FAO 2011). However, this requires access to land, knowledge, and markets (ADB 2015), which is not easy for women in places where men traditionally control resources or are legally entitled to inherit land.

Dependency-inducing customs: Certain customs increase the dependency on men and limit them from owning land. This impacts their representation and role in irrigated agriculture as key decision makers or influencers. As more men migrate from rural areas to cities to look for better jobs, women will increasingly be the ones to grow tomorrow's food. Their role as customers of irrigation services in finding appropriate solutions to improving irrigation management and inclusion is increasingly important.

Challenges That Women Irrigators Face in Water Management Decision Making

The practical measures for the inclusion of women in water user organizations (WUOs) must address a number of key issues:

- Women are often hesitant to express their viewpoints when their husbands or men in general are present because of cultural or family norms in which men are representatives. It is often only when women are widows, or their husbands hold migrant employment, that equal participation is accepted.
- Women may struggle to exert authority when holding elected positions because this can contrast with their social position outside of organizational processes.
- Meetings are typically scheduled to suit men's preferences and often conflict with the multiple roles women must perform (for example, productive farmwork, child-rearing, managing the household, and providing food for the family).
- Unless women are involved in all organizational engagements, they often have limited or incorrect information about activities and the rules, such as those governing water management, which discourages their active participation.
- There is often little appreciation of women's contributions, which undermines their value as key contributors and relegates them to supporting roles.
- Deeply seated norms about traditional roles often conflict with organizational processes and roles and can be difficult to overcome—not least the rights to voice opinions, hold leadership positions, or act as enforcers in a manner equivalent to men.

THINK ABOUT

Including women farmers in problem identification, consultation, and solution-building in varied cultural contexts; and



Crafting water-management institutions that enable active and meaningful participation of women.



Measures That Can Support the Empowerment of Women in Water Management

A more enabling institutional and social environment can be created to help women assume more control over water management functions.

- Conduct gender-specific training needs assessments to provide interventions targeted at women.
- Undertake irrigation planning and design on a consultative basis, specifically including women in all discussions.
- Provide technical training on irrigation management (infield and irrigation system).
- Provide targeted training for women in on-farm water management, agriculture improvements, value chain enhancement, and so on.
- Hold targeted workshops for male leaders and wider farmer groups to raise awareness of the value females can add to their WUO functioning, as well as the importance of gender focus and gender equity universally.
- Include women in WUO general bodies and ensure specific places for women are reserved in executive committees to encourage their engagement in decision making.
- Employ women as unskilled and semiskilled laborers in earth work, construction, and maintenance work.
- Conduct study tours to locations where women do play leadership roles and are empowered to manage activities and support women to take up WUO roles.
- Incorporate gender-disaggregated data and reporting in project monitoring systems.

Motivations from the Farmers' Perspective

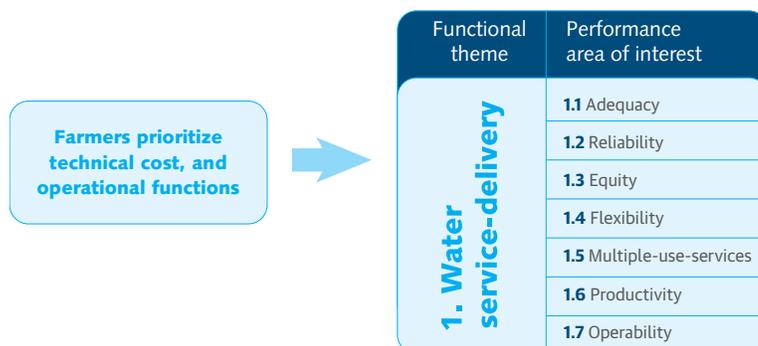
Irrigation farmers are motivated by the need for a secure water supply, but that alone does not explain choices and actions. Secondary motivations include the need for building and maintaining social relationships, asserting land rights by being active on the land, ensuring continued operational status of the irrigation system, and maintaining their way of life. A key need to be met is to provide an adequate and reliable supply that is equitably distributed and that can be accessed with flexibility. This is shown in Figure 3.1.

There are a few dynamics on irrigation schemes that incentivize or disincentivize farmers' motivations to participate in management, operations, and maintenance (MOM); conform to rules; and pay fees.

Free riders, suckers, and the commons dilemma: If farmers share a limited resource, a cycle of decreasing adherence to rules can be triggered by *free riders* who gain at the expense of *suckers*. This leads to Hardin's well-known *tragedy of the commons* (1968). When individual users act independently, their behavior ends up being contrary to the common good of all. Regardless of whether they are driven by self-interested priorities or a reality of relative chaos and uncoordinated collective action that undermines more constructive motivations, the result is a depletion of the resource and the degradation of social order and the infrastructure supporting them. In the case of water users:

- **Free riders** ignore the rules and use more water than they are allocated, either by extending the irrigation duration, using water on days they are not supposed to, or changing the flow pattern by breaking earth canals or gates. Free riders are most often located at the top end of canal systems, where their physical location gives them access to water first.
- **Suckers** are those who initially follow the rules but, because of the actions of free riders, end up with less water than they are allocated. One free rider triggers the next sucker to become a free rider and so on.

FIGURE 3.1. Main Priority of Water Service Delivery for Farmers



A SHIFT FROM BEING "RULED" TO BEING A CUSTOMER

One opportunity is to institutionalize a conscious shift in emphasis from the farmer as "subject" in a hierarchical system to the farmer as a "customer," and sometimes co-owner, in a service-oriented system.

Such a shift can radically change perspectives, motivations, and ways of engagement. The discussion on service is not just about getting water in the right amount and at the right time but also who gets to determine what is right and how processes happen.

The cascading effect presents a real difficulty in addressing the commons dilemma (Ostrom 1990). Tang (1992) highlights that free riders are enabled by the belief that their actions as a single irrigator in a much larger system will not have a major impact on other farmers. Relative to the overall water use, the amount used in their individual free riding is viewed as quantitatively *insignificant*. This motivation for free riding can similarly be applied to the nonpayment of irrigation service fees.

A combination of factors on poorly performing schemes can quickly lead to a kind of operational chaos not attributable to any specific individual. System design and operation with unsteady flows, shortages, and excesses act to undermine collaboration. These system inadequacies are always experienced most severely at the downstream end of canal systems and, in some cases, cannot be avoided even when free riding is absent. The links between upstream and downstream farmers are often physically and sociologically distant without adequate accountability mechanisms in place, which only adds to the phenomena of free riding because there is no incentive to contribute (time or money) when supplies are irregular and uncertain. System infrastructure that is functionally inadequate, either through the original design or degraded condition, also contributes to the chaos, and technical functionality has to be secured.

A Sociotechnical Angle on Enforcement and Compliance

Institutional solutions are essential to constrain farmers' inevitable motivation to get access to more water and pay less for it. Technical design interventions also play a role in facilitating social and individual behavior and are important in

BOX 3.2. Engineered Control Structures and Compliance Behavior

The nature of shared irrigation infrastructure on smallholder plots on canal schemes where a tertiary canal, usually earthen, serves many farmers (on approximately 30 to 100 hectares) makes it difficult to physically enforce compliance because the water flows past their field in the canal to supply tail-enders. In piped systems, however, it is practical to provide one hydrant in each of the smallholder's fields. Physical enforcement is thus possible by locking hydrant valves.

On canal schemes when farm sizes are large (for example, 20 to 100 hectares) however, one or more canal outlet gates is typically constructed to serve a single farmer. In these cases, physical enforcement can be achieved in the distributary canal system, thereby limiting free riding using technology, rather than social monitoring mechanisms that are essential on smallholder canal schemes with smaller plots.

crafting institutional solutions. One example of this sociotechnical interplay is explained in Box 3.2.

Implications for Institutional Design—Farmer’s Perspective

Failure of institutional processes, with noncompliance by free riders, can prompt a downward spiral of noncompliance that leads to the unraveling of scheme sustainability, both technically and financially. The commons dilemma highlights how fundamental it is for rule setting and institutional development to start with an inclusive process that defines the farmers’ expectations and perspectives and makes explicit their associated responsibilities in the process. Enforcement is not the panacea for all problems.

Another important opportunity relating to scheme design is having continuous rather than rotational systems (Bos, Burton, and Molden 2005). Continuous flow delivery systems are associated with lower efficiencies because tailwater losses tend to be higher when flows do not match actual consumption. They do, however, have the advantage of physically ensuring a more equitable water apportionment in the supply system with engineered proportional division structures. Rotational systems, on the other hand, require operator control on a time basis, and operators are more easily subject to manipulation or rent-seeking behavior by upstream farmers. This points to the need to undertake technical and institutional redesign in parallel with each other (see Box 3.3).

3.3 The Water User Organization’s Perspective

Water User Organizations (WUOs) provide services to irrigators and other water users (for example, stock farmers and fisher people and for domestic supply). They are commonly established using formal laws, acts, and regulations, but some operate on informal local arrangements while still others use customary law.

BOX 3.3. Undertake Technical and Institutional Redesign at the Same Time

A sociotechnical view on institutional design highlights that institutional responses are directly impacted by the behavioral implications of different technological elements in the system. This points to the opportunity for codesigning technical and institutional changes to maximize synergies for easier, less costly, and better service delivery and to achieve improved water user compliance. Literature on irrigation modernization surprisingly stresses the fundamental importance of addressing both in parallel to optimize performance outcomes.



WUOS: MANY TYPES AND MANY SIZES

WUOs can be tiny, literally composed of three or four farmers collaborating around a shared canal, or they can be major organizations. In Spain, France, Mexico, the United States, South Africa, and Australia, for example, WUOs are responsible for MOM of large scale schemes (more than 10,000 ha in size) and serve agriculture, urban, and other types of users.

There are many kinds of WUOs, most commonly irrigation organizations (IOs), water user associations (WUAs), and irrigation water committees. Hodgson (2003) argues that nonspecific WUOs can be inadequate for the unique task of collective irrigation water provision and full empowerment of irrigators and their water-service organizations. Inadequacy is as a result of, among other factors: (a) the unusual nature of the supplier-user relationship (wholly interdependent on each other); (b) the individual use of public assets that demands legal clarity; (c) the reality that full cost-recovery for MOM is often not viable; and (d) the potentially conflicting legal linkages between land and scheme hydraulic boundaries demanding compulsory membership. Notwithstanding legal variations, sustainable and effective WUOs share the following characteristics:

- They provide a **specific water-management service** in terms of irrigation and drainage and, in some cases, water to other users, such as villages and towns, fish-farmers, and so on.
- They **operate within a defined land area** with a boundary linked to the hydraulic command area of the system that all users agree on (that is, the *service area*).
- They are **nonprofit entities** in which any surplus of income after expenditure is retained within the WUO and not transferred to beneficiaries or shareholders.
- They are **self-governing with decisions being democratically made** by the WUO participants, who benefit from and pay for the services that the WUO provides.

In developing and transition countries, WUOs fall into two main groups: indigenous organizations on community-managed irrigation systems and formal legal entities. The latter are often established through irrigation management transfer (IMT) processes. *These two types of WUOs are outlined in Box 3.4 and Box 3.5.* Successful WUO experiences are well-documented in both formal legal and traditional institutional arrangements, but simple replication of one success to other contexts have yielded mixed and often disappointing results (Meinzen-Dick 2007). In some parts of the world shifts are being made away from WUOs as they are perceived to be incapable given failures, despite the successes. A summary of WUO development experiences in a global overview is included in online Appendix 1 (World Bank 2020a) and highlights important lessons from around the world.

WUO Functions and Motivations

Because a WUO provides a specific service in a defined area, it is relatively easy to determine its effectiveness by asking: Is the service provided correctly in terms of the

BOX 3.4. Indigenous Irrigation

Meinzen-Dick (2007), in an overview of water user organization (WUO) history and the various institutional “panacea” that were popularized over time, highlights the many cases of successful indigenous irrigation-management organizations that rose to international prominence in the 1970s. These were mostly documented in Nepal, Philippines, Indonesia, Sri Lanka, and India. Scheme size was relatively small—up to a few hundred hectares—but also included large schemes such as Chhatis Mauja in Nepal, covering 3,000 hectares. Farmers collaborated without any external involvement in scheme construction in difficult mountainous terrain and in management, operation, and maintenance (MOM). Sustainable, rules-based water-service delivery over long timelines was achieved.

In the Philippines, complex multilayered organizations evolved where scheme-level *zanjeras* (local WUOs named after the Spanish derivative of *zanjera*, meaning ditch or canal) demonstrated indigenous competency at higher levels. Multiple *zanjeras* coordinated into federation structures for the management of shared water sources for irrigation (Tang 1992). These marked achievements showed then, and now, what can be achieved using indigenous institutional arrangements.

These “endogenous” successes have mostly (if not all) occurred in cultures with centuries of irrigated farming experience. **The farmers thus have long-evolved technical experience with irrigation, locally developed irrigation technologies, related rules, and social mechanisms for water management. Such WUO achievements, though notable, are not always easily replicated because social norms, knowledge, and historical livelihood strategies are different elsewhere, explaining to some extent the varied outcomes when simplistic replication was attempted.**

agreed-on performance criteria? The main motivation for a WUO is to meet the needs of its members and maintain its legitimacy. The farmers are the people who, through their representation, should control the WUO’s actions. It is essential that service-delivery performance criteria are defined, explicit, and widely understood.

Three governance incentives—transparency, participation, and accountability—need to be formally established in the WUO constitution. Even when informal arrangements are relied on, these must still be explicit and understood by all. WUO participants are responsible for paying for some or all of the service and need to be included in defining the level of service and in setting the contributions (cash, labor, or in-kind) accordingly. The WUO thus has motivations related to all three



BOX 3.5. Formalized WUOs and IMT

More than 70 countries have undertaken irrigation management transfer (IMT) programs providing for the establishment of water user organizations (WUOs) and the transfer of public irrigation schemes or parts thereof (Suhardiman and Giordano 2014). The IMT process and formalization of WUOs was prompted in part by the successes that were observed in indigenous, community-managed systems, the fiscal crisis of the 1990s, a lack of public funding for ongoing subsidies of large schemes, and widespread scheme underperformance (Meinzen-Dick 2007).

The idea was that by devolving responsibility to WUOs for management, operation, and maintenance (MOM) of lower levels of large schemes and the successes of community-managed arrangements could be repeated. This was expected to reduce MOM costs and improve performance, but outcomes were variable (Lankford et al. 2016). Failures were linked to multiple challenges, including a lack of clear legal arrangements for asset use and control and fee retention for MOM, poor institutional design and implementation, and a governance capability gap of farmers, who were shouldered with the heavy transaction costs of a new governance role. The lack of appreciation of the power disparity between the WUO's responsibilities at the tertiary or secondary level and the state agency role at bulk-water-supply level was another factor (Lankford et al. 2016).

However, formally structured WUOs based on legal arrangements have been highly effective in developed countries and remain an important way of regularizing chaotic and moribund schemes and agencies in developing countries.

Attention to enabling laws and regulations, especially for fee retention, compulsory membership, and use right or ownership of assets, remains key to IMT and WUO establishment success, especially on large-scale schemes.

groups of service-delivery functions (shown in Figure 3.2 with an emphasis on organizational functions).

Guidance on WUO Institutional Development

The approach motivated in the resource book is that best-fit institutional designs, co-constructed by multiple stakeholders and actors, will be more responsive to site realities than those created by a team of external specialists. The resource book recognizes that WUOs, as institutions of collective action, are ubiquitous in some shape or form. They inevitably shape social action because of the functions they perform. Without prescribing a specific model or legal framework, which has often been counterproductive, experience suggests that WUO institutional design responses need to do the following:

FIGURE 3.2. WUO Priorities across Three Domains, with Organizational Functions Dominant



Note: capex = capital expenditure; MOM = management, organization, and maintenance; WUO = water user organization.

- **Be clear about the specific functions the WUO plays in irrigation service delivery and build a WUO that is agile and organized around that purpose—without mission creep.** The WUO mandate and specific form of organization must be acceptable to members and higher-level agencies to receive required legitimacy to mobilize social action and to be able to enforce rules.
- **In the case of new scheme development, or when a rehabilitation occurs, the WUO needs to be established upfront,** before construction starts, and become part and parcel of the development process.
- **Be site- and country-specific, and build on both local and international experiences** and successes in consultation with all six actors in the service-delivery chain. **Invest in farmer governance capability (concerning their WUO roles) through training and mentoring** into the medium term (10 to 15 years) in a process that takes much longer than the typical five-year project cycle, thus requiring additional partnerships. These include nongovernmental organizations (NGOs), private sector, and government-supported WUO governance interventions beyond the normal investment project duration.
- **Make particular provisions for women’s representation, and support specific initiatives that raise women’s technical competence and esteem.** Promote attitudinal change of men in relation to women in governance and to their contributions to irrigation scheme performance.

EXPLICIT AND AGREED UPON RULES

A key characteristic of effective WUOs is that rules are explicit and agreed upon between all users, whether formal and legally structured or informal and based on local norms and traditional practice.

RETHINK PRIORITIES



Make sure that WUOs are front and foremost in the scheme operational design. Engineers and sociologists must work together on the software and hardware elements to ensure functionality, not just institutional form. Alone, neither will succeed.

PARTNERSHIPS AND TRUST

Even when WUO rules are crystal clear and the main system is functional and orderly, there are many judgement based decisions that operators have to make. These can be captured in detailed agreements, but due to hydraulic complexity and monitoring challenges, their practical use has limitations. There always has to be trust in professional judgement, which can be fostered only by a partnership approach.

- **Promote and lobby for enabling WUO-specific laws and regulations** building, where necessary, on existing legislation in a pragmatic manner (using the tactic of *bricolage* termed by Cleaver [2002] discussed further in Appendix 1). These laws would need to include specific provisions for compulsory membership, ring-fencing of irrigation service fees at the WUO level for MOM, right of use and possible shareholding by farmers in the irrigation assets (transferred by the state), and transparent and explicit water and land tenure provisions in the irrigation scheme context.
- **Make explicit provisions for institutional learning and change in the WUO constitution.** Irrigation service provision is highly dynamic and has to be responsive to dynamic realities in water-resource availability, evolving farmer needs, and externalities such as policy and political shifts. WUOs that have built-in processes for self-assessment, learning, and reshaping themselves will achieve better outcomes for their membership.

WUO development or modernization strategies will vary between subschemes, between schemes in one country, and between countries themselves. In developing solutions for performance problems, there is a strong case to be made that institutional setups are best based on a partnership approach.

Partnerships can be established between farmers, their WUOs, private sector, and NGOs as appropriate and will have the greatest chance of success when developed in participation with a wide range of in-country stakeholders (Lankford et al. 2016; Meinen-Dick 2007). Suhardiman and Giordano (2014) argue that great gains can be made by building the trust between the farmer and the field-level operator from the agency. This needs to be prioritized to a much greater extent in institutional development initiatives.

BOX 3.6. Pay Attention to the Power Balance between WUOs and Agencies/ Operators

Although indigenous and small to medium-sized community-managed schemes are often autonomous in all aspects of water-service provision, in large-scale schemes, the relationship is different. The WUO is always a small part of a much bigger system. In striving for partnerships, the dominating power of the I&D agency must be addressed through accountability, representation, and transparency in its rules and relationships.

3.4 The I&D Agency Perspective

Origins of the Agencies

The rapid expansion of large-scale irrigation and drainage (I&D) systems in the 20th century led to the establishment of irrigation and drainage agencies, mainly to drive the planning and construction of major public irrigation schemes. This role subsequently evolved into MOM, but they retained their original construction-oriented character. In most cases, I&D agencies share similar organizational characteristics (after Lankford et al. 2016; Obertreis et al. 2016; Suhardiman and Giordano 2014). They are typically:

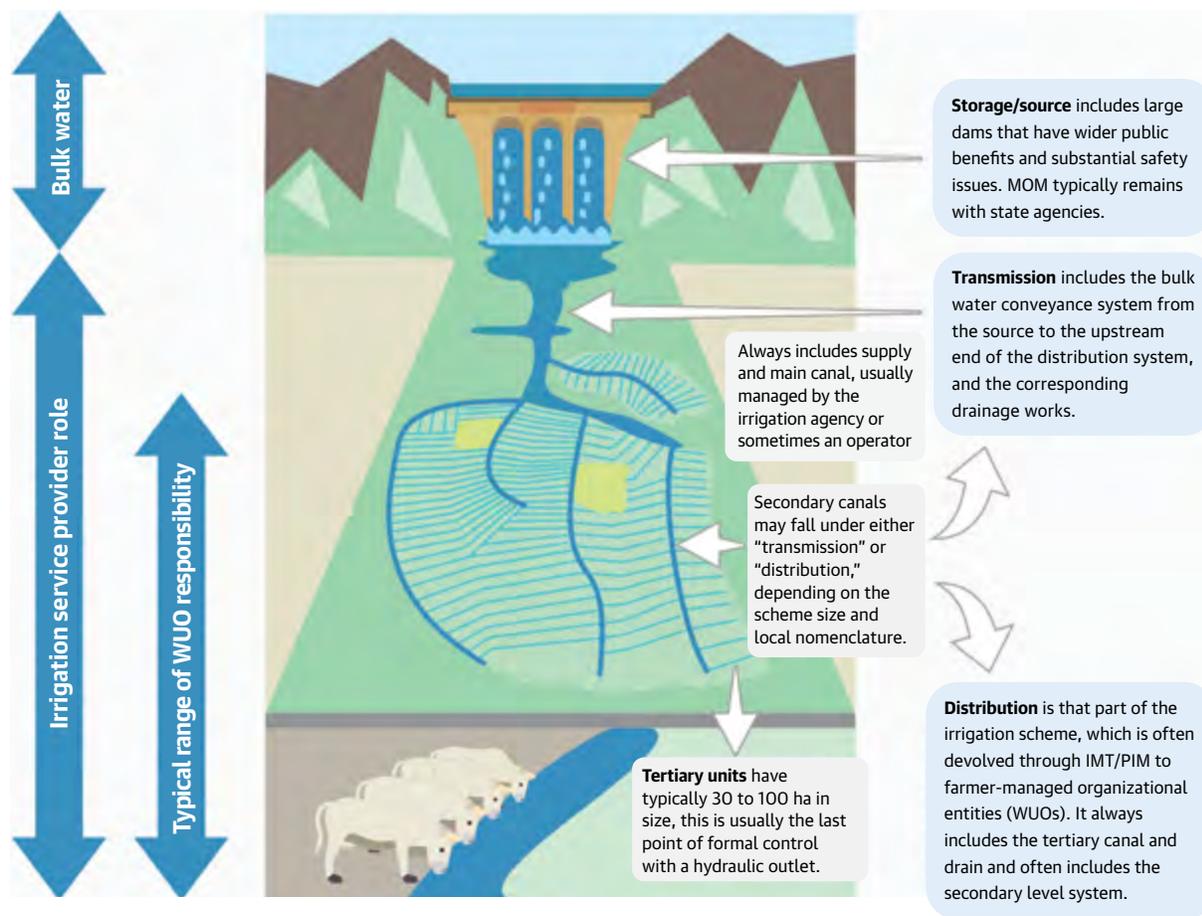
- **Infrastructure-centered** with a focus on canals, lining, pump stations, and irrigation technology and with performance linked to narrow physical criteria like transmission efficiency, rather than service-delivery and governance criteria
- **Dominated by technical rather than social expertise**—there is a lack of specialized personnel with competency in social mobilization, participatory management, and rural livelihoods, and so on, all key to successful scheme MOM involving farmers
- **Beset by heavily vested interests** in maintaining the status quo, including control of large budgets for infrastructure spending and control of water
- **Powerful political entities that** act not only as implementers of higher-level policy but also shape and define policy driven by the interests of their leadership and staff

Many I&D agencies are now reforming through decentralization and moving away from a technocentric and compliance approach to a more service-oriented approach. This is a particularly difficult transition for the massive agencies that oversee operations on millions of hectares of irrigation in central Asia and in the Far, Middle, and Near East. The reform or modernization agenda is made even more difficult by diversity within agencies, created by interventions over decades. Agencies often have varied policies and rules and oversee services to different cultural groups. Although there is a wide range of I&D agency types, they tend to share similar challenges.

The challenges are systemic and affected by institutional path dependency (see more in Appendix 1) where institutional forms and norms persist by virtue of past practices and intransigence to change. Changing the laws, rules, attitudes, administration systems, and organizational structure all take time and require strong political leadership. Irrigation institutional reform regarding irrigation has inadvertently altered some of the roles and activities performed by the agency. The spread of the IMT and participatory irrigation management (PIM) agenda shifted some of the operation and maintenance (O&M) responsibility from the I&D agency to water users



FIGURE 3.3. Varied I&D Agency Roles in Large-Scale Schemes



Note: ha = hectare; I&D = irrigation and drainage; IMT = irrigation management transfer; MOM = management, operation, and maintenance; PIM = participatory irrigation management; WUO = water user organization.

organized as WUOs (Figure 3.3). This has created some space for the agency to assume other responsibilities that include river basin planning, watershed management, technical support to WUOs, environmental monitoring and enforcement, water resource management, system modernization, and agricultural extension services (Svendsen 2005). Understanding the incentives of I&D agencies is key to developing modernization strategies to address the problems on large-scale public schemes.

Vested Interests and Resistance to Change

Waves of institutional reforms in irrigation such as the formation of WUAs, promotion of IMT, and introduction of irrigation service fees (ISF) for cost recovery have tended to treated irrigation agencies as political entities. Most of these irrigation solutions have overlooked the reality that irrigation bureaucracies are

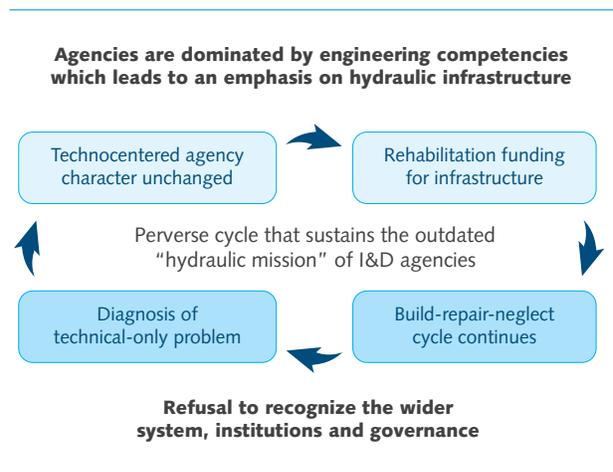
heterogeneous policy actors with varying interests, goals, and agendas (Suhardiman and Giordano 2014).

Although irrigation bureaucracies promote the national objective of their governments, they have their own sets of interests and ideologies (Molle, Mollinga, and Wester 2009). Following from the “hydraulic mission” to drive economic growth with large-scale water-infrastructure investment, continued infrastructure development and related technical expertise were essential organizational features that guaranteed the autonomy of irrigation bureaucracies. This technical character has defined their interests and motivations. In India, for example, the irrigation bureaucracy consists mostly of junior engineers, paraprofessional engineers, assistant engineers, and executive engineers (Suhardiman and Giordano 2014), a situation of technocentrism that reflects a much wider global norm. In both India and Uzbekistan, the state water-user interface has become fundamentally tied to the larger political-economy culture (Mollinga and Veldwisch 2016). Irrigation reform efforts in most Asian states, pushed by international organizations, have been unsuccessful because hydrobureaucracies are averse to remodeling their organizational structure, which are centrally controlled and have a technical professional disposition (Mollinga and Veldwisch 2016).

In I&D agencies, there is an incentive that works to maintain their technical character and their focus on infrastructure (see Figure 3.4). The degradation that results from long-term deferred maintenance represents a powerful incentive to motivate only technical rehabilitation measures to repair the engineering elements of the schemes (for example, pump stations, intakes, canals, gates).

This type of reinvestment, which reflects the classic build-neglect-rebuild cycle, ensures a new and constant flow of funds that effectively maintains the engineering status, power, and autonomy of the I&D agency that was responsible for the neglect cycle in the first place (Gonzalez and Salman 2002). To drive the process of planning, design, and construction of technical rehabilitation—rather than true modernization of technical and governance systems in tandem—the dominant skill required is engineering competency. This reinforces the essential nature of the agency without requiring any change to its core structure and makeup.

FIGURE 3.4. Cycle of I&D Agency Resistance to Change



Note: I&D = irrigation and drainage.

BOX 3.7. Performance along the Water-Supply Chain: The Upstream Mile Conundrum

The performance of large-scale irrigation depends on the interaction between the different tiers, typically the bulk-supply transmission system, the secondary canals, and the tertiary units. Water distribution in the tertiary block cannot function well if the secondary canal does not deliver the water in a reliable, equitable, and timely manner, and the secondary canal cannot function well if the main system is not operated well (Wade and Chambers 1980). When the upstream mile functioning is inadequate, this undermines efforts to bring about change at any downstream location on the scheme.

Key Opportunities for I&D Agency Institutional Reform

Some practical suggestions as to how the key governance incentives of transparency, participation, and accountability can be established in practice (after and Lankford et al. [2016] and Suhardiman and Giordano [2014])—across all six perspectives—include:

- **A focus on the empowerment of farmers at the point where they interface with the service provision entity personnel in the field** (that is, WUO, irrigation agency, or private sector operator). Field staff have multiple accountabilities: to their supervisors, local authorities, traditional power-brokers, and farmers. Irrigation field staff need to be encouraged to emphasize service-provision tasks and focus their efforts on planning, securing budgets, and pursuing political strategies to get services to farmers.
- **Strengthening farmers' channels of communication about service problems, raising knowledge of these, and increasing their leverage through specific rules and processes**, will incentivize greater responsiveness from field-operational staff and their higher-level organizations. Bimonthly meetings to discuss delivery issues and challenges, institutionalized in the agency and understood by the farmers, for example, is one institutional design response to increase farmer leverage and accountability.
- **Service agreement contracts are key to defining operators' and farmers' responsibilities and expectations**. Clearly articulated service-delivery contracts empower farmers because they specify water service-delivery parameters and provide a quantifiable basis for farmers to engage with operators where services fall short. Contracts can be simple and are informed by system design, measurement realities, operational parameters, and irrigation service fee structures (see Chapter 2).

- **Redistribution or relocation of the functions, services, and personnel from higher-level offices of irrigation agencies to more localized irrigation offices** within direct reach and contact of farmers. Such a measure allows for physical contact, more direct access, and personal relationships to be established, thereby contributing to governance strengthening.
- **Creation of a more business-like performance structure for management and employees based on performance incentives.** Chief executive officer (CEO) type leadership contracts can be established so that pay is aligned to performance of the system and lower-level staff, rather than government and bureaucratic benchmarks. Rules can be established so that irrigation officers are incentivized to respond to external (farmer-induced or system-communicated) feedback (complaints-processing efficiency, response times for repairs, and so on).
- **Reform of I&D agencies so they have a regulatory and training role in WUO functions and oversight.** This could include specific incentivized targets that pertain to WUO performance audits, as well as irrigation staff, farmer, and WUO administrator training. More often than not IMT and PIM have caused a *removal* of agency functions related to direct MOM activities, rather than a *change* of functions that includes WUO support.
- **Realignment of the status and employment conditions of key gatekeepers within all levels of the system so that they are rewarded by the system functioning as a whole,** rather than in response to individual irrigators. This could include incremental incentives for meeting service-delivery targets (based on selected performance indicators described in Chapter 2), along with changes to lines of reporting and accountability, with emphasis on downward linkages to the irrigators themselves.

I&D Agency Reform through Decentralization: Some IMT and PIM Experiences

Over three decades of investments in irrigation institutions, IMT and PIM as a key decentralization strategy have yielded mixed results. Examples from Mexico, Chile, Turkey, and Kyrgyzstan demonstrate successes, less so in Albania, India, Pakistan, and Uzbekistan. The specific reasons for these mixed results is not certain, but it could be both or either weak implementation or fundamental flaws in the organizational design for the context (FAO 2007; Meinzen-Dick 2007; Vermillion 1994).

Success factors: A study of 108 IMT cases in Asia (Mukherji et al. 2009) concluded that smaller systems growing nonpaddy crops—and when IMT and PIM is implemented with the help of NGOs—have a higher chance of success. The latter finding is likely caused by the reality that NGO involvement typically extends beyond the limited project horizon. IMT and PIM initiatives in China were also observed to be



more likely to succeed than anywhere else in Asia. PIM and IMT have been more successful on smaller schemes than larger schemes.

Failure factors: A recent review of 64 World Bank irrigation sector projects in 16 countries identified a number of challenges regarding IMT and PIM (Valieva and Abubeker 2018), shown in Table 3.1. Studies show that despite several rounds of investment in WUO formation and training, many initiatives failed within a few years of project closure. Large-scale systems are challenged by the sheer scale of the training and the organizational establishment of many legal entities (WUOs). This is compounded by the need for more complex representation in WUO federations in upward tiers to secondary and apex levels. Elaborate and lengthy participatory processes can also become overly prescriptive and detached from the overall aim of the investment.

One example of a multi-pronged devolution strategy is documented in the case study of the Nigerian TRIMING (Transforming Irrigation Management in Nigeria) project outlined in Figure 3.5. This case went beyond limited devolution and establishment of WUAs and included interim regulatory measures that were based on a pragmatic “bricolage”¹ approach to enable role and function changes within the project time-scale. New WUA-specific legislation and two regulations were developed under the project to achieve long-term legal transformation (passed by the

TABLE 3.1. Key Limiting Factors on IMT and PIM in 64 Projects, 1994-2004

Category	Findings
Design	<ul style="list-style-type: none"> Overambitious project designs, particularly for the complex and delicate institutional change programs envisaged Overly complex project design with many or unconnected components
Institutional	<ul style="list-style-type: none"> Little political or administrative commitment to core principles of the project (for example, needs-based budgeting, adequate funding of O&M, setting and collecting ISF) Resistance to institutional change within government and their agencies. Underestimating government's readiness and ability to implement institutional reforms in the water-resources sector Capacity building and irrigation scheme management transfer (part of many projects) typically takes longer than the project timeline allows In early stages, there can be elite capture by more influential farmers
O&M and cost recovery	<ul style="list-style-type: none"> Lack of O&M funding post project to sustain infrastructure Frequently overestimating beneficiaries' capacity (for example, expectations of farmers to pay full investment of rehabilitation and O&M costs often proved to be unrealistic, and full cost recovery as envisioned by some projects failed to be achieved)

Note: IMT = irrigation management transfer; ISF = irrigation service fee; O&M = operation and maintenance; PIM = participatory irrigation management.

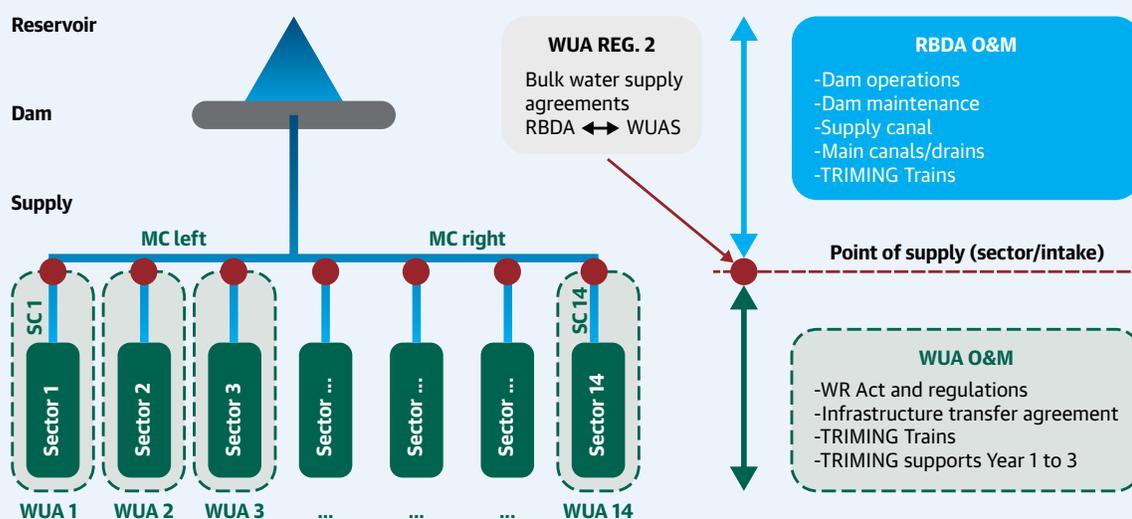
U.S. House of Representatives in 2018, and pending Senate approval at the time of publishing). The project was characterised by extensive WUA establishment and support, socio-technical re-design, land-mapping and registration. A fundamental change was the shift in role of the I&D Agency from operator of the entire scheme, to that a bulk water services provider (dam, supply and main canals) with the additional role of supporting WUAs in their functions. The institutional re-design process extended over three years involving multiple stakeholders from all involved actors. The revised institutional setup showing the devolution to WUAs at sector-level is shown below (details are online in Appendix 2 [World Bank 2020b]).

3.5 Government and Line Ministries Perspective

This section highlights key issues related to intergovernmental relations, ownership and use rights of water and infrastructure, and systemic mismanagement. It concludes with two examples of how radical change can be initiated when government actors are inspired and drive transformations from within.

FIGURE 3.5. TRIMING Project in Nigeria: A Multidimensional Modernization Effort

Scheme organizational levels



Note: Figure depicts devolution through irrigation management transfer (IMT), participatory irrigation management (PIM), and water user association (WUA) training on the Kano scheme in Nigeria. MC = main canal; O&M = operation and maintenance; RBDA = River Basin Development Authority; SC = secondary canal; TRIMING = Transforming Irrigation Management in Nigeria; WR = water resources.

Intergovernmental Relations

Irrigation governance at the national level involves both water-resource development and management, as well as agricultural development and support. Government responsibility for irrigation is often split, somewhat uncomfortably, between water-resource and agricultural line ministries. When working in the irrigation domain, practitioners face the reality that the planning and regulation of irrigation activity requires the bridging of at least two political domains. *First-mile* responsibilities, such as dam maintenance and operations, supply canal operations, river basin management, water-use permitting and allocation, and so on, typically reside with the water ministry. *Last-mile* responsibilities are related to on-farm agricultural activities, including field irrigation, and usually reside with the agricultural ministry. Some of these responsibilities are devolved to regions or delegated to I&D agencies, making collaboration and implementation more difficult. Typical government responsibilities for irrigation are summarized in Table 3.2. Practical engagement with irrigation and drainage reform projects brings challenges of coordination across ministries and agencies with the potential for power struggles regarding resources and authority. Rent-seeking opportunities and the nature of large-scale investments can cause intense rivalry between dominant bureaucracies and ministries (Molle et al. 2009). A classic example is the competition in the United States between the Bureau of Reclamation and the U.S. Army Corps of Engineers over the construction of dams in the western part of the country (Molle et al. 2009; Reisner 1993).

TABLE 3.2. Ministries with Involvement in Aspects of Irrigation Development

Government ministry/ local government	Activities and responsibilities
Water resources ministries	Policies, legal regulations, budgeting, and investment in <i>water resources development</i> , use, and management across all sectors of the economy
Agriculture ministries	Implementing policies, legal regulations, budgeting, and investment in the <i>agricultural sector</i> including irrigation
Irrigation ministries (where they exist)	Implementing policies, legal regulations, budgeting, and investment <i>for irrigation development</i> , including <i>design, construction, operation and maintenance</i> , and, often, provision of irrigation advisory services
Ministry of finance	<i>National budgets to line ministries</i> and management of ODA and MFI loans
Local government authorities	<i>Local land and water rights administration</i> and rural development

Note: MFI = multilateral financial institutions; ODA = overseas development assistance.

In many countries, the split of water resources and agriculture development responsibilities presents similar challenges and competition between those two ministries, which can undermine project interventions. The ministerial arrangement in Vietnam is one solution to this problem. There, all of the irrigation responsibilities fall under the ministry of agriculture, which acts as a single powerful administration in driving the irrigation agenda (Molle, Mollinga, and Wester 2009). Though such high-level reform is beyond the reach of most international financial institution (IFI) investment projects, it highlights the importance of collaboration among all government entities involved in irrigation and drainage governance.

Securing Water Entitlements to Reduce Risk and Incentivize Growth

The state usually claims ownership over national water resources with rights of use allocated to users through various administrative systems. *Ownership* of water is defined by “the right acquired to the user under government regulation or water law for the abstraction, diversion, and use of water” (World Bank 2002). Water rights have traditionally been linked to land tenure rights, but because of increasing water stress in the past few decades, many countries have undertaken water-law reform. This has involved the introduction of explicit rights (modern water rights) that specify the volume and the institutional arrangements for allocation, registration, monitoring, and enforcement (Hodgson 2006).

The legal control of water resources is directly in the hands of the government, and the power remains with the state to extract and allocate water. In most cases, the users do not control or own the resource until it is delivered to their property (World Bank 2004). In practice in developing countries, the state administrative capability to monitor and enforce compliance is a limiting factor to effective control. This limits the assurance that rights (on paper) are translated to access and control of water itself (Schreiner et al. 2018). The state has two main incentives to promote stronger mechanisms for water entitlements for irrigators:

- **First, more secure access to water** will translate to increased irrigation production and economic benefit, subject to other critical limiting factors in the enterprise system being adequately addressed.
- **Second, farmers as a lobbying group have collective political power** through protest and as an electorate. The state, therefore, has a vested interest in reforms that move to secure greater certainty of supply for agricultural water users.

SCRUTINIZE RIGHTS “ON PAPER” AND WHAT THAT MEANS IN PRACTICE

Uncertainty in supply translates to risk for irrigation enterprises and farmer livelihoods. When analyzing problems related to irrigation service delivery at the farm level, attention must be given to how water rights are enshrined in law, mechanisms of allocation and enforcement, and water administration at the scheme level.



**POLICY REFORM:
INFRASTRUCTURE
OWNERSHIP AND FEE
COLLECTION RIGHTS CAN
INCENTIVIZE SCHEME MOM**

When policy—and legal mechanisms—are reformed to allow for infrastructure ownership and for irrigation service fees (i.e., water fees, taxes, etc.), it will act to incentivize farmers to first pay their fees and then to take greater responsibility for maintenance of their assets.

Ownership and Use Rights of Public Irrigation Infrastructure

Regarding irrigation infrastructure, the state—often through I&D agencies—owns, operates, and maintains the water-supply systems such as reservoirs and main canal systems. The *de facto*, if not always the *de jure*, rights for infrastructure use below the main canal or secondary canal are, in the case of IMT interventions, passed to various forms of water user groups (WUGs) for MOM (World Bank 2002). These types of *de facto* arrangements for use rights over physical infrastructure are still prevalent in large-scale irrigation projects in developing countries (World Bank 2002). There is a need to formalize these rights through engagement with the relevant line ministries because of two problems:

1. A lack of explicit legal provisions for use of publicly funded infrastructure assets presents limitations for effective control and MOM from a user’s perspective. If private sector operators or WUOs do not have legally enforceable rights of use, ownership, or shareholding, this acts as a disincentive to invest in maintenance.
2. The absence of a legal right to collect, retain at scheme level, and use revenues for MOM undermines the ability of operators or WUOs to sustain their operations. The revenue generated from water use, and from use of public (irrigation) assets, is typically added to centralized public funds, leaving schemes dependent on budget applications to the government treasury. Funds are often received late or not at all. Actors responsible for MOM, such as WUOs or private sector operators, need to be given clear legal rights to:
 - a. create their own financial self-governing entity;
 - b. distribute water for irrigation purposes; and
 - c. collect water fees to reinvest revenue back into water infrastructure and technology (World Bank 2002).

Adequate legal basis for the “ring-fencing of irrigation service fees” at scheme level is a high priority for the modernization and reform process.

Systemic Mismanagement in the Irrigation Sector

Corruption forms a structural problem in almost all countries of the world. In the irrigation sector, corruption is often systemic—that is to say, it is not the misconduct of one (or a couple of) person(s) but rather an informal yet well-structured institutional system. Engaging in extortion and illegal payments to higher officials is not typically a choice of an individual functionary; it is an obligation to continue

employment in the bureaucracy or to be promoted (Butterworth and de la Harpe, 2009a, 2009b; Zinnbauer and Dobson 2008).

Although corruption is endemic globally, strategic measures can be taken to minimize its negative impact—specifically, paying attention to institutional mechanisms that include the three principles of good governance (participation, transparency, and accountability). This can be achieved by establishing explicit rules; supporting I&D agency, irrigator, and WUO-member education; as well as defining specified and widely publicized mechanisms for addressing and reporting grievances.

A TRIPLE DEFENSE AGAINST CORRUPTION

Three governance principles are a strong bulwark against corruption: participation, transparency, and accountability (these are expanded in Chapter 4).

Policy Dialogue on Irrigation Governance Beyond the Traditional Discourse

Irrigation agencies and farmers are often constrained by the overall governance context, which makes sector reform a precarious affair. The opposite can also be true when the broader agriculture/water/rural development/jobs agenda pushes the irrigation sector to be smarter in achieving these broader development goals. This is particularly true in the increasing emphasis on reducing total water-use in agriculture, and in discussions on more climate-smart investments and water-smart agricultural policies. These narratives determine fund availability and influence policy measures that promote and enable certain technologies, crop choices, management incentives. Although the irrigation sector is often slow to respond, there are cases of policy success.

Effective institutional reforms are necessarily led from within, enabled by political decisions by the relevant government and line ministries. One example in India, described in Box 3.8, shows how inspired leadership within an irrigation bureaucracy that had long-inhibited institutional reform was able to turn service delivery around (Brewer et al. 1999; World Bank 2004). The case study of Madhya Pradesh (full description in Appendix 2) shows how a chief minister pursued agricultural growth through irrigation development as a political strategy to win agrarian votes.

Similarly, the visionary agricultural minister in Mali initiated IMT in the 1970s long before it was called IMT (full description in Appendix 2) in small steps over long timelines through experiment, demonstration, and partnerships with selected groups of willing farmers and NGOs. The process ran against the flow of wider government support whose interest at the time was to maintain a highly centralized management. The initiative eventually led to the well-known radical transformation of the Office du Niger over a period of more than 20 years.

These examples highlight the power of strong leadership from within government to drive institutional reform. Similarly, reform that is externally prompted is possible only when it is actively supported by leadership within government (World



Bank 2004). If successes can be achieved, and positive outcomes demonstrated, that can mobilize higher-level political support in key line ministries to drive for policy and/or legislative change.

3.6 Private Sector Perspective

Rationale for Private Sector Involvement

Public investment in irrigation has been waning the past few decades, and the sector is facing acute finance scarcity. There is an urgent need for increased investment given critical levels of water stress, climate change, and a burgeoning population (Lankford et al. 2016), and increased private sector investment is an important opportunity. The problem of low irrigation scheme performance and poor asset management and maintenance place an immense fiscal burden on the public sector. Financial strength, technical capability, and management competency are key reasons for the involvement of the private sector through

BOX 3.8. Championing Change with Leadership: Success in Madhya Pradesh, India

Indian large-scale gravity irrigation systems have demonstrated an increasing gap between irrigation potential created and utilized. Despite continuous investments to improve performance by rehabilitating infrastructure, there currently exist more than 20 million hectares of unused irrigation potential. The Madhya Pradesh state demonstrated how leadership led to an unprecedented agricultural growth rate exceeding 20 percent per year since 2012. To combat corruption and turn around performance of agriculture, the chief minister brought in an energetic leader who adopted a results-oriented, modern management approach. The results were notable. Canal irrigated area expanded from less than 1 million hectares in 2010 to 2.39 million hectares by 2015.

An emphasis was placed on last-mile projects (that is, the last mile to the farmers' fields), a performance-oriented approach, and technology adoption:

- Gatekeepers sent daily reservoir water-level gauge readings by short message service (SMS) to the central web-based management information systems (MIS), converted into stored volume based on reservoir specific depth-volume curves.
- Based on these readings, senior management set reservoir-specific irrigated crop area targets for the coming winter season (*rabi*) at the end of the monsoon season (mid-September).

box continues next page

BOX 3.8. Championing Change with Leadership: Success in Madhya Pradesh, India (*continued*)

- Prior to the *rabi* season, the district office staff inspected all systems and reported back on repairs required and costs to ensure the system functioning. Authority was delegated to executive engineers (EEs) to execute works needed to meet performance targets.
- Each week, there was a video conference with the basin office chief engineers, the superintending engineers, and the divisional EEs. This was chaired by the principal secretary and engineer-in-chief to discuss the ongoing situation.

Breaking the cycle of poor system performance, low staff morale, political interference, and reorienting staff to results delivery was facilitated by:

- strong support and leadership from the highest level within the state (the chief minister);
- incentivizing staff performance with a reward culture (awards for best performers);
- senior staff of the department making frequent field visits; and
- information communication technology (ICT) supporting communication, performance monitoring, and system management.

The combination of a champion who was focused on delivering results, the adoption of modern management methods, strategic planning, and strong leadership from the top were pivotal for making irrigation improvements. It reinforces that government champions are essential to achieve major gains in irrigation and drainage development and performance.

See online Appendix 2 (World Bank 2020b) for the full description.

public-private partnerships (PPPs) (Darghouth et al. 2007; Meinzen-Dick 2007). The private sector includes all third parties and economic actors that are not directly controlled by government (Darghouth et al. 2007). Although the private sector is widely involved in agricultural production and support services, the focus here is on involvement in I&D service provision (that is, the business of water).

It has long been hoped that the inclusion of the private sector would inject fresh funds, modernize irrigation practices and management methods, and alleviate some government responsibilities and inefficiencies (Darghouth et al. 2007). The main interest of the private sector is to generate profits from investments made in

Private sector
incentive



irrigation systems or from the provision of I&D services (Mandri-Perrot and Bisbey 2016). There are five main advantages of involving the private sector in I&D schemes (Mandri-Perrot and Bisbey 2016), but the main motivation for the public sector (that is, government) revolves around the value for money:

- **Improved quality of irrigation services:** Bringing in private service providers helps improve efficiency and accountability in service delivery. For example, in the case of Morocco's El Guerdane scheme and the Compagnie Sucrière Sénégalaise, the objective was to improve the sustainability and quality of irrigation and drainage services and ensure regular and more equitable delivery for tail-enders.
- **Separated governance and operation of schemes:** Private sector contracts with governments allow for the separation of O&M functions from policy and regulation functions, which reduces political interference and allows for efficient asset management and maintenance.
- **Reduced fiscal constraints to fund high upfront costs:** Private sector participation has also been a solution to step in when government funding is lacking. A major benefit has been a reduction in the government's fiscal and administrative responsibilities to finance irrigation schemes.
- **Improved collection of irrigation service fees:** Because the primary concern for the private sector is to remain financially sustainable, most private sector investors are more efficient in the collection of service fees.
- **Improved asset management and infrastructure maintenance:** Private sector funding and management best practices have usually allowed for better asset management.

Types of PPPs

The intention in structuring PPPs is to create an incentive for investment by specifically addressing some of the risks and diversifying responsibilities (Darghouth et al. 2007). There are two main types of PPP arrangements: service contracts (investments or capital expenditure [capex] are fully public) and public service delegation (with an increasing degree of private sector investment and risk). In reality, PPPs are highly context-specific and are a composite of various categories (Darghouth et al. 2007). The range of private sector involvement is shown in Figure 3.6. This section is drawn from the World Bank Toolkit for PPPs (Mandri-Perrott and Bisbey 2016), which provides more detailed information for interested readers.

PPPS IN THE BROADEST SENSE OF THE TERM

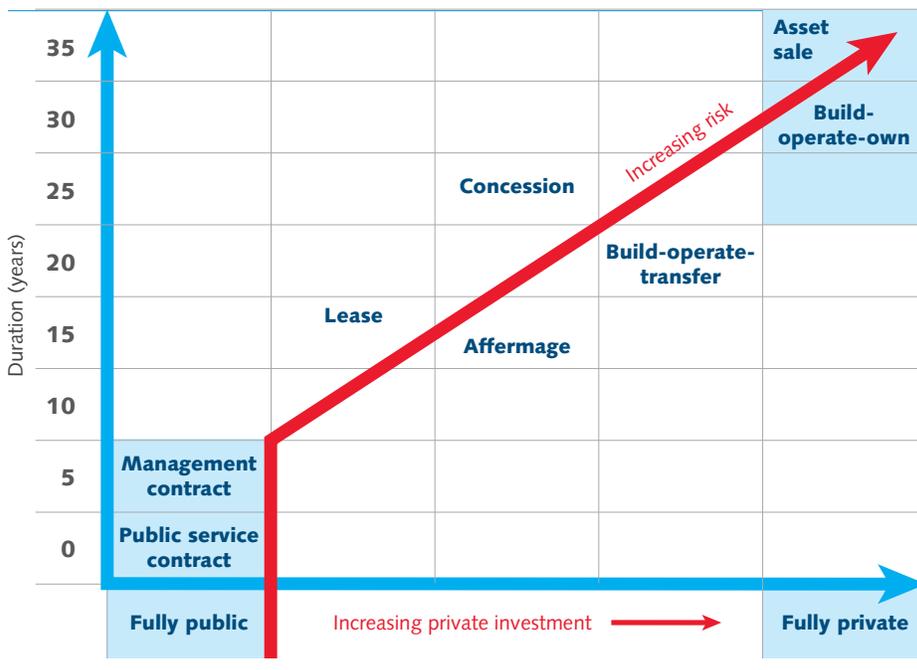
Public-private partnerships refer to any kind of involvement of the private sector in irrigation and drainage management, operation, and maintenance, from contracted operators to risk-taking investors.



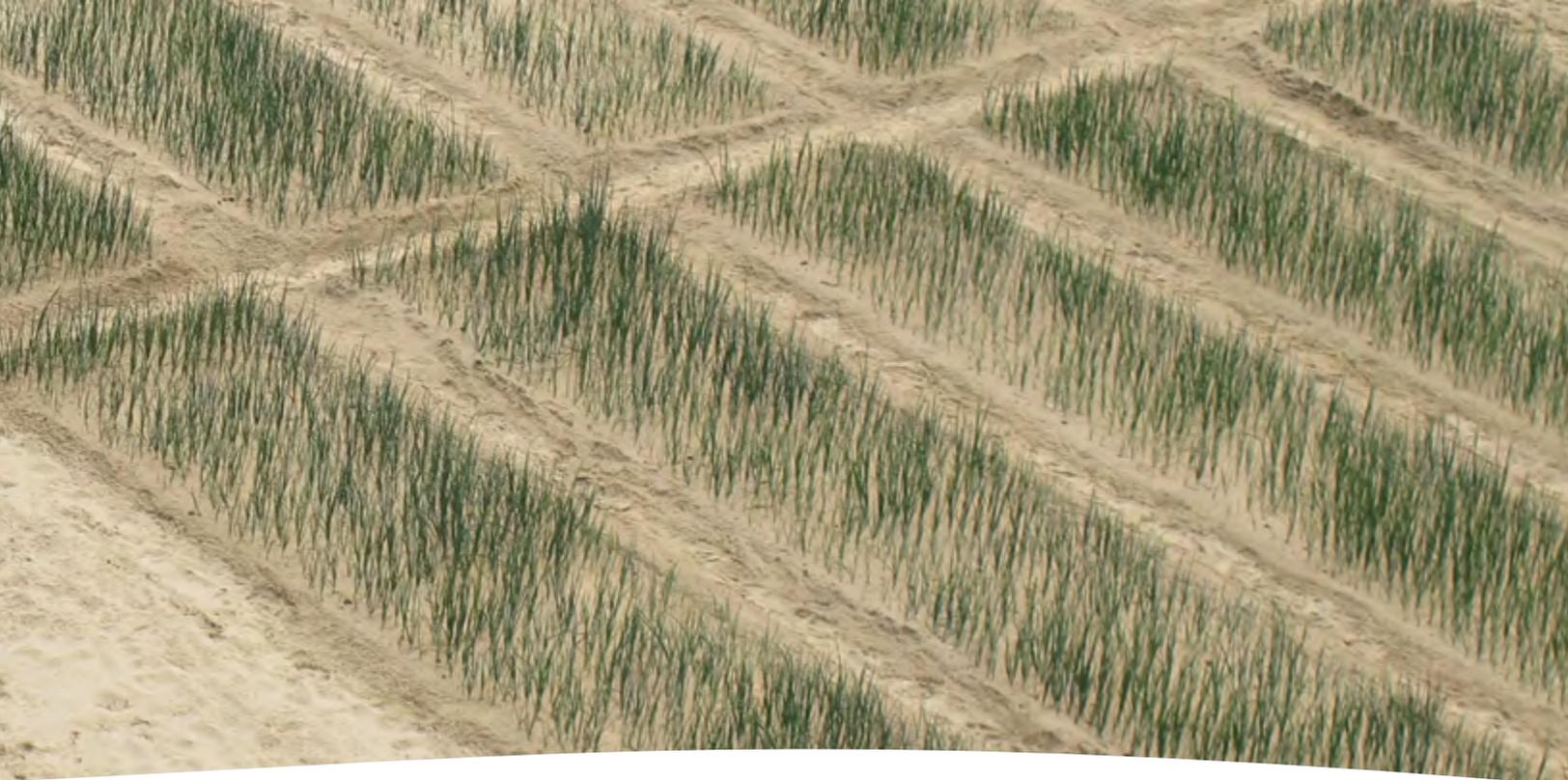
Service Contracts (Investments Fully Public)

- **Public service contracts:** These are task-specific and the public agency outsources certain services such as maintenance, meter reading, or fee collection. These are usually short-term contracts and renewable.

FIGURE 3.6. Types of Irrigation and Drainage Contracts Involving the Private Sector



Source: Mandri-Perrott and Bisbey 2016.



- **Management contracts:** These contracts are more long term—about three to five years—and the responsibility of operating a government organization is transferred to a private operator. In the simplest type of management contract, the nonpublic operator pays a fixed fee for performing managerial tasks.

Public Service Delegation (Increasing Private Investment and Transfer of Risk from Public to Private Parties)

- **Lease:** Under this arrangement, the operator is responsible for operating and maintaining the business, but the financial investment comes from the public partner. The incentive for the operator is to increase sales to increase profits. In this type of arrangement, the operator pays the contracting authority a fixed contractual rent.
- **Affermage:** The key difference between a lease and an affermage is that, under an affermage, the lease amount that is paid by the operator to the government depends on the revenue amount that is collected by the operator. The public and private partners share the risk in this measure.
- **Concession:** This is a long-term contract that hands over almost all responsibility of operation, maintenance, and financing investments to the private operator.
- **Build-operate-transfer (BOT):** Under this agreement, the asset remains indefinitely with the private operator. These contracts have varying risk profiles: low risk when the government pays a fixed contractual amount to the operator and higher risk when profit is based on operational revenue generated by the private sector partner. Under a BOT, the assets remain with the private partners for the

life of the agreement. Variations are based on the specific functions that are transferred to the operator.

- **Asset sale (divestiture):** Under this agreement, the asset is completely privatized. The sale involves a fixed-term license, and if the contract is terminated, the divested assets return to the government.
- **Private sector operation and transfer—an attractive but challenging pursuit:** Despite the strong motivations that favor private involvement in I&D MOM, there are relatively few examples of successful PPPs in large public irrigation systems around the world compared with other sectors, such as roads and power generation, particularly in developing countries. The El Guerdane PPP in Morocco is one successful example, detailed in the case study descriptions in Appendix 2. Institutional reform by bringing in private sector actors has many potential benefits, but the presence of large externalities, and other sources of market failure, makes private stakeholders nervous about investing in irrigation and drainage projects (Darghouth et al. 2007; Meinzen-Dick 2007). There are potential binding constraints to profitability for a private I&D service provider in an operational role:
 - The water users (mainly irrigators) must generate sufficient farming profit from their enterprises so that they have **affordability to pay**.
 - Water users must be **willing to pay** for the value of irrigation water, comprising the MOM component and, if a private sector partner has made an investment in the bulk water supply, the capital investment component.
 - **Mechanisms for enforcement** of nonpayment that are hydraulically practical (that is, enabled by the physical closure and locking of valves or gates), widely understood, organizationally manageable, and socially acceptable.

Bernier and Meinzen-Dick (2015) identify seven main challenges for irrigation PPPs: (a) difficulty in aligning development and profit objectives; (b) inherent risks in agriculture caused by price and market instabilities, international health and sanitary requirements, local and export compliance standards, and so on; (c) need for irrigation support, not just irrigation financing; (d) need for information on water availability and all water uses, under climate change; (e) land and water rights; (f) priorities for investment; and (g) sharing of costs, benefits, and risks.

The two summaries of private sector involvement that follow highlight several of the challenges related to the highly complex and specialized financial, social, and contractual arrangements that are part of PPP arrangements. PPPs are not always the best solution, as shown by the Senyera summary description in Box 3.9 (and detailed in Appendix 2). Yet in Morocco, the El Guerdane PPP is widely accepted as an example of the real success that can be achieved through PPPs (see Box 3.10). This was a world-first in irrigation, constructed with private investments in 2010.

BOX 3.9. Senyera Scheme in Spain: From a PPP Back to a WUA Operational Model

Privatization of the irrigation services in an age-old Senyera communal irrigation system in the south of Spain caused problems for users. In 2004, Tecvasa, a private company, implemented a drip irrigation system. Users were apparently not satisfied with the service and discontinued the contract when it ended after almost 10 years, reverting to a self-organized water user association (WUA) management system. The explanation is given below:

Tecvasa had the right to decide about schedules, flow rights, water distribution and the choice and quantity of fertilizer in the water. Water users maintained their rights to water shares but their right to use and control the infrastructure was withdrawn, as they did not have access to the distribution facilities and thus were not able or allowed to operate the drip irrigation system by themselves. This power, driven by the criteria of maximizing business profits, with the lack of transparency and an iron-clad contract, transferred high operating costs to irrigators, kept maintenance investments to a minimum and generated no return for users from technological improvements that were gradually incorporated into the irrigation system. Even from an exclusively economic perspective, contrary to neoliberal discourses about private, free-market management, Senyera's experience shows how collective action administers irrigation more efficiently than giving up management to a private enterprise. Much of this advantage is due precisely to the shared collaboration morality and quest for the common well-being, which outsourced management cannot provide, because they need to maximize industrial profit. ... The contract was not extended for several good reasons: high system operation and maintenance costs, the lack of transparency and access to operation facilities, and disputes about legitimacy. Furthermore, there was a strong drive to return to communal autonomy and self-governance, through a process of re-collection. Farmers remembered and re-worked their social practices, their informal networks and the benefits of collective action (Sanchis-Ibor, Boelens, and García-Mollá 2017, 46).

BOX 3.10. Morocco's El Guerdane—A World First in Irrigation PPPs

The El Guerdane scheme in the Souss region in the south of Morocco has long suffered from water scarcity. Because of the region's limited rainfall, farmers relied on private wells that pumped into the groundwater from the Souss aquifer for irrigation. Since the 1960s, the high quantities of water extraction resulted in the overexploitation of the Souss aquifer, and the level of groundwater was falling by an average 2.5 meters a year. This made the extraction of water more expensive for farmers, resulting in abandoned farmland. To remedy this problem, in 1995, the government initiated the watershed management plan of Souss-Massa, which allocated an annual 45 million cubic meters of water to the El Guerdane irrigation scheme and covered a total of 10,000 hectares. The objective was to complement the current irrigation with surface water, alleviating pressure from the stressed aquifer. Because there were concerns that a publicly funded project would require substantial public investment or lower quality of service, the government sought collaboration with the private sector. The goal of implementing a PPP scheme was to:

- reduce the public sector's subsidies for investment and operation and maintenance (O&M);
- improve sustainability and quality of irrigation and drainage service to its farmers at an affordable cost;
- promote the modernization of irrigation practices; and
- promote efficient use of water resources through the use of right incentives (volumetric).

The El Guerdane experience has been successful in many respects:

- The public sector was able to minimize its public funding (for initial investments and O&M subsidies) and procure new hydraulic assets through private sector investment.
- The farmers were able to receive better and more sustainable irrigation and drainage services at the same prices they were paying before.
- The private sector made a profit from distributed contractual risks and the introduction of innovation billing.
- Additional jobs were created through the construction and the re-energized irrigation farming sector that followed.

Other research has found that there were some losers in the process, with perceptions of marginalization on the part of some of the people in the locality (Houdret 2012). Although there were some trade-offs in regard to social and resource impacts at El Guerdane, the project is widely regarded as a financial and agricultural success.

See Appendix 2 (World Bank 2020b) for the more detailed case study on the El Guerdane BOT scheme.



Irrigation and domestic water-supply systems are inevitably used for multiple functions. This creates an opportunity to increase water productivity and reduce water scarcity.



The BOT project was successful in that it generated many new jobs in the agriexport production chains, though not without various social challenges (see Appendix 2). It reflects the deep-seated complexities, and possible gains, when designing and assessing the value of private-sector involvement in I&D MOM.

3.7 Nonirrigation Water User's Perspective

MUS Defined

In reality, people use water that is supplied by any system for different uses, whether at the household, scheme, or catchment scale. The multiple-use systems (MUS) approach recognizes this and aims to ensure that domestic water supply, or irrigation systems, are designed and managed with multiple uses and multiple users in mind. The approach explicitly acknowledges a set of diverse users that de facto share the infrastructure and water resource, often using engineered systems that were not intended to do so (van Koppen et al. 2006).

MUS evolved from a convergence of three approaches: the livelihood framework, ecosystem services, and water-services management in both irrigation and domestic systems. The **livelihood approach** shows the benefits for the poor and vulnerable in accessing available water for diverse livelihood activities. In the **domestic water-supply** sector to households, productive uses—both agricultural and small-scale commercial—show incremental benefits versus costs. The **ecosystems services** approach highlights the critical importance of upstream-downstream linkages and the related economic and environmental costs and benefits (Renault et al. 2013).

MUS approaches were developed collaboratively by several research institutes working across the spectrum of global water situations and include an array of responses that link water usage with cultural dynamics and productive priorities. A MUS view offers a more complete picture of water-management situations and facilitates more appropriate solutions to resource management and service provision challenges (Bingham 2007).

MUS at Different Scales

The MUS way of viewing water-use reality takes people's **multiple water needs as a starting point** for providing integrated water services and moves beyond the conventional design divisions between domestic, agricultural, and other productive uses.

Awareness of MUS practice at different scales is important (Renault, Wahaj, and Smits 2013):

- **At household scale**, MUS includes domestic consumption, garden irrigation, and small-livestock watering.
- **On irrigation schemes** and in addition to irrigation, MUS includes domestic water supply to villages and urban settlements; fish and water-poultry production; livestock watering; groundwater recharge; laundry and bathing; swimming and recreation; and environmental needs and impacts (waterlogging, drainage, downstream releases, and so on).
- **At watershed scale**, MUS also covers multisectoral use at a higher scale, including agricultural, hydropower, urban-domestic, industry, mining, and recreational sectors. Addressing these higher-level competing needs in a water-stressed world is a priority. Integrated water resources management (IWRM) governance approaches for engaging with these challenges are most important but beyond the scope of the resource book.

THINK ABOUT SYSTEM PERFORMANCE FROM THE PERSPECTIVE OF:

- irrigators
- domestic users
- livestock farmers
- fisherpeople
- water poultry farmers
- recreational use
- hydro power
- downstream users
- environmental needs

Thus, there are different entry points to considering MUS, whether linked to the origin of existing systems (water supply or irrigation) or new interventions or projects (domestic supply, irrigation, or watershed conservation and development). Although the perspectives of other nonirrigation water users are grouped together, they are obviously diverse in their purpose and the level of service that they need.

Low Volumes but High Importance

Independently or as a group, **non-irrigation users** supplied by the irrigation system generally demand only a small fraction of water volume. Although volumetric impact is likely to be relatively small, the performance demands of domestic water supply can be completely different. Most notably, domestic supply requires much higher levels of reliability because people need water 365 days a year, which can have significant operational implications for the irrigation supply operators and technical demands on the system.

Regardless of the challenges, an MUS-sensitive approach to technical system design and water-management arrangements is of high social and economic importance and will, therefore, have a significant bearing on the planning, design, and management of systems. Awareness of the de facto and likely future diverse users and understanding their performance requirements is essential to achieving

MULTIPLE USES ARE OF HIGH SOCIAL IMPORTANCE

Irrigation practitioners (technical and institutional) need to design with the different performance criteria of multiple users in mind.



appropriate technical and organizational responses. These responses will contribute to increasing benefits from existing and planned irrigation interventions.

AGRICULTURAL VERSUS DOMESTIC SUPPLY PARAMETERS

There are marked differences between agricultural and domestic water supply performance criteria. These differences are widely misunderstood (Mason et al. 2013) and can lead to mistaken water-services concepts and solutions being applied to irrigation services (see more in Appendix 1).

Agricultural Water Supply—Technical and Management Implications

Agricultural demand includes three main areas: irrigation users, livestock-farming users, and fish-farming users. These are discussed in overview from a management perspective.

Irrigation demand: Agriculture demand is highly heterogeneous, given diversification of crops; changing markets and the ongoing development of alternative water sources; and irrigation demand over time and across the scheme spatially. Although design-stage assumptions are necessary to inform technical decisions, they, along with significant management challenges, have to be addressed from the start of actual irrigation operations (Renault, Wahaj, and Smits 2013). A key difference between irrigation services and other MUS services appears over the course of the year, between growing and rainfall seasons. Irrigation needs at the peak of the season can be 10 times the demand at planting time. It can also be zero at certain times of the year, when crop cover combined with climatic conditions do not call for additional water for growth (Renault, Wahaj, and Smits 2013).

Livestock services: Water services to livestock are a “direct service” and a reality on most smallholder schemes in developing countries where livestock make an important contribution to their livelihood (Renault, Wahaj, and Smits 2013). This can be the cause of major social conflict when resources are scarce, exemplified by warring factions and strife between pastoralists and irrigators—for example, in Nigeria and Tanzania. Livestock quantitative demands (cattle use 20 to 25 liters per day; goats, sheep, and pigs use 5 to 7 liters per day) are small relative to irrigation demand, but livestock require water reliably and in an easily accessible way for drinking, cooling, and cleaning. Designs that accommodate access ramps into canals and watering troughs supplied by canals can ease these kinds of tensions. Access paths and bridges are also key services needed to accommodate livestock and avoid or minimize damage to canals and other water infrastructure.

Aquaculture: The Food and Agriculture Organization of the United Nations (FAO 2000) identify that fishing can be divided into two main systems: (a) land-based systems, including purpose-specific ponds, or ad hoc use of canals and rice-irrigation paddies and (b) systems in which enclosures such as cages or rafts are used within larger bodies of water, such as lakes, reservoirs, or rivers (and the sea). There is

extensive fishing in whatever water bodies are accessible to intensive capture-fisheries, supplied in the MUS case, by irrigation scheme hydraulic systems. Fishing can also be part of a household's livelihood, combined with irrigation farming, or it can be a separate enterprise. If fish are included in the paddy-field system, the irrigator's combined requirements have to be met, impacting both volumes supplied and seasonal demand. If aquaculture is a standalone system—for example, in ponds within an irrigation scheme—the particular water-supply cycle of that system has to be identified and accommodated in the service regime (Renault, Wahaj, and Smits 2013).

Domestic Water Supply—Technical and Management Implications

Domestic water is required for multiple purposes with different quality and quantity requirements. Domestic water uses include drinking, cooking, laundry (clothes washing), bathing, sanitation, and peripheral household activities such as car washing, some of which require much lower-quality levels than others. Renault, Wahaj, and Smits (2013) describe a case in Sri Lanka that resonates with many irrigation schemes in the developing world. Laundry and bathing water is mostly provided by water in the canal system, whereas drinking and cooking water is derived from standpipes or groundwater hand pumps. This kind of grouping is termed *partitioning of service requirements* and can be a useful tool in planning for the required services.

Irrigation services and domestic water-supply services have broad similarities but do not share many institutional arrangements. There is a tendency to oversimplify I&D challenges by applying solutions that work in water services. This can be misleading about ideas of tariff setting, operator arrangements, and enforcement, among others. Although both drinking water and irrigation water-supply systems must manage and transport water using costly infrastructure, I&D institutional arrangements tend to be distinct from those of drinking-water supply. In a MUS context, this brings management complexity. A detailed comparison between domestic and agricultural water-supply service-delivery modalities and considerations is provided in Appendix 1.

Closing Note on Multiple-Use Systems and Service Provision

The discussion in this section on MUS shows that irrigation, livestock, aquaculture, and domestic water users have different kinds of needs that translate into different operational parameters, all of which require diverse institutional and management responses and complicate scheme planning and operations. Demands are highly varied spatially across schemes and over time within a scheme. MUS is inevitable, and careful attention needs to be paid to how these different users are consulted and included in planning processes. Their needs must be quantified and provided for by the irrigation operational entity—whether WUO, I&D agency, or commercial sector operator. The Mapping System and Services for Multiple Uses of Water Services (MUSMASS) approach and software



package formulated by FAO (Renault, Wahaj, and Smits 2013) is a purpose-specific MUS planning and operational tool for this purpose.

A MULTI-STAKEHOLDER PARTNERSHIP APPROACH

- Allow groups to collaborate and contest solutions to large and complex problems
- Can be short term or multiyear engagements and be structured or improvised in nature
- Different groups can have a shared problem or goal while having diverse and competing interests

INSIDE KNOWLEDGE IS ONE KEY



The in-country water-resource, irrigation, and farming stakeholders have rich insights on the problems and possible solutions. Ask and listen.

3.8 Mobilizing Stakeholders—Pointers for Action

A Multi-Stakeholder Partnership Approach

Effective stakeholder engagement is key to identifying problems and making meaningful reforms to I&D governance. There are strategic ways of working with diverse groups that can both unlock innovation and achieve longer-term governance collaboration. An MSP is one such example. A detailed guideline, developed by the Centre for Development Innovation at Wageningen University (Brouwer and Woodhill 2016) is outlined in Box 3.11 and can be referred to for more detail.

The MSP approach is a “form of governance, a way in which groups of people can make decisions and take action for the collective good, be it at local, national, or international scale” (Brouwer and Woodhill 2016). This process can take many forms, such as a short-term partnership or a multiyear engagement through coalitions, alliances, and platforms or even participatory governance. These partnerships can be very structured or more improvised and fluid. The essential objective is to allow groups to collaborate and contest solutions to large and complex problems or help capitalize on potential new opportunities. An MSP is based on the overarching concept that different groups can have a shared problem or goal while having diverse and competing interests.

So regardless of form, to function well, MSPs should have most of the following characteristics:

- Shared and defined “problem situation” or opportunity
- Engage all key stakeholders in the partnership
- Work across different sectors and scales
- Follow an agreed-on but dynamic process and timeframe
- Involve stakeholders in establishing their expectations for a good partnership
- Work with power differences and conflicts
- Foster stakeholder learning
- Balance bottom-up and top-down approaches

BOX 3.11. A Multi-Stakeholder Partnership Approach: Tools and Methodologies

- **Stakeholder identification:** Who are the main stakeholders, and how do we know the right ones are involved? (See online Appendix 1 [World Bank 2020a] for more on stakeholder identification.)
- **Power:** How can we deal with power differences?
- **Common goal:** How can we define a common goal between diverse stakeholders? Should there be one?
- **Governance structure:** How do we organize our collaboration and decision making?
- **Conflict:** How do we deal with conflicts between stakeholders?
- **Capacity:** What can we do if essential stakeholders lack the capacity to lead and deliver?
- **Efficiency:** In which situations are MSPs not the right choice?
- **Tools:** What tools are available for helping the MSP achieve its goals?
- **Facilitation:** Who should facilitate an MSP: one person or a group? From within the system or an outside professional?

Source: Brouwer and Woodhill 2016.

There are various consultation approaches that fit different situations. Careful consideration must be given to the reason for consultation, the capabilities of those being consulted (for example, language skills, literacy levels, location along the system, understanding of issues, seniority within an organization, and so on), and the timescale and resources that are available.

A detailed stakeholder identification and analysis process is included in Appendix 1 (World Bank 2020a) of the resource book, which helps identify who needs to be involved and the nature of their involvement. This ranges from simply being informed to being consulted to actively participating in decision making.

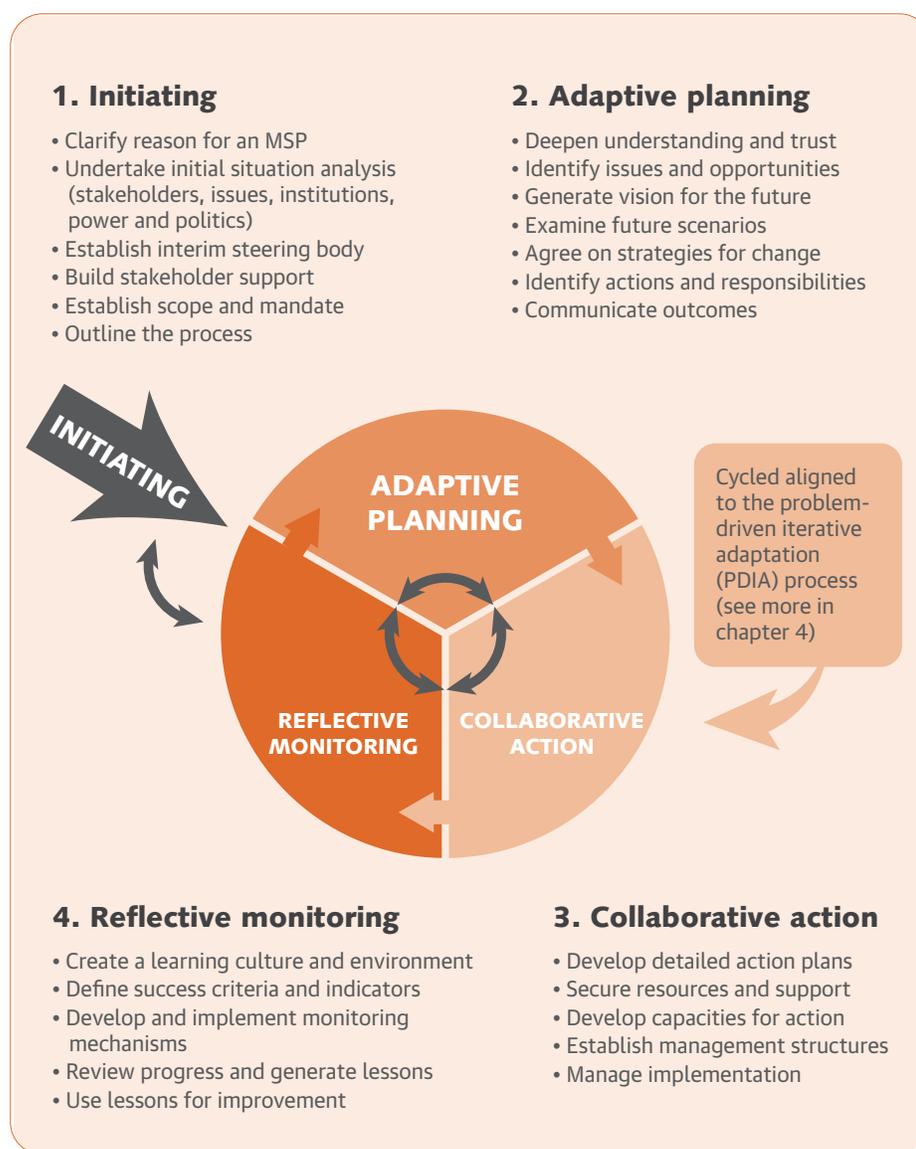
There are seven principles that inform MSP engagement and will increase the chance of meaningful outcomes (Brouwer et al. 2016). Although MSPs may be planned ad hoc, there are four phases that guide the design of the MSP process, which is illustrated in Figure 3.7.

The phases are closely aligned to the Problem Drive Iterative Adaptation (PDIA) process that is suggested to be a useful technique to guide the process of taking action (more on this in Chapter 4). One underpinning theory in both MSP and PDIA is the Kolb action-learning cycle (Kolb 1984). The MSP approach outlined here can thus be seamlessly integrated into the PDIA steps described in Chapter 4.

There are many types of MSP activities that can be used to work with groups to explore and define problems and develop solutions (see Box 3.12, Brouwer and Woodhill 2016 for more). MSPs help to build connections, establish shared



FIGURE 3.7. The MSP Action-Learning Cycle



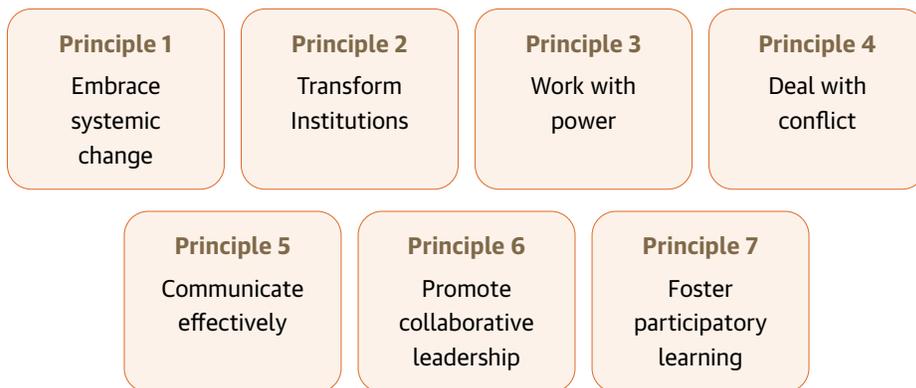
Source: Brouwer and Woodhill 2016.

Note: MSP = multistakeholder partnership; PDIA = problem-driven iterative adaptation.

language, co-create, and generate commitment leading to the convergence of ideas and the resolution of divergence.

Information-Gathering to Inform Stakeholder Dialogue and Consultation

Participatory rural appraisal (PRA) was developed nearly four decades ago (Chambers 1981) but is still a highly suitable way to learn about rural conditions in



a rapid and cost-effective way. PRA facilitates direct engagement with stakeholders and includes the following key features:

- Faster-than-conventional data-gathering processes
- Learning directly from potential beneficiaries and other stakeholders
- Building trust and relationships
- Opportunities to build innovations and flexibility in solutions

Although a full PRA may not be feasible during time-bound and high-pressure reconnaissance or fact-finding visits, there is much that can be gathered in advance from desk reviews and initial field visits. PRA is a fast and useful way to develop an initial

BOX 3.12. Types of MSP Activities and Events

- **Preparation and planning meetings** involving those who are initiating, organizing, or facilitating the MSP
- **Individual or small group meetings** with key people whose support and influence are critical
- **Meetings of a steering or advisory group** established to help guide and support the overall MSP process
- **Multi-stakeholder workshops** involving various combinations of relevant stakeholders
- **Single-stakeholder workshops** that enable a single group or sector to prepare for engaging in the MSP
- **Working groups** that undertake specific organizational, research, or communication activities
- **Field visits** and study tours
- **Seminars or conferences** that engage a wider audience
- **Media events**

Source: Brouwer and Woodhill 2016.



snapshot understanding of the situation. This can be followed up with a more comprehensive and methodical process, including specialists and relevant agencies such as NGOs and academic institutions, to inform the analysis and planning process.

Read before You Think

An essential starting point is a desk review of in-house reports, other agency project reports, and research documents. These provide context and start to frame who the key stakeholders are likely to be. Consulting with colleagues who have engaged in the sector, or in the same location, is also valuable. Often it is the unrecorded insights of experienced individuals, and their understanding of institutional aspects and key people to consult, that provides deeper insight.



Walk before You Talk



Getting into the field is the best way to get oriented on irrigation issues. Footwork and field inquiry, seeing the physical reality, walking the canals, and listening to farmers, operators and stakeholders provides perspective that cannot be obtained from reports or journal papers. Maps, satellite images, and reports can inform a walk-through plan of the irrigation system. Transect walks, including to the source, the main hydraulic elements, and the most downstream of the irrigated lands, are particularly useful. The walks will generate active discussion from farmers and other scheme stakeholders on history, problems, and possible solutions that provide invaluable context.

Google Earth and Digital Tools

Google Earth is one of the easiest and immediately available tools with capabilities far beyond satellite images. It is a valuable first point of entry. Google Earth allows rapid visual orientation: overview of topography, the irrigation system layout, cropped areas, other water bodies and sites of interest like villages, and urban areas prior to traveling to the project site. Other Internet data searches (just Google it) can access all sorts of information like reports, legal documents, and other literature and information (for example, FAO AQUASTAT water resources maps). Where available, geographic information system (GIS) platforms can be used to quickly access meta-data and other site-specific information.

Overcoming Resistance to Change Using Threshold Theory

Behavior in groups and the power of peer pressure: Threshold theory is used to understand why groups behave like they do and provides a model for collective

behavior, from ants to wildebeest to human society. The basic premise, put forward by Granovetter (1978), is that individual actors (be they insects, wildebeest, or people) will make a choice between two alternatives depending on how many other actors around them are behaving in that way. Each individual is not, however, influenced by the same level of group behavior; some will decide to change after only one or two others have done so, whereas others will require many in the group to make the change before they do.

The threshold model shows that behavioral change can be promoted through peer pressure, and it explains some unusual behaviors from individuals when they are part of a group. Most famously, threshold theory explains why people who are normally law-abiding citizens participate in riots. Applied to development, it shows how groups can rise up against seemingly insurmountable challenges like corruption or systemic incompetence. Granovetter (1978) relates threshold with the benefit that one gets from participating in collective behavior or not. This means that everyone will, consciously or unconsciously, will calculate the costs and benefits from acting in one way or the other. Those costs are often linked to beliefs or religious and cultural values.

In relation to I&D institutional development, the key is to achieve understanding of the issues and to create space for “lead individuals” with low thresholds to see the value and then articulate and support the change. For example, societies and cultures with a strong collective tradition often have difficulty implementing water-related sanctions on irrigators who do not conform to rules or do not pay. For example, sanctioning older people, particularly those who are poor, or widows is often difficult. Although these collective values are socially admirable, failure to pay and the resultant cycle of free riding (which itself has characteristics of threshold behavior) can lead to MOM failure, contract breach with a bulk-water supplier, and a resultant lack of irrigation supply for all. Threshold theory posits that the cost of conforming to social values and norms would be weighed by individuals against the costs of a failure to receive irrigation water (assuming that the causal linkages are well understood).

Using threshold theory to change perspectives in such situations would create space (through facilitation in groups) for individuals who understand the failure cycle and support the principles of fee payment, as well as enforcement, to raise their voices. When they do so, those with the lower threshold can be prompted to change, and so on, until the wider group is mobilized to a shared viewpoint. In facilitating

A STRATEGY TO TRIGGER ATTITUDINAL CHANGE



Threshold theory provides a strategic way of promoting a cascade of change from within a group by first enabling those individuals with low thresholds to raise their voice.

YOUR THRESHOLD FOR SOCIAL ACTION?



In simple terms, your threshold is the number of people who have to do something before you join in.



change—and in particularly overcoming the first threshold level—trust between the practitioner and potential agents of change is of high importance.

Building Trust and Creating Space for Voice

Trust is critical to promoting changes in viewpoint. Stated simply, people are unlikely to accept new ideas from someone until they have a sense of personal trust in that individual. When trust is low, every communication interaction and decision is burdened by uncertainty and the second-guessing of motivations. This slows down progress. By contrast, when individuals or groups operate with high levels of trust, it acts to catalyze performance. Communications and decisions are better, simpler, and quicker, leading to much better outcomes.

Interpersonal trust is then a factor for practitioners moving to make changes to the status quo. Avenues of change will inevitably leave some people feeling discomfort—either because of loss of power, access to financial control, or control of physical assets. The time spent establishing trust with a group, and building relationships, is an important investment. It warrants conscious attention to how this can be done and justifies time in doing so.

Note

1. “Institutional bricolage is a process through which people, consciously and non-consciously, assemble or reshape institutional arrangements, drawing on whatever materials and resources are available, regardless of their original purpose. In this process, old arrangements are modified, and new ones invented. Institutional components from different origins are continuously reused, reworked, or refashioned to perform new functions. Adapted configurations of rules, practices, norms and relationships are attributed meaning and authority. These refurbished arrangements are the necessary responses to everyday challenges and are embedded in daily practice. Bricolage is a fundamentally dynamic process characterized by variable levels of institutional visibility and functioning” (Cleaver and de Koning 2015, 4).



CHAPTER 4.

Solving Performance Problems

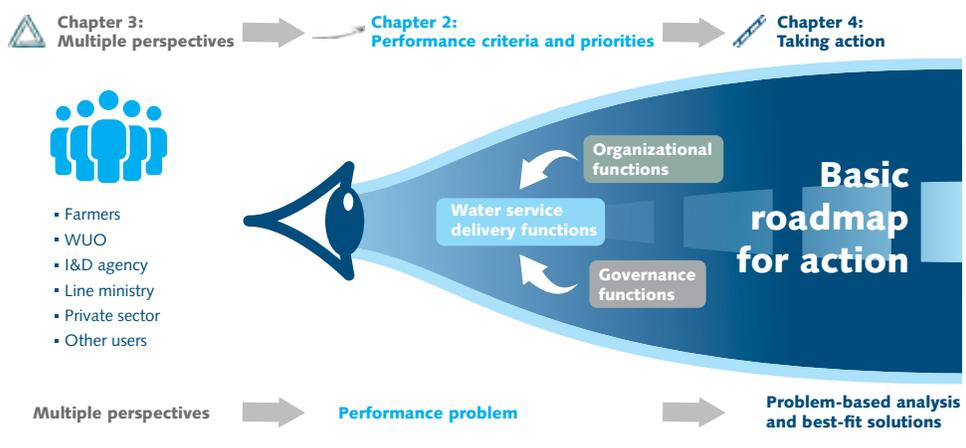
This chapter suggests a roadmap for action around a problem definition and collaborative solution development.

4.1 The Framework for Action

This final chapter is about acting. The content follows from the two main conceptual building blocks in the resource book—that of service-delivery performance (Chapter 2), which has to be viewed from different stakeholder perspectives (Chapter 3). The conceptual framework is shown again in Figure 4.1.

The chapter is framed on an action-learning cycle that is a central to both the multi-stakeholder partnership approach (MSP) and the problem-driven iterative approach (PDIA). The main precept is that solutions to irrigation and drainage (I&D) governance challenges cannot be found through a linear process. Action learning involves a process of conceptualization, action, concrete experience (outcomes),

FIGURE 4.1. The I&D Resource Book Approach—Action Informed by Appreciating the Needs of Multiple Perspectives on Service-Delivery Performance



Note: I&D = irrigation and drainage; WUO = water user organization.

and reflective observation (Kolb 1984). Plans are systematically and continuously redefined based on the learning process. The basic road map is summarized here and expanded in the rest of the chapter:

Basic road map for action

Reflect on expectations:

Ask who needs what kind of performance

Define problems and set objectives:

Use research, fieldwork, and work with MSPs.

Plan and act:

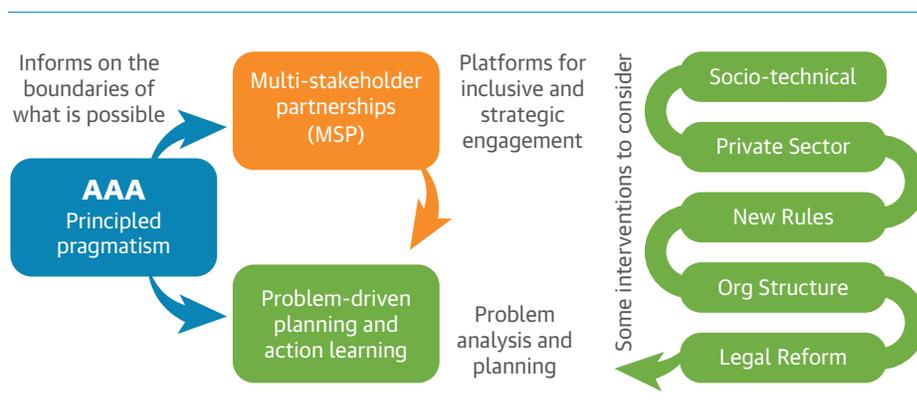
Get the ball rolling in an action-learning & planning process.

CATALYZE CHANGE

Long-term workable solutions lie within the government organizations, irrigators, and other groups affected by irrigation schemes. The real task of the outside expert is to be a catalytic force to trigger, and then facilitate, a process of discovery, learning, problem solving, and action planning.

Chapter 4 starts with a section on ways of thinking and working when moving to action. These include: three overarching governance principles; using the working concept of principled pragmatism; and pointers to how legal reform can be used as an instrument of change. These are easily aligned and used with iterative learning approaches. Stakeholder engagement underpins the process and is facilitated by creating multi-stakeholder partnerships (MSPs) to identify problems, explore options and develop solutions (MSPs are outlined in Chapter 3). The relationship between all the concepts and approaches is shown schematically in Figure 4.2, followed by more detailed descriptions in the rest of the chapter.

FIGURE 4.2. Overview and Interconnection of Principled Pragmatism, MSPs, and PDIA Approaches



Note: AAA = authority, acceptance, and ability.

TRIPLE A – PRINCIPLED PRAGMATISM

Principled pragmatism revolves around an inquiry into authority, acceptance, and ability (AAA). It is a framework for inquiry rather than a method and enables a more guided exploration of the boundaries of what is realistically possible in a given political and capability context. Using AAA enables more strategic information gathering and facilitation in the multi-stakeholder engagement process and solution building in the PDIA process, particularly PDIA Step 4.

MSP – A MULTI-STAKEHOLDER PARTNERSHIP APPROACH

The use of an MSP facilitates constructive engagement with the parties who are involved in I&D service delivery. The approach is useful for all stages of the action road map. A premise of the resource book is that the “insiders” on a scheme or within a country, usually with competing interests, will be the ones best equipped to identify the core problems and develop appropriate solutions. The most that “outsiders” can do is to facilitate, consult, inform, and catalyze the process. An MSP approach ensures inclusion and supports constructive resolution of problems (Brouwer and Woodhill 2015).

PROBLEM-DRIVEN PLANNING AND ACTION LEARNING

Problem-based analysis, action-oriented decision making, and ongoing revision is best achieved in an action-learning cycle (Kolb, 1984). One tool is PDIA, outlined in this guide. This and other similar approaches enable groups to define binding institutional constraints, followed by problem definition, leading to options for solutions. These kinds of approaches provide direction to groups and teams as they explore practical, feasible solutions to address key the binding organizational and institutional constraints (Andrews et al., 2017; Srivastava et al., 2019).

4.2 Key Features of Good Governance

Good governance in I&D water services provision is the main goal. An effective framework that motivates individuals or entities to act collaboratively has three core elements (based on Mumssen, Saltiel, and Kingdom [2018], amended for an irrigation context):

TRANSPARENCY is composed of all possible ways that irrigators can access information to ensure a sound understanding of decision-making mechanisms in their organizations. A requirement of *transparency provides a motivation* for the actors who are responsible for service delivery to carry out their tasks in an exemplary fashion.



PARTICIPATION refers to the procedures by which water users engage in the management, operation, and maintenance (MOM) of systems to achieve their desired level of water service provisions. By giving attention to users' rights and responsibilities, they will be meaningfully involved in decision-making processes. Thus, *stakeholders are likely to be more motivated* to comply with legal rules and regulations.

ACCOUNTABILITY concerns “the obligation of one actor to provide information about and/or justification for his or her actions in response to another actor with the power to make those demands and apply sanctions for non-compliance” (Wetterberg & Brinkerhoff 2016). Accountability directly determines the primary incentives to which the leadership of water user organizations (WUOs), irrigation agencies, and private sector operators of irrigation schemes respond. *These incentives are linked to performance criteria* defined by (service) agreements for irrigation supply and by the governance structure of the higher-level organizations (WUO, irrigation agency, operator) to the water user.

TARGETED LEGAL AND REGULATORY REFORM IN SUPPORT OF CHANGE

Not all problems in irrigation and drainage require support from laws and regulations, but some do. Consider how legal reform targeted at specific constraints can support desired actions to be taken, rather than attempting wholesale “best-practice” legal reform to lead governance changes.

4.3 Legal and Regulatory Reform: An Instrument of Change

Legal and regulatory reform offers opportunities for nuanced changes as well as fundamental shifts to the rules of the game. The way reform has been undertaken in the past is one possible contributing factor for the irrigation and drainage governance gap. There is often a quest to put in place an ideal “enabling legal environment” for irrigation and drainage (and water resources management), which has led to laws and regulations that look remarkably similar across countries, regardless of local context and capability to implement them. Some legal frameworks are rendered functionally irrelevant to the problems identified at the ground level. These failures should not be reason to shy away from using legal frameworks. They

can be tools to convey the authority to take action, clarify roles and responsibilities, or place obligations on water users and public entities to enforce behaviors.

The content of the existing legal framework helps shape the field of which actions are more feasible and which are more difficult to take. When stakeholders are asked to define specific problems to address, they often prioritize the overall weakness of the legal framework. There may, however, be a very narrow gap or constraint that implicates legal or regulatory provisions and contributes to the perceived problem. When trying to identify possible solutions, it is important to recognize that certain action options may need targeted legal or regulatory provisions. Some may go beyond irrigation and drainage to the broader legal frameworks for water resources management, environment, and administrative law. When it comes to taking a chosen action, having a good understanding of the wider legal framework can inform targeted changes that are needed to strengthen the authority to act. The Institutional Diagnostic Tool (IDT) produced by the World Bank is a useful application for understanding the existing legal and regulatory arrangements for the water sector within a country.

If drafting amendments or new legislation or regulations is required to take the desired action, then effective navigation of political realities and principled pragmatism, discussed in the next section. ‘Institutional bricolage’ is also a useful, even essential approach, and entails the assembly, or reshaping of institutional arrangements, using whatever materials and resources are available (Clever and de Koning 2015). For legislation and regulation to be effective, their objectives, form and function should align with the political economy realities and institutional framework of the country (Mumssen et. al., 2018b). The burdens from broad legal framework reforms can easily add up to levels that are not implementable, unless each provision is specifically tailored to the purpose. Coherence and comprehensiveness of the overall legal framework are essential, but equally important is the detail that allows responsiveness to specific problems.

Finally, it is important to recognize that legal frameworks can sometimes pose inherent challenges for iterative adaptation in irrigation and drainage, but there are ways to try to address this. In many countries, the lawmaking process—and the regulation-making process—can take years or even decades. Even if there is recognition that something is not working, or is not implementable, it may not be politically feasible to make any changes. Thus, the choices that are made in laws and regulations can have long-lasting impacts. Evaluate critically what is needed in primary legislation within the context of the country’s legal tradition. First see what can be included in easier-to-change regulations and where changes can be made using ‘bricolage’ to solve the specific I&D governance problems. Only then consider change to higher-level legislation as essential.

4.4 Principled Pragmatism—The Triple-A Viewpoint

It is a major challenge to identify legal, technical, and institutional solutions that are technically and financially feasible, and these can still be incompatible with the existing incentive structures and norms. Designing institutional reforms requires making realistic predictions as to whether they are administratively and politically feasible. To help with this, Andrews, Pritchett, and Woolcock (2017) present the idea of principled pragmatism, the main idea of which is that the opportunity and space for change is affected by three factors: **authority, acceptance, and ability (AAA)**.

Following these three elements of principled pragmatism provides a basis for pragmatic inquiry regarding issues in the exploratory and consultation processes and in defining solutions through the PDIA process. A facilitated discussion with the various actors (multiple perspectives described in Chapter 3) in engagements, such as those described in the MSPs, will give insight into what is realistically possible. “Getting real” greatly increases the chance of successful outcomes.

Table 4.1 provides a line of questioning to guide stakeholders through this prioritization process, assessing the authority to engage, the degree of acceptance, and the ability to effect change.

The results from these discussions can be conceptually presented in Venn diagrams (Figure 4.3). When discussing causes leading to performance deficiencies, for example, stakeholders might identify that high levels of authority, acceptance, and ability already exist for resolving the problem, which indicates a large change space or positive inclination for radical or aggressive reform in the short term.

GET REAL WITH PRINCIPLED PRAGMATISM

Authority refers to the support (political, legal, organizational, and personal) needed to affect reform or policy changes or build state capability. Certain reforms require more authority than others; hence, it is crucial to gauge the amount of authority one already has and the gaps that need to be addressed.

Acceptance relates to the degree to which those who will be affected by reform or policy change accept the need for and implications of change. Any action for reform will have different levels of acceptance.

Ability concentrates on the practical side of reform or policy change and the need for time, money, skills, and the like to even start any kind of intervention.

Source: Andrews, Pritchett, and Woolcock 2017.

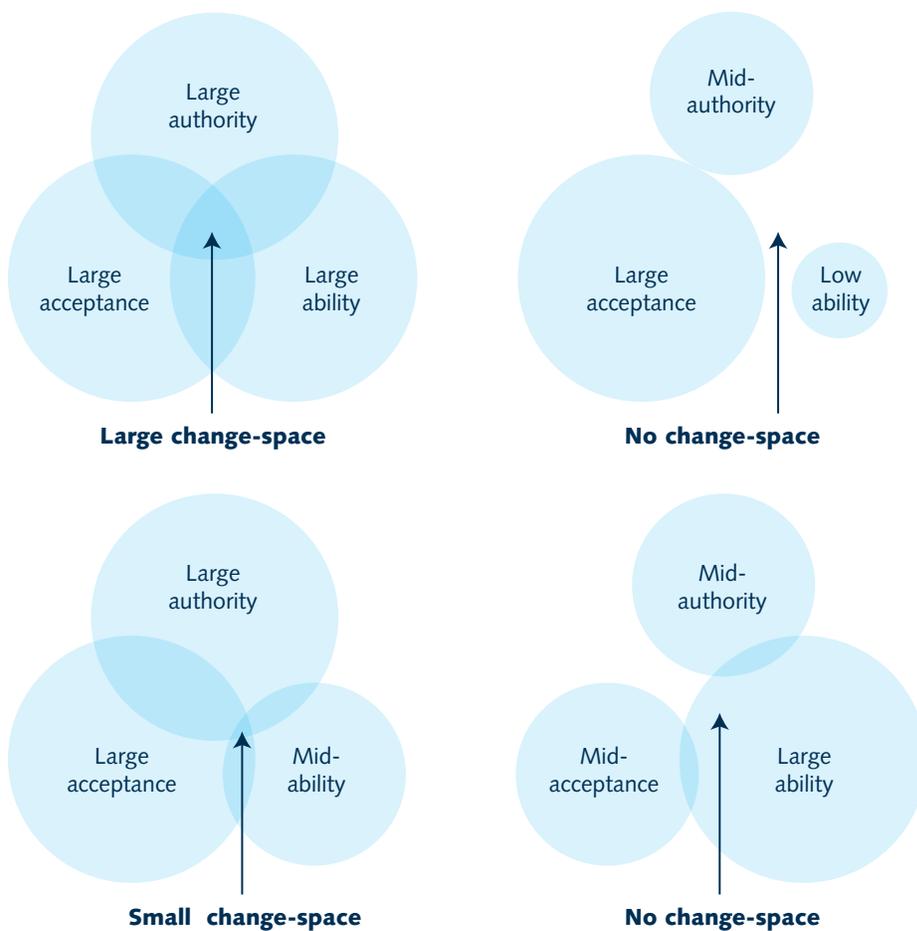
TABLE 4.1. Line of Questioning to Gain a More Pragmatic View of Reality

	Questions to help you reflect on the contextual change space	AAA estimations (low, mid, large)	Assumptions
Authority	<p>Who has the authority to engage:</p> <ul style="list-style-type: none"> • Legal? Procedural? Informal? <p>Which of the authorizer(s) might support engagement now?</p> <p>Which probably would not support engagement now?</p> <p>Overall, how much acceptance do you think you have to engage, and where are the gaps?</p>		
Acceptance	<p>Which agents (person or organization) have an interest in this work?</p> <ul style="list-style-type: none"> • For each agent, on a scale of 1-10, think about how much they are likely to support engagement. • On a scale of 1-10, think about how much influence each agent has over potential engagement. • What proportion of "strong acceptance" agents do you have (with above 5 on both estimates)? • What proportion of "low acceptance" agents do you have (with below 5 on both estimates)? <p>Overall, how much acceptance do you think you have to engage, and where are the gaps?</p>		
Ability	<p>What is your personnel ability?</p> <ul style="list-style-type: none"> • Who are the key (smallest group of) agents you need to "work" on any opening engagement? • How much time would you need from these agents? <p>What is your resource ability?</p> <ul style="list-style-type: none"> • How much money would you need to engage? • What other resources do you need to engage? <p>Overall, how much ability do you think you have to engage, and where are the gaps?</p>		

Source: Andrews, Pritchett, and Woolcock 2017. Reproduced with permission of Oxford Publishing Limited.

Note: AAA = authority, acceptance, and ability.

FIGURE 4.3. Identifying “Space for Change” Using a Triple-A Analysis



Source: Andrews, Pritchett, and Woolcock 2017. Reproduced with permission of Oxford Publishing Limited.

Areas that are identified to have small or no change space signal that stakeholders believe that the gaps in authority, acceptance, or ability need to be addressed before resolving the problem. This would demand a longer time horizon.

Expanding the space for positive change identified through a Triple-A perspective increases the likelihood of reform outcomes being politically and administratively feasible and, therefore, increases the chance of success. One of the best ways the “change space” can be expanded is by using MSPs.



EINSTEIN ON PROBLEMS



“If you have one hour, spend 59 minutes defining the problem and one minute resolving it.”



4.5 Problem-Driven Action-Learning Planning Approach

A Problem-Centered Approach

Taking time to identify problems is critical to solving them. Once a problem is properly defined, best-fit solutions rather than blueprint solutions can be formulated. Cameron (1986) highlights the importance of a problem focus, noting that institutional change and improvement will be best achieved through *knowledge of the problems rather than knowledge of success*. The risk of not paying careful attention to defining the problem is that spurious solutions are developed and don't address the fundamental issues.

Avoid the Isomorphic Mimicry Trap

There is a natural tendency to propose solutions based on broad issues such as “poor irrigation performance” or “low agricultural productivity.” In other words, the effect is defined and then routinely attributed to a range of assumed causes or constraints, including: (a) weak institutional capacity of the irrigation agency; (b) deteriorated irrigation infrastructure caused by deferred operation and maintenance (O&M); (c) low cost recovery from water users for irrigation services provided; and (d) limited water-user participation in scheme MOM. *The actual problem is often missed in this process.*

Instead, a set of “solutions” with predetermined outcomes, such as a blueprint irrigation management transfer (IMT) and participatory irrigation management (PIM) approach, is deemed appropriate. Such blueprint approaches include: (a) strengthening or transforming the irrigation agency; (b) rehabilitating irrigation infrastructure; (c) establishing cost recovery through measurement of water; and (d) establishing water user associations (WUAs) or strengthening their capacity for improved tertiary and field system performance. These components are translated into project financing areas, with relevant baseline and monitoring and evaluation indicators attributed to meeting activities-oriented targets. However, these may not be the best and most cost-efficient responses to the actual problem.

Effective problem definition requires setting aside preconceptions, beliefs, and assumptions, and each situation needs to be approached with an open and critical mind. There is a natural tendency when facing problems to repeat what worked before based on experience of what worked elsewhere. Using solutions that are translated with a focus on form, rather than function, or that mimic other successes, processes, and systems is called *isomorphic mimicry* (Andrews et al. 2007).

Writing on “best-fit” institutional solutions (Srivastava et al. 2019) point to the fact that imported institutional models tend to perform worse than locally owned solutions. The latter are much more likely to fit the institutional and political context and achieve better service delivery. The PDIA is a way of working to identify problems and solve them, effectively avoiding the trap of mimicry.

A Search-Frame Analysis and Planning Approach

One useful approach based on the Kolb learning cycle is PDIA. This was developed by the Harvard Centre for International Development and is a practical technique to identify and solve local institutional problems in complex systems, in an inclusive way (Andrews et al. 2017). It aims to build organizational capabilities through learning iterations to execute and implement institutional responses. It seeks to obtain institutional reforms using a non-linear approach, aiming for “best fit” solutions to achieve a greater degree of success. Key elements include:

- engaging a broad set of stakeholders to bring in various perspectives and provide a more viable and realistic set of reforms;
- the facilitation of problem-driven learning;
- stepwise interventions that enable an iterative process, allowing review and reflection of assumptions to arrive at a solution; and
- review of action-based learning.

The process can be simplified into a sequence of actions that are expanded below (drawing on Srivastava et al. 2019). These steps are conceptual and need to be

customized to each situation and can be used as needed. They provide a navigation route from the functional problem (i.e., lack of performance) through to the core problems and then prompt the formulation of best-fit solutions through an action-learning process.

UNDERSTAND THE CONTEXT

The first step is to understand the local context that is relevant to delivery of services—most important is the institutional architecture and the associated political economy. Reform efforts that are conscious of political and economic realities tend to work in line with undeniable overarching norms and practices and are more likely to succeed.

- **Historical and political context:** Consider the historical background, such as the colonial legacy, and how this would have influenced irrigation practices and development. Issues of political settlement, institutional and organizational complexity, civil war and conflict, and so on can leave a legacy of depleted capacity.
- **Organization of government:** The national, regional, and local organizational and institutional (legal) arrangements are essential building blocks of problem analysis. The different tiers of government and their de jure and de facto roles and responsibilities need to be clarified and mapped.
- **Responsibilities for I&D service delivery:** Map out the entities and relationships of the various government entities involved in practical water management, including ministries, departments, agencies, cooperatives, WUAs, and so on. Consider who carries the legal responsibility for service provision and which entities actually deliver the services (also called production and can be delegated to service contractors and so on). Define their roles and functions in relation to the services.
- **Service characteristics:** Identify the type of services that are provided, including (a) public or private; (b) market weaknesses and failures (monopoly, externalities, information asymmetries); (c) tasks and transactions involved; and (d) demand characteristics (that is, performance criteria).

FIVE WHYS TO GET TO THE ROOT OF THE PROBLEM

IDENTIFY THE FUNCTIONAL PROBLEM

Deconstructing the problem is key to finding solutions. A multi-stakeholder engagement process is the best way of capturing all perspectives on key problems, using MSPs as described in Section 3. There are a number of overarching questions that are useful to identify the functional problem:

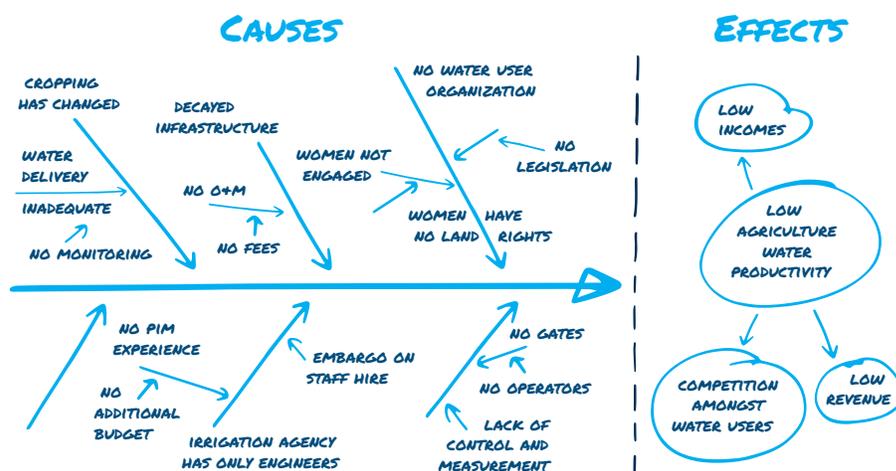
- **What is the sector performance problem?** Problems should be defined in terms of their functional deficiencies and not the absence of certain forms. Functional failures are those that lead to performance failures.
- **Do these problems have a clear link to poor development outcomes?** In other words, make sure to identify the problems that really matter. Think about which of the problems would best explain the service-delivery failures.
- **Are these problems widely acknowledged as being important?** Ask: Is there motivation within the government and within other influential stakeholders (private sector, farmer groups, financing agencies, and so on) to address the problems? To whom does it matter, and who needs to care more? This will throw light on who can influence change or who is affected by it. It will also identify likely resistance to change and lead to discussion on how disinterested parties can be motivated to give issues more attention.

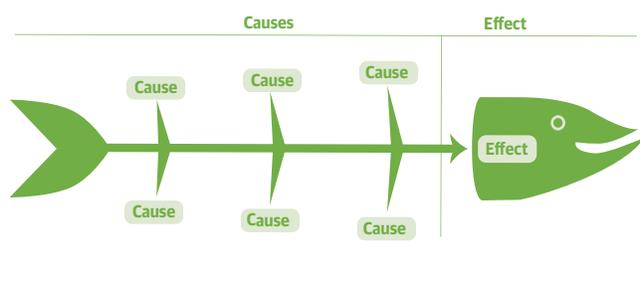
To drill down into the causes these questions seek to answer, the five whys can be asked until all reasons and answers are exhausted along each main cause. The technique requires group work to identify the problem, to ask why it is happening, and then to repeatedly query the reasons (five times why) until the core issue becomes clear.

DIAGNOSE BINDING CONSTRAINTS

Binding constraints are those that have the closest proximity to the problem—that is, are causal. There are many problem definition techniques, and one of the most useful is the fishbone (Ishikawa) method. The fishbone diagram illustrates the

FIGURE 4.4. Example of Fishbone (Ishikawa) Problem Analysis Drawing





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relationships among several causes of a performance problem, rather than just linear cause and effect. Fishbone diagrams are effective in illustrating the actors and relationships to causes and effects.

The problem definition activity is also based on stakeholder group work to identify the overall need (basically, what achievements are wanted)—for example, increased

productivity of agriculture water use for rice from 3.5 kg/m³ to 6 kg/m³. Once the expected achievement for all stakeholders is agreed on, a spine is drawn across a sheet of paper. The initial problem (low rice yield) is written on the left, and categories of causes are written on each of the “bones” angled off the spine. Connections can be made to highlight links between various causes and the identified problem. Causes are not presented in order of hierarchy or significance, which means that judgment is needed later to prioritize the causes of the problem.

The example in Figure 4.4 shows an analysis of why rice yields are low and thereby points to potential solutions. A subsequent exercise addresses the causal problems that were defined and describes the situation after the problems have been resolved. The approach enables stakeholders to document what the fundamental problems are and what changes will be required to achieve the desired outcome. Once the necessary changes are identified, attention can be shifted to planning the change using the search framework.

DEVELOP SOLUTIONS

The development of solutions to the identified problems then follows. These need to be technically and politically feasible, again informed by the Triple A considerations.

The Search Frame

The identification of the core problem is used as the starting point for developing a **search frame**. The search frame is exactly that—it “searches” for a set or a best-fit solution. It avoids a linear (logical framework) path to an outcome and instead focuses on a learning process of initial solutions followed by reflection and modification.

This planning approach is based on the view that truly effective governance solutions result from the establishment of learning organizations (more on these in online Appendix 1 [World Bank 2020a]). Optimum solutions are rarely static in their form and

SEARCH FRAME VIDEO LINK



Video: “Search Frame: Let’s Be Logical and Not Just a Framework”

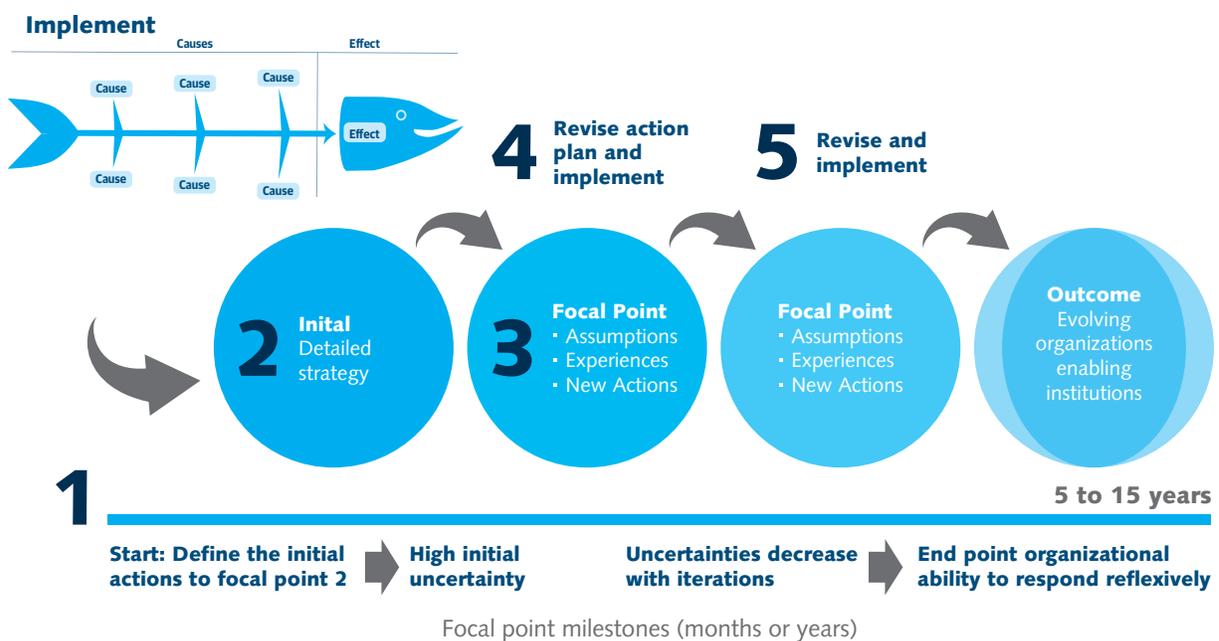
<https://vimeo.com/154939293>

cannot be found through a linear and time-bound pathway. The learning cycle embedded in the search framework ensures that reflective observation and analysis follows concrete action and actual experiences. The insights gained from the action (and outcomes/experiences) are then used to inform a new round planning and action.

When using the search frame approach, milestones and timelines are pre-determined to ensure that reflection is programmed (with timelines) and takes place systematically. This approach to the ongoing development of improved plans and strategies, at selected intervals along a development pathway, enables the ‘searching’ for increasingly better solutions. The search framework can be broken down into five rolling stages that take a long-term view of the project, listed below and shown schematically in Figure 4.5.

- 1. Map out solutions to the identified problems:** After diagnosing the fundamental service-delivery issues, map out solutions. These could include technical, organizational, role redefinition, new functions and rules, and so on. Organize them into a program action plan.
- 2. Develop focal points or milestones where achievements will be reviewed,** and define the different interventions that are needed to move along the path to solve the overall problem. Set timelines for the focal points (for reflection), and change as needed.

FIGURE 4.5. The Search Cycle



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3. **Conduct a review with relevant stakeholders** from the multistakeholder platforms when the next focal point (time-determined milestone) is reached. Reflect on the assumptions made, what has been achieved, and what lessons have been learned (experiences). This could include a review of the problem itself.
4. **Adjust the action plan** and revisions to the future focal points, including the estimated timelines. Document the learning and redesign process.
5. **Proceed to implement (act) in line with the revised plan.** Repeat steps 3, 4, and 5 along the path to the end goal, making ongoing iterations at each focal point.

The search framework is different from the linear log frame that defines timelines, costs, and indicators against each output. It builds on scheduled reviews, involving reanalysis of problems and revision of action plans on an ongoing basis. This learning can be established in the organizational rules, with intervals over months or years. The outcome is intended to be a stable learning organization, or organizations, that systematically build on their own experience through ongoing reflection, analysis, re-planning, and action.

4.6 Summary and Closing Comments

Main Elements of the Perspectives on Functional Performance Approach

PRACTICAL FIRST PRINCIPLES: The resource book describes practical ways of engaging with irrigation-related water management processes. It includes detailed performance criteria for water-services delivery and describes working concepts and foundational principles that are needed to achieve these. The many examples that are given are inspirational and intentionally non-prescriptive and can be drawn upon as needed in program design or evaluation activities.

A FUNCTIONAL FOCUS: Techniques for problem analysis and developing best-fit solutions revolve around the three areas of performance: **water service delivery, organizational resources, and governance.** The multiple actors whose performance needs are key to problem identification are farmers, WUOs, I&D Agencies, private sector, line ministries, and then a range of other water users and interests (including fisher-people, herders, domestic users, IWRM entities, navigation, hydro-power, ecological needs, among other). The roles and issues of key players, and their motivations, are described with an emphasis on performance expectations, and on functions. This understanding of performance-needs, and user-motivations, informs the institutional design and strategic planning processes that follow.

*Work with options,
not prescriptions*

*Functions always
go before form!*

*Think ... six-plus actors
and identify their diverse
performance needs*

MULTI-STAKEHOLDER PARTNERSHIPS: The institutional design process depends on active participation from the multiple actors involved in I&D governance. The use of **multi-stakeholder partnerships (MSPs)** provides a **dynamic collaborative space** for diverse groupings to engage around conflicting needs, jointly define problems, and develop solutions. The farmers' and other water users' perspectives are a top priority in the desired shift to a service-oriented culture. MSPs are a strategic way of mobilising people and ideas and are integrated with the overarching problem-driven approach to developing solutions.

PROBLEM-CENTRED THINKING: Problem definition is a critical step in **crafting institutional solutions**. Ways of deconstructing problems, leading to new solutions are outlined in the book. A process of discovery, by working with MSPs, using legal and regulatory analysis and other irrigation diagnostic models and tools, are expected to lead to fresh insights into causal problems, and inform the development of locally appropriate governance solutions.

INCLUSIVE ACTION-LEARNING: The process of **collaborative analysis and solution development** is guided by a search framework that is based on an **action-learning cycle**. Staged milestones for assessing interim progress and outcomes are set, enabling a structured process of review and strategic redesign in an ongoing cycle of refinement. Adopting principled pragmatism, by considering the Triple As of authority, ability, and acceptability, will aid realism in what can be achieved in a given political and administrative context.

Milestones on the Roadmap for Action

The general plan is to collaboratively identify the underlying core problems and establish new, service-delivery performance targets for water users, and service-providers. Functions and responsibilities need to be defined and assigned to different actors. The reflexive search framework facilitates practical solutions to be systematically developed in response to interim outcomes along the way. The suggested stages of engagement can be summarised as follows:

Understand the context and reflect on expectations

The starting point of I&D governance interventions involves the collection of general information, the identification of stakeholders and water-users, followed by an initial exploration into their performance needs. The process includes: data collection; stakeholder identification; the establishment of multi-stakeholder

MSPs support analysis and catalyse collaboration

Use Principled Pragmatism to get real

Define the problems and get best-fit solutions

Build learning organizations that plan, act, review, strategize, and re-plan

partnerships; an exploration of roles, functions and performance expectations; and an analysis of the historical and political context.

Define problems and set objectives

The next stage involves a more-targeted enquiry of performance problems by working with groups of stakeholders, in various interest and informant groups using an MSP approach. Activities would include: detailing of the de-facto characteristics of the current service-delivery arrangements; using irrigation system modelling and/or audits (such as MASSCOTE and MUSSMAS) as appropriate to identify issues; facilitated participatory problem identification methods (such as developing Ishikawa diagrams) drawing on the detailed performance areas in the resource book. The underlying performance problems thus defined, and causality identified, then leads to definition of the performance expectations of different actors, and the specific functions needed to achieve these.

Plan and implement the action

The development of an action plan to meet the performance expectations is iterative, based on the idea of learning organizations. A search frame approach (PDIA) facilitates a reflexive action and re-planning process leading to the ongoing improvement of strategies and plans. The use of MSPs in the process facilitates locally informed refinements, and catalyses action in the ongoing process. In defining the action plan, the Triple-A viewpoint will bring realism and pragmatism as to what can be achieved. A key working concept in action-planning is to build from what is available by adopting an approach of institutional bricolage that enables realistically achievable goals in the short-term towards longer-term transformation goals.

Actions can cover a wide range of interventions independently, or in parallel, including: institutional re-design and shifting of functions and responsibilities; participatory irrigation management or irrigation management transfer; skills and capability development; changes to technical elements (modernization, system re-design, or simplifications); socio-technical interventions to make management easier or more effective; unlocking specific legal obstacles through new legislation or regulatory changes; financial support interventions or fee-structure changes; public private partnerships in various forms; and policy interventions among other. Many inspiring examples of these are presented in the resource book, that are not prescriptive, but can be drawn upon and modified as useful to each situation.

MULTIPLE ACTORS WITH DIVERSE NEEDS IN A DYNAMIC REALITY

Irrigation systems are complex socio-biological-systems that are dynamic and diverse. Innovative and site-specific solutions, developed by all the actors, creating reflexive learning organizations are needed.

Closing Comments on the Way Forward

Institutions need to be strengthened with opportunities to grow and enhance their capabilities to manage the complex irrigation challenges of the current age. Historically, the focus of engagement in the irrigation sector has been on infrastructure development and, to a lesser extent, policies. Work on institutions (that is, the laws, regulations and rules, and related organizational structures that give force to these in practice) has most often been a sideshow. The relationship between effective institutions and effective irrigation systems is well-known, but complex problems still beset complex irrigation systems. The reality of increasing resource stress, both natural and financial, adds a sense of urgency to the institutional mission. Too often, a deterministic Newtonian approach that works well for infrastructure engineering—but not for people—has been pursued. Irrigation systems need to be understood differently. They are complex, socio-biological-systems that are dynamic and diverse. Institutions that work in one situation, experience has shown, rarely work in the next without local modifications and amendments.

Institutional failures and poor irrigation performance have been blamed on low capacity, perverse incentives, misdirected policies, and weak implementation. Although these are all contributing factors in some measure, they likely fail to capture the essence of the problem. Institutional project activities of the past have aimed to “fix the institutions” with a focus on form and organizational structure. The central message of this resource book is that *functions, processes, and related capabilities must be the priority focus of all irrigation institutional interventions*. By first defining performance needs and related functions (detailed in Chapter 2), then the actors who can and must provide those functions (Chapter 3), in the form of responsive organizations, can be created, structured, or crafted. The organizational architecture, the rules of the game (laws, regulations, and bylaws), and innovative technical interventions that change social behavior are the instruments to be used in service of functionality. By focusing on the primary functions of water service delivery and viewing these from the six perspectives of the main stakeholders, it is possible to achieve more successful outcomes.

Large-scale schemes present an important opportunity, given their physical footprint on the planet and in terms of the volume of water that is managed to produce food. A harsh lesson of experience for development practitioners is that only approximately half of WUO and IMT processes have been viewed as successes. Although implementation failure rather than institutional design is no doubt responsible in some measure for failures, more innovative and responsive solutions are needed. The approaches that are set out in the resource book define a process and provide detailed context in the hope that this will inform new and pragmatic frames of understanding and help the negotiation of longstanding and

difficult governance challenges. Irrigation departments and WUOs are often old, firmly established, protective, and habit-based institutions. As historical monopolies with heavy path dependency, they are slow in changing course in the face of fast-modernizing sociotechnical shifts. The rapid trend of shallow-well irrigation now taking place within large-scale public schemes, for example, whereby farmers avoid the transaction costs of collective action and instead carry the financial cost of pump-equipment purchases and energy, is one reflection of performance weaknesses and of opportunistic, dynamic change in irrigation and drainage.

Awareness of the reality that irrigation systems are de-facto multiple-use systems means a much broader understanding of functionality, involvement of, and servicing of a wider stakeholder base is required. Service provision flexibility needs to be accommodated in a different way if irrigation management arrangements are to be fully relevant to diverse users, and farming practices. The historical focus on water engineering systems supplying farmers, in obedience of rules that they had no part in making, is from a past age that is no longer relevant. The tech- and information-driven options that farmers have at their disposal today requires fresh thinking, responsive to these new needs. Problem-driven approaches focusing on causality, performance, and functionality as set out in this book, rather than on conformation with pre-set rules and policies, are essential concepts for confronting these vexing challenges. Great care is needed in specifying what outcomes of such process should look like. The best practitioners can hope to achieve is to set the direction of enquiry, and to catalyse a collaborative process of problem-identification and then, of solution-building.

It is the authors' hope that the principles, concepts, and practical information in the resource book will open new ways of thinking about old—even ancient—I&D management problems. We believe that core problems can first be identified, and locally responsive I&D governance solutions can be tailored. These tailored solutions, it is anticipated, will meet the diverse and dynamic functional needs of the many kinds of schemes, organizations, and people involved in irrigation and drainage governance. Good luck.

References

- Abernethy, C. L. 1984. "Methodologies for Studies of Irrigation Water Management." Report OD/TN 9, October, Hydraulics Research, Wallingford, United Kingdom.
- . 1986. "Performance Measurement in Canal Water Management: A Discussion." ODI/IIMI Irrigation Management Network Paper 86/2d, Overseas Development Institute, London.
- ADB (Asian Development Bank). 2009. "Participatory Small-Scale Water Resources Sector Project ADB 39432-013 (Bangladesh)." Reports and Recommendations of the President, ADB, Mandaluyong City, Philippines.
- . 2015. "Chhattisgarh Irrigation Development Project: Project Completion Report." ADB, Mandaluyong City, Philippines.
- . 2017. "Irrigation Subsector Guidance Note: Building Blocks for Sustainable Investment." ADB, Mandaluyong City, Philippines.
- Andrews, M., L. Pritchett, and M. Woolcock. 2017. *Building State Capability: Evidence, Analysis, Action*. Oxford: Oxford University Press.
- Arner, D. W., J. N. Barberis, and R. P. Buckley. 2015. "The Evolution of Fintech: A New Post-Crisis Paradigm?" University of Hong Kong Faculty of Law Research Paper 2015/047; UNSW Law Research Paper 2016-62. <https://ssrn.com/abstract=2676553>.
- Barker, R., D. Dawe, and A. Inocencio. 2003. "Economics of Water Productivity in Managing Water for Agriculture." In *Water Productivity in Agriculture: Limits and Opportunities for Improvement*, edited by J. W. Kijne, R. Barker, and D. Molden. Colombo, Sri Lanka: International Water Management Institute (IWMI) and Wallingford, UK: CABI Publishing.
- Batchelor, C. & Schnetzer, J. 2018. *Compendium on Climate-Smart Irrigation: Concepts, Evidence and Options for a Climate-Smart Approach to Improving the Performance of Irrigated Cropping Systems*. Rome, Italy: Global Alliance for Climate-Smart Agriculture.
- Bernier, Q., and R. S. Meinzen-Dick. 2015. *Public Private Partnerships for Irrigation: Expanding Access or Increasing Inequality*. Washington, DC: International Food Policy Research Institute.
- Bingham, R. 2007. *Multiple Use Services: Meeting the Productive and Domestic Water Needs of the Rural Poor*. Medford, MA: Tufts University.
- Bos, M. G., M. A. Burton, and D. J. Molden. 2005. *Irrigation and Drainage Performance Assessment, Practical Guidelines*. Wallingford, United Kingdom: CAB International Publishing.
- Bos, M. G., D. H. Murray-Rust, D. J. Merry, H. G. Johnson, and W. B. Snellen. 1994. "Methodologies for Assessing Performance of Irrigation and Drainage Management." *Irrigation and Drainage Systems* 7: 231-61.
- Bottrall, A. 1981. "Comparative Study of the Management and Organization of Irrigation Projects." Staff Working Paper 458, World Bank, Washington, DC. <http://documents.worldbank.org/curated/en/613981468767055677/Comparative-study-of-the-management-and-organization-of-irrigation-projects>.

Brewer, J., S. Kolavalli, A. H. Kalro, G. Naik, S. Ramnarayan, K. V. Raju, and R. Sakthivadivel. 1999. *Irrigation Management Transfer in India: Policies, Processes, and Performance*. New Delhi and Calcutta: IBH Publishing Co. Pvt. Ltd. and Oxford.

Brouwer, H., and Woodhill, J. 2016. *The MSP Guide, How to Design and Facilitate Multi-Stakeholder Partnerships*. Wageningen: Wageningen University and Research, CDI, and Rugby, UK: Practical Action Publishing. doi:10.3362/9781780446691.

Buchanan, R. 1992. "Wicked Problems in Design Thinking." *Design Issues* 8 (2), 5-21. <http://www.jstor.org/stable/1511637>.

Burton, M. 2010. *Irrigation Management: Principles and Practices*. Wallingford, United Kingdom: CAB International Publishing.

Burton, M. A., and I. M. Mututwa. 2002. "A Methodology for Performance Assessment of Irrigation and Drainage Systems." Draft Paper.

Butterworth, J., and J. de la Harpe. 2009a. "Grand Designs: Corruption Risks in Major Water Infrastructure Projects." U4Brief No. 27, CMI and U4, Anti-Corruption Resource Centre, Bergen, Norway.

———. 2009b. "Not So Petty: Corruption Risks in Payment and Licensing Systems for Water." U4Brief No. 26, CMI and U4, Anti-Corruption Resource Centre, Bergen, Norway.

Cameron, K. S. 1986. Effectiveness as Paradox: Consensus and Conflict in Conceptions of Organizational Effectiveness. *Management Science* 32 (5): 539-53.

Chambers, R. 1981. "Rapid Rural Appraisal: Rationale and Repertoire." *Public Administration and Development* 1: 95-106.

Christen, R. P., and J. Anderson. 2013. "Segmentation of Smallholder Households: Meeting the Range of Financial Needs in Agricultural Families." CGAP Focus Note No. 85, World Bank, Washington, DC. <http://documents.worldbank.org/curated/en/2013/04/17816749/segmentation-smallholder-households-meeting-range-financial-needs-agricultural-families>.

Christiansen, J. E. 1942. "Irrigation by Sprinkling." *California Agriculture Experiment Station Bulletin* 670: 94-124.

Cleaver, F. 2002. "Reinventing Institutions: Bricolage and the Social Embeddedness of Natural Resource Management." *The European Journal of Development Research* 14 (2): 11-30.

Cleaver, F., and J. de Koning. 2015. "Furthering Critical Institutionalism." *International Journal of the Commons* 9 (1): 1-18.

Darghouth, S., H. Tardieu, B. Préfol, A. Vidal, J. Plantey, and S. Fernandez. 2007. "Emerging Public-Private Partnerships in Irrigation Development and Management." Water Sector Board Discussion Paper Series 10, World Bank, Washington, DC.

de Fraiture, C., D. Wichelns, J. Rockström, and E. Kemp-Benedict. 2007. "Looking Ahead to 2050: Scenarios of Alternative Investment Approaches." In *Water for Food, Water for Life: A Comprehensive Assessment of Water Management in Agriculture*, edited by D. Molden, 91-145. London: Earthscan: Colombo: International Water Management Institute.

Deininger, K., and D. Byerlee. 2011. *Rising Global Interest in Farmland: Can It Yield Sustainable and Equitable Benefits?* Washington, DC: World Bank.

- Ellis, F. 1998. "Household Strategies and Rural Livelihood Diversification." *The Journal of Development Studies* 35 (1): 1-38.
- Fan, Y., Z. Gao, S. Wang, H. Chen, and J. 2018. "Evaluation of the Water Allocation and Delivery Performance of Jiamakou Irrigation Scheme, Shanxi, China." *Water* 10: 654.
- FAO (Food and Agricultural Organization). 2007. "Irrigation Management Transfer: Worldwide Efforts and Results." FAO Water Reports 32, IWMI and FAO, Rome.
- . 2011. *The State of the World's Land and Water Resources for Food and Agriculture (SOLAW): Managing Systems at Risk*. Rome: FAO.
- . 2016. AQUASTAT Main Database - Food and Agriculture Organization of the United Nations (FAO). Website accessed on 21/11/2018 11:44.
- . 2017a. *The Future of Food and Agriculture: Trends and Challenges*. Rome: FAO.
- . 2017b. *The State of Food and Agriculture: Leveraging Food Systems for Inclusive Rural Transformation*. Rome: FAO.
- Gonzalez, F., and S. Salman. 2002. "Institutional Reform for Irrigation and Drainage: Proceedings of a World Bank Workshop." World Bank Technical Paper 524, World Bank, Washington, DC. <https://openknowledge.worldbank.org/handle/10986/14095>.
- Granovetter, M. 1978. "Threshold Models of Collective Behaviour." *American Journal of Sociology* 83: 489-515.
- Hardin, G. 1968. "Tragedy of the Commons." *Science* 162 (3859): 1243-48.
- Hodgson, S. 2003. "Legislation on Water Users' Organizations." FAO Legislative Study 79. Rome: FAO.
- . 2006. "Modern Water Rights Theory and Practice." FAO Legislative Study 92. Rome: FAO.
- Houdret, A. 2012. "The Water Connection: Irrigation and Politics in Southern Morocco." *Water Alternatives* 5 (2): 284-303.
- Ikeda, J., and K. Liffiton. 2019. "Fintech for the Water Sector: Advancing Financial Inclusion for More Equitable Access to Water." World Bank, Washington DC.
- Inocencio, A., M. Kikuchi, M. Tonosaki, A. Maruyama, D. Merrey, H. Sally, and I. de Jong. 2007. "Costs and Performance of Irrigation Projects: A Comparison of Sub-Saharan Africa and Other Developing Regions." IWMI Report 109. Colombo, Sri Lanka: International Water Management Institute.
- Julaniya, R. S., M. Singh, M. G. Choubey, and S. Biswas. 2016. "A Management Approach to Increase Irrigated Area and Production in Madhya Pradesh, India." 2nd World Irrigation Forum (WIF2), Chiang Mai, Thailand, November 6-8, 2016.
- Kolb, D. A. 1984. *Experiential Learning Experience as the Source of Learning and Development*. Englewood Cliffs, NJ: Prentice Hall.
- Lankford, B. 2012. "Fictions, Fractions, Factorials and Fractures: On the Framing of Irrigation Efficiency." *Agricultural Water Management*, 108 (27).

- Lankford, B. A., I. Makin, N. Matthews, A. Noble, P. G. McCornick, and T. 2016. "A Compact to Revitalise Large-Scale Irrigation Systems Using a Leadership-Partnership-Ownership 'Theory of Change.'" *Water Alternatives* 9 (1): 1-32.
- Lowder, S. K., J. Scoet, and T. Raney. 2016. "The Number, Size, and Distribution of Farms, Smallholder Farms, and Family Farms Worldwide." *World Development* 87: 16-29.
- Malano, H., and M. Burton. 2001. *Guidelines for Benchmarking Performance in the Irrigation and Drainage Sector*. International Programme for Technology and Research in Irrigation and Drainage.
- Malik, R. P. S., S. A. Prathapar, and M. Marwah 2014. "Revitalizing Canal Irrigation: Towards Improving Cost Recovery." IWMI Working Paper No. 160. International Water Management Institute (IWMI), Colombo, Sri Lanka.
- Mandri-Perrott, C., and J. Bisbey. 2016. *How to Develop Sustainable Irrigation Projects with Private Sector Participation*. Washington, DC: World Bank. <https://openknowledge.worldbank.org/handle/10986/24034>.
- Mason, N., D. Harris, and R. Batley. 2013. *The Technical Is Political: Understanding the Political Implications of Sector Characteristics for Delivery of Drinking Water Services*. London: Overseas Development Institute (ODI).
- Meinzen-Dick, R. 2007. "Beyond Panaceas in Water Institutions." *Proceedings of the National Academy of Sciences* 104 (39): 15200-5.
- Merrey, D. J. 1997. *Expanding the Frontiers of Irrigation Management Research: Results of Research and Development at the International Irrigation Management Institute 1984-1995*. Colombo, Sri Lanka: International Water Management Institute (IWMI).
- Merrey, D. J., R. Meinzen-Dick, P. P. Mollinga, and E. Karar. 2007. "Policy and Institutional Reform: The Art of the Possible." In *Water for Food, Water for Life: A Comprehensive Assessment of Water Management in Agriculture*, edited by D. Molden, 193-231. London: Earthscan and Colombo: International Water Management Institute.
- Molden, D. J. 2007. "Summary for Decision-Makers." In *Water for Food, Water for Life: A Comprehensive Assessment of Water Management in Agriculture*, edited by D. Molden, 1-37. London: Earthscan and Colombo: International Water Management Institute.
- Molden, D. J., M. A. Burton, and M. G. Bos 2007. "Performance Assessment, Irrigation Service Delivery, and Poverty Reduction: Benefits of Improved System Management." *Irrigation and Drainage* 56 (2-3): 307-20.
- Molden, D., J. M. Faures, M. Finlayson, H. Gitay, J. Muylwijk, L. Schipper, D. Vallee, and D. Coates. 2007. "Setting the Scene." In *Water for Food, Water for Life: A Comprehensive Assessment of Water Management in Agriculture*, edited by D. Molden, 42-53. Colombo, Sri Lanka: International Water Management Institute.
- Molden, D., K. Frenken, R. Barker, C. de Fraiture, B. Mati, M. Svendsen, C. Sadoff, and M. Finlayson. 2007. "Trends in Agricultural Water Development." In *Water for Food, Water for Life: A Comprehensive Assessment of Water Management in Agriculture*, edited by D. Molden, 57-89. Colombo, Sri Lanka: International Water Management Institute.

- Molle, F., and J. Berkoff, eds. 2007. *Irrigation Water Pricing: The Gap between Theory and Practice*. Wallingford, United Kingdom: CAB International Publishing.
- Molle, F., P. P. Mollinga, and P. Wester. 2009. "Hydraulic Bureaucracies and the Hydraulic Mission: Flows of Water, Flows of Power." *Water Alternatives* 2 (3): 328-49.
- Mollinga, P., and G. J. Veldwisch. 2016. "Ruling by Canal: Governance and System-Level Design Characteristics of Large-Scale Irrigation Infrastructure in India and Uzbekistan." *Water Alternatives* 9 (2): 222-49.
- Mukherji, A., B. Fuleki, T. Shah, D. Suhardiman, M. Giordano, and P. Weligamage. 2009. "Irrigation Reforms in Asia: A Review of 108 Cases of Irrigation Management Transfer." Background paper 3, submitted to Asian Development Bank, October 2009.
- Mumssen, Y., G. Saltiel, and B. Kingdom. 2018. "Aligning Institutions and Incentives for Sustainable Water Supply and Sanitation Services." Report of the Water Supply and Sanitation Global Solutions Group, Water Global Practice, World Bank, Washington DC.
- Murray-Rust, D. H., and W. B. Snellen. 1993. *Irrigation System Performance Assessment and Diagnosis*. Sri Lanka: International Irrigation Management Institute.
- Mututwa, I. M. 2002. "A Framework for Performance Assessment of Irrigation and Drainage Schemes." Unpublished MPhil thesis, University of Southampton.
- Nieuwoudt, W., and G. Backeberg. 2011. "A Review of the Modelling of Water Values in Different Use Sectors in South Africa." *Water SA* 37 (5): 703-10.
- North, D. 1990. *Institutions, Institutional Change, and Economic Performance*. Cambridge: Cambridge University.
- Oad, R., and P. G. McCornick. 1989. "Methodology for Assessing the Performance of Irrigated Agriculture." *ICID Bulletin* 38: 42-53.
- Obertreis, J., T. Moss, P. Mollinga, and C. Bichsel. 2016. "Water, Infrastructure, and Political Rule: Introduction to the Special Issue." *Water Alternatives* 9 (2): 168-81.
- Ostrom, E. 1990. *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge: Cambridge University Press.
- . 1992. *Crafting Institutions for Self-Governing Irrigation Systems*. Oakland, CA: Institute for Contemporary Studies Press.
- . 1993. "A Communitarian Approach to Local Governance." *National Civic Review* 82 (3): 226-33.
- . 2005. *Understanding Institutional Diversity*. Princeton, NJ: Princeton University Press.
- Oweis, T., A. Hachum, and A. Bruggeman, eds. 2004. *Indigenous Water-Harvesting Systems in West Asia and North Africa*. Aleppo, Syria: International Center for Agricultural Research in the Dry Areas.
- Perry, C. 2007. "Efficient Irrigation, Inefficient Communication, Flawed Recommendations." *Irrigation and Drainage* 56: 367-78.
- Reisner, M. 1993. *Cadillac Desert: The American West and Its Disappearing Water*. New York: Penguin Books.

- Renault, D., T. Facon, and R. Wahaj. 2007. "Modernizing Irrigation Management—The MASSCOTE Approach." FAO Irrigation and Drainage Paper 63, Food and Agriculture Organization, Rome.
- Renault, D., and P. W. Vehmeyer. 1999. *On Reliability in Irrigation Service Preliminary Concepts and Application*. Colombo, Sri Lanka: International Irrigation Management Institute.
- Renault, D., R. Wahaj, and S. Smits. 2013. "Multiple Uses of Water Services in Large Irrigation Systems. Auditing and Planning Modernization, The MASSMUS Approach." FAO Irrigation and Drainage Paper 67, Food and Agriculture Organization, Rome.
- Rueda, R., and L. C. Moll, 1994. "Sociocultural Perspective on Motivation." In *Motivation: Theory and Research*, edited by H. F. O'Neill, Jr., and M. Drillings, 117–36. Hillsdale, USA: Lawrence Erlbaum Associates, Inc. ISBN 978-0-8058-1286-2.
- Rockstrom, J., N. Hatibu, T. Y. Oweis, and S. Wani. 2007. Managing Water in Rainfed Agriculture. In *Water for Food, Water for Life: A Comprehensive Assessment of Water Management in Agriculture*, edited by D. Molden, 315–354. London: Earthscan and Colombo: International Water Management Institute.
- Ryan, M. R., and L. D. Deci. 2009. "Intrinsic and Extrinsic Motivations: Classic Definitions and New Directions." *Contemporary Educational Psychology* 25: 54–67.
- Sanchis-Ibor, C., R. Boelens, and M. García-Mollá. 2017. "Collective Irrigation Reloaded. Re-collection and Re-moralization of Water Management after Privatization in Spain." *Geoforum* 87: 38–47.
- Schreiner, B., B. van Koppen, S. Byakika, and D. Maharaj. 2018. *Establishing Hybrid Water Use Rights Systems in Sub-Saharan Africa: A Practical Guide for Managers*. Pretoria, South Africa: Pegasys Institute.
- Shah, T. 2014. "Accelerating Smallholder Irrigation in Sub-Saharan Africa: Lessons from South Asia's Groundwater Revolution." In *Proceedings of the Workshop on Irrigation in West Africa: Current Status and a View to the Future*. Ouagadougou, Burkina Faso, December 1–2, 2010. Edited by R. E. Namara and H. Sally, 373. Colombo, Sri Lanka: International Water Management Institute (IWMI). doi:10.5337/2014.218.
- . 2018. "Institutional Patterns in Farmer-Led Irrigation: Global Trends and Their Relevance to Sub-Saharan Africa." Unpublished Report, World Bank, Washington, DC.
- Shah, T., J. Burke, and K. Villholth. 2007. "Groundwater: A Global Assessment of Scale and Significance." In *Water for Food, Water for Life: A Comprehensive Assessment of Water Management in Agriculture*, edited by D. Molden, 395–423. London: Earthscan and Colombo: International Water Management Institute.
- Siebert, S., J. Burke, J. M. Faures, K. Frenken, J. Hoogeveen, P. Döll, and F. T. Portmann. 2010. "Groundwater Use for Irrigation: A Global Inventory." *Hydrology and Earth System Sciences*, 14:1863–80. <https://doi.org/10.5194/hess-14-1863-2010>.
- Small, L. E., and M. Svendsen. 1990. "A Framework for Assessing Irrigation Performance." *Irrigation and Drainage Systems* 4 (4): 283–312.

- Srivastava, V., E. Amjad, and C. Kullmann. 2019. "Getting Practical: The Search for 'Best Fit' Solutions to Improve Water Sector Outcomes: A Primer on a Problem-Driven Diagnostic Approach." World Bank, Washington, DC.
- Suhardiman, D., and M. Giordano. 2014. "Is There an Alternative for Irrigation Reform?" *World Development* 57 (C): 91-100.
- Sur, M., D. Larson, E. Kucheriavenko, and K. Masykanova. 2014. "Facilitating Smallholder Access to Markets." Prepared for Standing Committee for Economic and Commercial Cooperation of the Organization of Islamic Cooperation (COMCEC).
- Svendsen, M., ed. 2005. *Irrigation and River Basin Management: Options for Governance and Institutions*. Wallingford, United Kingdom: CAB International Publishing.
- Svendsen, M., M. Ewing, and S. Msangi. 2009. "Measuring Irrigation Performance in Africa." Discussion Paper 00894, International Food Policy Research Institute, Washington DC.
- Tang, S. 1992. *Institutions and Collective Action: Self-Governance in Irrigation*. San Francisco: ICS Press.
- Thenkabail, P. S., C. M. Biradar, P. Noojipady, V. Dheeravath, Y. Li, M. Velpuri, M. Gumma, O. R. P. Gangalakunta, H. Turrall, X. Cai, J. Vithanage, M. A. Schull, and R. Dutta. 2009. "Global Irrigated Area Map (GIAM), Derived from Remote Sensing for the End of the Last Millennium." *International Journal of Remote Sensing* 30 (14): 3679–33.
- Valieva, S., and R. K. Abubeker. 2018. "Project Review Summaries: Volume III - Sustainable Irrigation Performance under Changing Conditions Position Paper." Unpublished report, World Bank, Washington DC.
- van der Ploeg, J. D. 2008. *The New Peasantries: Struggles for Autonomy and Sustainability in an Era of Empire and Globalization*. London: Earthscan.
- van Hofwegen, P. J. M., and H. M. Malano. 1997. "Hydraulic Infrastructure under Decentralised and Privatised Irrigation System Management." In *Deregulation, Decentralisation, and Privatisation in Irrigation: State Functions Move to the Free Market*, DVWK Bulletin No 20, 188-216. Bonn: German Association of Water Resources and Land Improvement.
- van Koppen, B., P. Moriarty, and E. Boelee. 2006. "Multiple-Use Water Services to Advance the Millennium Development Goals." Research Report 98, International Water Management Institute, Colombo, Sri Lanka.
- van Koppen, B., B. N. Tapela, and E. Mapedza. 2018. "Joint Ventures in the Flag Boshielo Irrigation Scheme, South Africa: A History of Smallholders, States, and Business." IWMI Research Report 17143, 37, International Water Management Institute, Colombo, Sri Lanka. doi: 10.5337/2018.202.
- van Rooyen, A. F., P. Ramshaw, M. Moyo, R. Stirzaker, and H. Bjornlund. 2017. "Theory and Application of Agricultural Innovation Platforms for Improved Irrigation Scheme Management in Southern Africa." *International Journal of Water Resources Development* 33 (5): 804-23.
- van Rooyen, C. J., and S. Nene. 1996. "What Can We Learn from Previous Small Farmer Development Strategies in South Africa." *Agrekon* 35 (4): 325-31.

- Vermillion, D. L. 1994. "Irrigation Management Transfer: Towards an Integrated Management Revolution." Paper Presented to the International Conference on Irrigation Management Transfer, Wuhan, PR China, September 20-24, 1994.
- Wetterberg, A., and D. W. Brinkerhoff. 2016. "The Political Economy of Public Reform Adoption: Patterns in Twenty Indonesian Districts." *International Public Management Journal* 19 (4): 476-512.
- Wada Y., L. P. H. van Beek, and M. F. P. Bierkens 2012. "Nonsustainable Groundwater Sustaining Irrigation: A Global Assessment." *Water Resources Research* 48 (6): W00L06.
- Wade, R., and R. Chambers. 1980. "Managing the Main System: Canal Irrigation's Blind Spot." *Economic and Political Weekly* 15 (39): A107-12.
- Woodhouse, P., B. J. Veldwisch, J. P. Venot, D. Brockington, H. Komakech, and A. Manjichi. 2017. "African Farmer-Led Irrigation Development: Re-framing Agricultural Policy and Investment?" *The Journal of Peasant Studies* 44 (1): 213-33.
- World Bank. 2002. *Bridging Troubled Waters: Assessing the World Bank Water Resources Strategy*. Washington, DC: World Bank, Operations Evaluation Department.
- . 2004. *Agriculture Investment Sourcebook*. Washington, DC: World Bank, Agriculture and Rural Development Department.
- . 2015. "Cambodian Agriculture in Transition: Opportunities and Risks." Economic and Sector Work Report No. 96308-KH, May, World Bank, Washington, DC.
- . 2017. *World Development Report 2017: Governance and the Law*. World Bank, Washington, DC.
- . 2018. "Sustainable Irrigation Performance under Changing Conditions." Unpublished Position Paper, World Bank, Washington, DC.
- . 2020a. "Irrigation and Drainage Governance Resource Book Appendix 1: Working Concepts and Pointers for Practical Action." World Bank, Washington, DC.
- . 2020b. "Irrigation and Drainage Governance Resource Book Appendix 2: Case Descriptions." World Bank, Washington, DC.
- You, L., C. Ringler, U. Wood-Sichra, R. Robertson, S. Wood, T. Zhu, G. Nelson, Z. Guo, and Y. 2011. "What Is the Irrigation Potential for Africa? A Combined Biophysical and Socioeconomic Approach." *Food Policy* 36 (6): 770-82.
- Zinnbauer, D., and R. Dobson, eds. 2008. *Global Corruption Report 2008: Corruption in the Water Sector*. Cambridge: Cambridge University Press.

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