



FINANCING ASIAN IRRIGATION

CHOICES BEFORE US

ASIAN DEVELOPMENT BANK



FINANCING ASIAN IRRIGATION

CHOICES BEFORE US



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Abbreviations

ADB	–	Asian Development Bank
BOO	–	build–own–operate
BOOT	–	build–own–operate–transfer
BOT	–	build–operate–transfer
CDM	–	Clean Development Mechanism
CODEVASF	–	Companhia de Desenvolvimento dos Vales do São Francisco e do Parnaíba (São Francisco and Parnaíba Valley Development Company), Brazil
EPC	–	engineering, procurement, and construction
FAIA	–	financially autonomous irrigation agency
FAO	–	Food and Agriculture Organization of the United Nations
I&D	–	irrigation and drainage
IFC	–	International Finance Corporation
IFI	–	international financial institution
IMT	–	irrigation management transfer
ISF	–	irrigation service fee
MOM	–	management, operation, and maintenance
O&M	–	operation and maintenance
PIM	–	participatory irrigation management
PPIAF	–	Public–Private Infrastructure Advisory Facility
PPP	–	public–private partnership
PRC	–	People’s Republic of China
ROT	–	rehabilitate–operate–transfer
SPV	–	special-purpose vehicle
TOT	–	transfer–operate–transfer
WUA	–	water user association

Executive Summary

Improved irrigation productivity—more crop per drop—is critical for Asia and the Pacific. By 2050, agriculture will need to produce 100% more food in developing countries, using diminishing water resources in the face of climate change impact and rapid population growth.

Vicious Circle of Neglect and Decline

Irrigation schemes in the region are aging and underperforming, and, with land in short supply, there is little scope for creating major new schemes. Persistent inability to attract adequate finance for irrigation works compounds the problem. The core challenge facing Asia's irrigation and drainage (I&D) is ensuring adequate financing for the recurrent spending and rehabilitation investment needs of existing large publicly owned and managed surface I&D schemes. Inadequate funding of management, operation, and maintenance (MOM), especially maintenance, is a vital factor in the widespread deterioration of surface irrigation systems across Asia. The region's I&D infrastructure is locked in a vicious circle of neglect and decline, resulting in poor service, low charges, meager revenue collection, underfunded operation and maintenance (O&M), delayed essential maintenance, and system failures, which in turn further worsen the downward spiral.

Compartmentalized Funding for Investment and for Operation and Maintenance

Effectively, financing of the capital and recurrent costs of irrigation are treated separately in different political, administrative, and financing silos. As a result, it has been easier to obtain funds for new investment than for essential routine maintenance. Capital investment to modernize dilapidated infrastructure can break this vicious circle and, in its place, spur the development of a virtuous circle of improved service and better cost recovery, provided that sufficient funding for O&M is maintained.

A necessary precondition for improving recurrent cost financing in irrigation is a fuller understanding of the actual costs and financial requirements of MOM in specific localities. The most reliable estimates for the Asian region, ahead of further research to refine the data, place the annual investment requirement between 2005 and 2030 at \$12.31 billion.

This figure is likely to be the minimum as I&D infrastructure has a finite life and depreciates rapidly if not maintained properly.

O&M costs must be estimated for each specific scheme, ideally with maintenance identified separately, and the asset renewal component must be based on asset management plans.

Attracting Investment Finance and Creating the Enabling Conditions

Until now, irrigation has relied almost entirely on public financing, and MOM funds have come mainly from government subsidies, irrigation service fee revenues, and other secondary revenue sources. A major driver of I&D sector reform is the desire of national governments to lessen the burden of public subsidies for water and energy and to lessen the dominance of public finance in investments in this sector. Broadening the range of public financing instruments, to include bond issues by autonomous irrigation agencies, for example, or raising the amounts generated from user charges—sensitive as this move may be in some quarters—will require serious reforms in I&D management and financing.

Public–private partnerships (PPPs) offer access to expertise besides finance, but international experience with PPPs in irrigation has been very limited. In Asia, the only ongoing PPP is the Bangladesh Muhuri scheme, a performance-based management contracting arrangement that is expected to evolve into lease contracting. This report explores various forms of PPPs, involving different degrees of risk transfer, ownership arrangements, and financial commitments.

Irrigation Reform

The future of Asian surface irrigation warrants a steady push toward greater efficiency and greater financial sustainability. These two aims are interlinked and mutually supportive. Elements of structural, institutional, financial, and efficiency reforms in government are discussed at length in this report. A number of strategic choices are presented.

In any case, improving financial sustainability for Asia's surface irrigation will mean

- (i) sustaining and increasing funding for investment from existing sources, mainly national governments and international financial institutions through viable and more attractive I&D projects;
- (ii) diversifying the sources of investment financing by creating the conditions that will attract commercial sources, including private equity;
- (iii) improving the supply of reliable recurrent funding for MOM from water user charges and other sources, while reducing the size of public subsidies; and

- (iv) integrating investment and recurrent finance by coupling the planning of capital and O&M costs and provisions for covering these costs.

The most useful approach to reform is to identify the following four types of actions, which may be taken separately or in combination:

- (i) preconditions, which must occur before other reforms can proceed;
- (ii) low-hanging fruit, that is, relatively easy and quick actions;
- (iii) no-regrets actions, done regardless of what is decided about other issues; and
- (iv) option-preserving actions, taken without closing off other potentially suitable options.

Finally, a sustainable I&D financing system will facilitate structural and managerial change. Financing should be viewed as a means of bringing about change, not simply as a way of paying the bills. Financing can be a powerful agent of reform.

Key Messages

- Improved irrigation productivity is critical for Asia. By 2050, agriculture will need to produce 100% more food in developing countries, using diminishing water resources in the face of climate change impact and rapid population growth.
- Asia's irrigation and drainage (I&D) sector must ensure that enough funds are available for the recurrent spending and rehabilitation investment needs of large publicly owned and managed surface I&D schemes. Insufficient management, operation, and maintenance (MOM) funding, especially for maintenance, contributes to the widespread deterioration of surface irrigation systems across the region. Adequate, constant funding for maintenance is an absolute priority.
- The most reliable estimates for the Asian region, ahead of further data refinement, place the annual investment required for irrigation MOM between 2005 and 2030 at \$12.31 billion.
- Until now, irrigation in Asia has relied almost entirely on public financing, from national and international sources. To broaden the range of public financing instruments and also make the most of opportunities for public-private partnerships, serious reforms must be made in I&D management and financing.
- A major driver of I&D sector reform is the desire of national governments to reduce the burden of public subsidies for water and energy and to lessen the dominance of public finance in investments in this sector.
- The actual costs and financial requirements of MOM in specific localities must be more fully understood to improve recurrent cost financing in irrigation.
- International financial institutions, already consequential agents of change are crucial agents of change in I&D financing, will become increasingly involved in projects aimed at adapting I&D schemes to rapidly changing circumstances. Their future involvement will increasingly be in projects pertaining to the adaptation of existing I&D schemes to rapidly evolving circumstances. The technical, institutional, managerial, and financial capabilities of their national counterparts must be strengthened in anticipation of this development.
- Improving financial sustainability for Asia's surface irrigation will mean
 - » sustaining and increasing funding for investment from existing sources, mainly national governments and international financial institutions, through viable and more attractive I&D projects;
 - » diversifying the sources of investment financing by creating the conditions that will attract commercial sources, including private equity;

- » improving the supply of reliable recurrent funding for MOM from water user charges and other sources, while reducing the size of public subsidies; and
- » integrating investment and recurrent finance by coupling the planning of capital and operations and maintenance costs (now compartmentalized into separate decision-making silos) and provisions for covering these costs.
- The most useful approach to reform is to identify the following four types of actions, which may be taken separately or in combination:
 - » preconditions, which must occur before other reforms can proceed;
 - » low-hanging fruit, that is, relatively easy and quick actions;
 - » no-regrets actions, done regardless of what is decided about other issues; and
 - » option-preserving actions, taken without closing off other potentially suitable options.
- A sustainable I&D financing system will facilitate structural and managerial change. Financing should be viewed as a means of bringing about change, not simply as a way of paying the bills. Financing can be a powerful agent of reform.

1 Introduction: Context and Challenges

1.1 Snapshot of the Asian Irrigation and Drainage Sector

Asia is the world's most dynamic region, with the fastest economic growth, yet over 75% of the region is water insecure. If left unmanaged, water insecurity could pose a serious threat to continued growth and prosperity. The irrigation subsector accounts for about 80% of freshwater demand in Asia.

By 2050, agriculture will need to produce 100% more food in developing countries, using diminishing water resources (FAO 2012). With climate change impact and rapid urban population growth, improved irrigation productivity (more crop per drop) becomes critical for regional food security. The expanding and changing characteristics of production will also require more water and reliable supplies.

So the question really is, how can we increase the 524 million metric tons of rice now produced annually to 700 million tons by 2025, using less land, fewer people, less water, and less pesticides?

State-built irrigation schemes are aging and underperforming. Low-cost recovery, poor service delivery, and deteriorating infrastructure are plaguing performance. Efforts by many national governments to rehabilitate the schemes are ongoing, but the results have been mixed at best.

1.2 Objectives of This Paper

This paper considers the prospects for sustainably funding large-scale, publicly owned and managed surface irrigation and drainage (I&D) in Asia.¹ Such schemes are extensive. With an area of 205 million hectares equipped for irrigation (Appendix 1), Asia has 70% of the world's total irrigated land.

The core challenge facing Asia's I&D sector, therefore, is ensuring adequate financing for the recurrent spending and rehabilitation investment needs of existing large, publicly owned

¹ Unless otherwise specified, the term "irrigation" used in this report should be understood to include drainage.

and managed surface I&D schemes. The Asian Development Bank (ADB) Evaluation Study on Irrigation and Drainage (2009) concluded that the sustainability of irrigation projects (assessed) has generally depended on the timely availability of funds for adequate maintenance. Adequate funding for operation and maintenance (O&M) must be built into national budgets, if not funded from other sources (ADB 2009, iii). In this context, the level, and rate of collection, of irrigation service fees has been identified as a key issue—largely unresolved so far.

1.3 Typology of Irrigation Systems

A simple typology of irrigation systems used in Molden (2007) is presented in Table 1.

Table 1: Typology of Irrigation Systems

Characteristics	Typical Asian Countries or Regions	Challenges and Issues
Large-scale public irrigation systems in dry areas growing staple crops	Northern People's Republic of China, dry parts of Indo-Gangetic Plain, Central Asia, terai of Nepal	Economic and financial viability, technical and managerial upgrading, water use efficiency
Large-scale public paddy irrigation systems in humid areas	Terraced systems in Southeast Asia, tank and delta systems of South Asia (e.g., Sri Lanka)	Similar to above, but with location-specific features and properties
Small- and medium-scale and managed systems built and managed by communities	Afghanistan, Indonesia, Nepal, Philippines, highlands generally	Rehabilitation, consolidation, improvement; highly varied circumstances
Privately managed commercial systems producing for local and export markets	Southeast Asia	Management of impact on local communities
Individually managed farm-scale systems producing for local markets	Widespread, particularly around cities	Competition for land in urbanizing areas, environmental (pollution and aquifer depletion) and health-related problems; reliance on groundwater or wastewater

Source: Molden (2007), pp. 388–389, with additions and amendments by the author.

The scope for creating major new schemes in Asia is very limited because of rural and urban development, and the consequent growing scarcity of suitable land, as well as increasing competition for water resources from all other sectors.

1.4 ADB Evaluation Study of Irrigation and Drainage

In 2009, ADB's Independent Evaluation Department (IED) released an evaluation study on I&D containing an assessment of the results of ADB operations in this sector since 1969 (ADB 2009). Evidence was drawn from 120 projects, 18 of which underwent in-depth analysis.

By the IED's own criteria, the project success rate was 33.3% for oldest projects, approved in the 1960s, and 61.5% for those approved in the 1990s. While these numbers showed progress in "learning by doing," they also indicate the scale of the challenges still standing in the way of improved performance in this sector.

In almost three-quarters of the projects evaluated in detail, actual costs were lower than appraisal estimates. This reduction was due to a narrowing in the scope of the projects, the devaluation of the local currency against the US dollar, the adoption of lower-cost components, and other factors. A third of the projects had been reformulated for better adaptation to the local environment and to operating conditions not foreseen at appraisal.

Practically all projects overran their original implementation schedules, by sizable periods varying from 4.2 to 17.1 years. Crop yield increased between 5%–40%, though economic rates of return fell short of those expected, mainly because of lower-than-expected prices for rice during key parts of this evaluation period.

From the financing viewpoint, the significant finding was that only six of the 18 projects studied in detail had "high levels" of sustainability. In this context, the level, and rate of collection, of irrigation service fees was identified as a key issue.

The report did not discuss diversifying the sources, the possibility of investment capital or the involvement of private partners in I&D operations.

1.5 Complex Challenges of Irrigation and Drainage and Way Forward

A major driver of reform in I&D is the desire of national governments to reduce the burden of public subsidies for water and energy, as well as to lessen the dominance of public finance in investments in this sector.

Attracting sufficient finance for recurrent O&M and the cost of rehabilitation and modernization has been a persistent challenge for the irrigation subsector. There has been a widespread failure to recover sufficient O&M costs from charges to farmers, and transfers from government budgets to irrigation authorities have not fully compensated for the shortage. The result has been a decline in the standard of service and a progressive deterioration in the condition of infrastructure, making farmers even less inclined to pay more for their water.

The poor cash flow discourages alternate potential financiers such as banks. International financial institutions (IFIs) and donor agencies have provided consistent support for irrigation investments, yet the results so far, particularly with regard to sustainability of investments, remain less than optimal.

Many I&D schemes are trapped in a vicious circle of poor financial flow and deteriorating services and physical infrastructure. Productivity is low and declining, water use in land and water management is inefficient and wasteful, and the financial and economic returns leave much to be desired. When funding for irrigation is insufficient, maintenance—commonly the largest element in management, operation, and maintenance (MOM) and the one most easily deferred—tends to be the biggest loser (Burton 2010).

Irrigation authorities can and should undertake internal reforms to place their management and operations onto a more “businesslike” footing, using modern approaches common in the private corporate sector (Burton 2010). In many cases, it may be best to delegate responsibilities for certain functions from irrigation authorities to water user associations (WUAs) or other farmers’ groups or local bodies. Such reforms will be even more important for irrigation authorities keen to attract commercial lenders or private equity investors. Apart from any extra funds they can bring in, external financial players can provide the expertise and discipline that can help turn the irrigation authorities into more efficient and productive entities.

The weight of evidence suggests that, in urban water services public–private partnerships (PPPs) should be evaluated more in relation to their contribution to efficiency than to their impact in generating new finance (Marin 2014). In *irrigation*, PPPs are likely to have a similarly favorable impact, though experience with PPPs is much more limited and is still evolving (Dargouth et al. 2007).

1.6 Finance as Agent of Change

Financing should be viewed as a means of bringing about change, not simply as a way of paying the bills. The behavioral impact of financing is just as important to consider as the volume of funding that can be provided.

The process of attracting external commercial finance (loans, bonds, or equity) will create the discipline necessary to drive change, the know-how to effect the necessary internal reforms, and the incentives for the parties concerned to implement efficiently what is needed.

2 Future Financing Needs of Asian Irrigation

This chapter is aimed at providing a perspective on the scale of financing likely to be required to transform existing irrigation systems over the coming few decades, dealing separately with the future costs of investment and O&M.

2.1 Estimates of Current Capital Investment and Annual Spending

The potential investments required in water infrastructure are staggering—up to \$11.7 trillion worldwide over 2013–2030, according to the latest estimates (McKinsey & Co. 2013). These suggest financing requirements far in excess of historical investments. Reliable information about the current level of spending and investment in the I&D sector at the global level or at the regional level in Asia is lacking. There are therefore no solid benchmarks against which to gauge future regional requirements for either capital investment or O&M in this sector.

So far, ADB has invested about \$9.5 billion in irrigation within overall sector lending of \$46.6 billion for water. ADB lending in irrigation has declined sharply since 2000. In 2016, it was about 14% (from 40% in 1990) of overall lending in water. The pipeline for 2015–2017 indicates that the major borrowers are countries in Southeast Asia (\$700 million) and Central and West Asia (\$512.6 million), followed by South Asia (about \$116.8 million). The low East Asia pipeline of \$175 million reflects the fact that the demand of the People's Republic of China (PRC) is for more integrated water resources investments, rather than for irrigation alone.

2.2 Projections of Future Investment Requirements

With one exception, reviewed later, there are still no authoritative and consistent estimates of the future global cost of irrigation infrastructure (WWC and OECD 2015).

This section first considers the future cost of capital investment in the development of new I&D infrastructure or the rehabilitation of existing infrastructure. It then looks at the annually recurring costs of O&M.

Investment Costs

Estimates of the future cost of investment in I&D depend on several key assumptions:

- The assumed split between the creation of new irrigated areas and the rehabilitation of existing ones. Some areas that are nominally equipped for irrigation are not being fully used for this purpose (because of a shortage of water or other reasons) and may need investment in new facilities to recreate their original capacity.
- The proportion of future irrigation to be provided by surface water as opposed to groundwater, the split between large- and small-scale systems, whether these are gravity-fed rather than pumped systems, etc. These different modes of operation have widely differing costs, which may be attributed to public or private agents. For example, the costs of groundwater systems tend to fall largely on individual farmers.
- The adequacy of O&M actually being done. The (strong) assumption of “optimal” O&M would prolong the life of an irrigation system and minimize future annualized investment needs. Adequate O&M spending minimizes the need for new capital investment.

Allowing for these important methodological and contextual factors, this report focuses on the set of investment requirements developed by the Food and Agriculture Organization of the United Nations (FAO) in 2003 and used in the International Water Management Institute’s comprehensive assessment of 2007. While dated, these requirements provide a robust starting point.²

FAO projections (2003) of capital investment needs for irrigation development and rehabilitation in 93 developing countries for 1998–2030 are shown in Table 2 for countries in East, Southeast, and South Asia.

Table 2: Projected Cost of Irrigation Development in Asia, 1998–2030

Item	East and Southeast Asia	South Asia
Irrigated area ('000 ha)		
1998	71,500	80,500
2030	85,300	95,000
Unit cost (\$/ha)		
New	2,900	2,600
Rehabilitated	700	900
Total cost (\$ million)		
New	40,000	37,600
Rehabilitated	46,400	68,500
Total	86,500	106,100

ha = hectare.

Notes: The above totals are affected by rounding. The estimates of irrigated area used in this table are earlier, and smaller, than the more recent ones cited in Appendix 2.

Source: Molden (2007), p. 368.

² Appendix 2 contains further data on the unit costs used in this and other exercises.

The unit costs used in Table 3 can be compared with others in Appendix 2, which illustrates the scale of differences between different estimates. One of the most recent estimates, based on yardsticks reflecting conditions across various Asian countries, is presented Table 3.

Table 3: Cost Ranges for Maintenance, Rehabilitation, and Construction

Cost Item	Average Cost (\$/hectare)
Annual maintenance	10–100
Rehabilitation of existing scheme	200–1,500
Construction of a new scheme	5,000+

Source: Burton (2010), p. 183.

The range of Burton's figures in Table 3 reflect the cumulative cost of neglecting maintenance: the longer the period of time since effective maintenance has been carried out, the larger the cost of maintenance and rehabilitation within their respective ranges.

The \$192.6 billion cost total in Table 2 (for Asia, excluding Central Asia) corresponds to an annual average of \$5.836 billion for the whole 33-year period. Since this report was written 17 years into the scenario period, the totals for the remaining period could be adjusted down accordingly, depending on how much of the work is assumed to have been done so far. On the (strong) assumption that all countries have so far spent the annual amounts inferred from these totals, this would leave a further \$93.37 billion to spend in 2016–2030, at the same annual average as above.

Another, probably more realistic, assumption to make is that Asian countries as a whole have made some progress in I&D development and rehabilitation since 1998, but not as much as the totals inferred from the International Water Management Institute's projections. On the assumption that half of the amount required has so far been spent, the remaining amount needed to be spent annually from 2015 up to 2030 would be \$8.936 billion.

These estimates exclude the Central Asian countries. If their future investment requirements were proportionate to the size of their irrigated area relative to that of other Asian regions, the overall totals above would need to be rounded up by about 5%, to about \$9.4 billion annually. Allowing for price inflation since 2003 would increase these estimates to \$12.31 billion.³

What is unclear is how far the unimproved infrastructure has deteriorated further since the early 2000s, when these estimates were framed. I&D infrastructure has a finite life and depreciates rapidly if not properly maintained. The implication of this is that the above estimates are therefore likely to be a minimum.⁴

³ The United States consumer price index rose by 31% between January 2003 and June 2015.

⁴ Some national estimates are difficult to reconcile with these totals. For instance, it is estimated that in India, a further investment of \$164 billion would be required over a three- or four-plan period (15–20 years), implying annual spending of either \$10.9 billion or \$8.2 billion in this country alone (Varma, Dhingra, and Raghu Rama Swamy 2013, 27).

2.3 Yardsticks for Operation and Maintenance Budgets

The required amount of O&M for surface irrigation schemes will vary according to such factors as overall project size and the scope for economies of scale topography and how much pumping is involved, siltation rate, number of mechanical installations needing maintenance, and complexity of the schemes, and other factors. The type of infrastructure covered by these estimates, such as whether headworks like dams or main canals are included, or whether estimates relate only to tertiary levels within the responsibility of WUAs, must also be specified.

O&M and MOM comprise several distinct elements and activities. If maintenance is regarded as the crucial neglected factor, then the size of total MOM or O&M would be of less interest than the cost of maintenance per se, which is believed to typically account for about 70% of O&M costs (Burton 2010, 58 and Figure 3.17).

A common planning yardstick is to allot O&M expenses of 2.5% of the investment cost for large schemes and 1.5% for small ones (FAO 2011). However, the empirical basis of this yardstick is uncertain, and the yardsticks and rules used in specific cases yield different results.

In practice, context-specific estimates, where these are available, would be preferable to the use of rules of thumb obtained from meta-analysis of evidence from widely different cases. In one specific estimate for the Kyrgyz Republic, an irrigation service fee (ISF) of \$50–\$65 per hectare for routine maintenance, occasional repairs, WUA O&M, and asset renewal was considered necessary. This would have meant an ISF rate three to four times higher than the current one (Beadle and Burton 2013).

Estimates of O&M cost usually relate to “optimum” or “adequate” spending levels. In reality, a number of irrigation agencies are overstaffed and have high administrative overhead, which preempts funds for frontline maintenance.

2.4 Conclusions

- There is a lack of reliable, comprehensive, and systematic estimates of the future investment requirements of Asian I&D.
- The most authoritative estimate, adjusted for geographic scope and updated for inflation, shows an annual investment requirement of about \$12.31 billion between 2005 and 2030 for the entire Asian region.
- Estimates of the cost of O&M must be made for each specific scheme, ideally with maintenance separately identified. The asset renewal component must be based on asset management plans.
- Taken at face value, the abovementioned aggregate investment cost estimates and earlier projections, such as those of the World Water Council in 2000, seem proportional. These estimates are also modest in comparison with the anticipated annual costs of achieving other water-related global goals in the Sustainable Development Goals, and they are a minor component. They are also a minor component of the future global costs of all categories of infrastructure (McKinsey & Co. 2013' WWC and OECD 2015).

3 Overview of Irrigation Financing

3.1 Status Quo

There are three main types of irrigation financing: working capital, financing of recurrent O&M costs, and investment financing.

Working Capital

Working capital is short-term funding to enable irrigation authorities and farmers themselves to manage the gaps between seasonal expenditures and income. For irrigation authorities, this can normally be covered by short-term loans from local banks or debit balances built up, and later paid off, from government sponsoring agencies. For farmers, seasonal cash-flow deficits are funded from a combination of their own savings, informal credit from relatives, rural credit, other microfinance agencies, moneylenders, etc.

Financing Recurrent Annual Costs of Operating and Maintaining Irrigation Systems at All Levels

Recurrent annual costs are funded by a combination of budgetary transfers from central or state governments to irrigation authorities, on the one hand, and revenues raised from ISFs from farmers, on the other. Locally, revenues may also be boosted by the sale of secondary services and natural resources.

Capital Investment in Irrigation and Drainage Infrastructure

Investment can be funded from four main sources:⁵ (i) *national public finance* paid for through national budgets sustained by local taxes, (ii) *international public finance* (IFIs and bilateral donor agencies), (iii) funds drawing on *private philanthropic sources*, and (iv) *commercial finance* (loans, bonds, and equity) to be repaid on market-related terms. Commercial finance can be from either public or private sources. In some Asian countries (e.g., the PRC) *state-owned banks* are important sources of capital for I&D infrastructure, though their terms tend to be more “concessional” than those of private lenders, where these exist. In practice, private philanthropic funds are not major sources of funding for irrigation investment and will not be discussed here.

⁵ Investment can also be funded from the irrigation department's or agency's own retained earnings, but in most countries these are not a feasible source. There are practically no cases in Asia where irrigation fees contribute toward capital cost recovery.

Borrowings for capital investment in irrigation are repaid from future cash flows, made up of tariff revenues, government budgetary allocations from national taxation, or aid and other domestic or foreign philanthropic transfers. These repayment sources have been referred to as the “3Ts” (tariffs, taxes, and transfers).

The main varieties of (repayable) commercial finance are differentiated mainly by the degree to which they accept risk. As a general rule, holders of equity in a venture take on the full risk of failure or default, while lenders take the least amount of risk—being repaid first in the event of a bankruptcy. Bondholders have a status intermediate between the two.

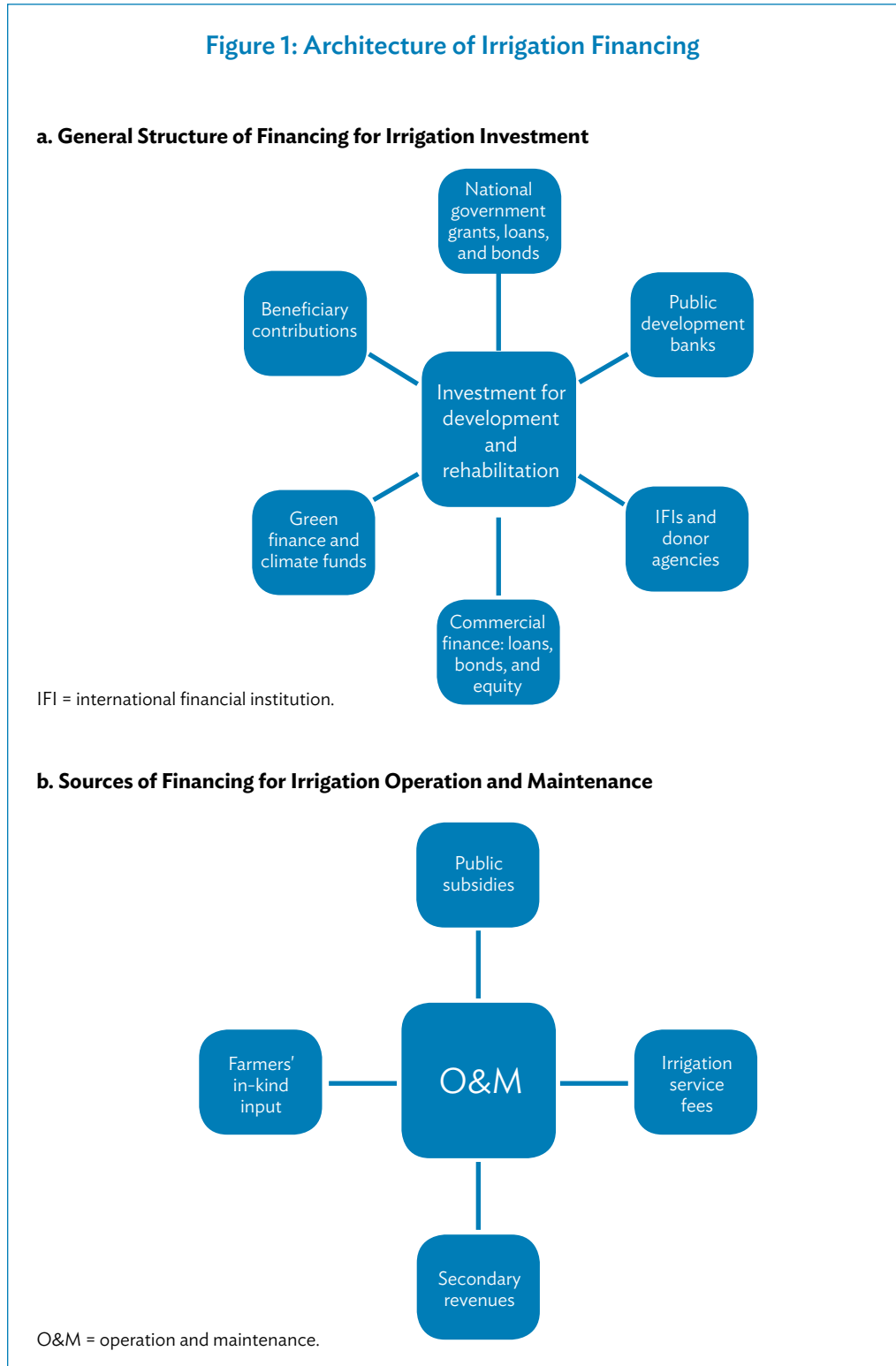
Although no type of financier is immune from the risk of nonrepayment, lenders are not technically “investors” in a project. The term “investment” implies the deliberate acceptance of some degree of risk, which banks go to some lengths to avoid. In the large, publicly developed surface irrigation schemes that are the main focus of this report, most commercial finance takes the form of loans, usually from publicly owned banks. Private equity is very rare, and if bonds are used, they are raised only by national and state governments on their own accounts or with their own guarantees.

Commercial finance for I&D can be either corporate (on the strength and security of the irrigation authority) or project finance (based on the cash flow expected from the project itself). The latter is described as nonrecourse finance since, in the event of default, the lender has no recourse to the balance sheet of the sponsoring organization. PPPs may involve the creation of a special-purpose vehicle (SPV) or special-purpose project (SPP) with the power to raise funds from the project’s own cash flow, but such schemes are rare in I&D (as discussed further in Chapter 6). For both corporate and project finance, the host government may offer guarantees (comforts) of various kinds to financiers, without which funds would not be forthcoming.

IFIs, such as ADB, the World Bank, the European Investment Bank, and many others, typically lend for irrigation through sovereign loans made to national governments, which agree to on-lend the funds to irrigation agencies, with the national government bearing credit risk and foreign exchange risk. IFI loans to subsovereign borrowers such as irrigation agencies or state governments are very rare, although the International Finance Corporation is empowered to lend directly to PPP projects. IFIs finance a relatively small volume of I&D investment, but they have a disproportionate value for this sector because of the attractive terms of their lending, the various kinds of “comfort” they can offer co-lenders, and the availability of technical assistance, capacity building, and other kinds of “value added” to their national counterparts.

There is a sizable private investment in irrigation by farmers themselves or through their WUAs and associations, mainly at the tertiary or quaternary field level. (This is even more typical of groundwater-based projects, which are not the main focus of this report.) Farmers’ investments can take the form of cash, labor, or materials, funded by savings or loans from family and friends, microcredit agencies, or moneylenders. The Kyrgyz Republic has an “Ashar” system, in which WUA members “pay” the ISF in kind in lieu of part of the monetary amount required (Beadle and Burton 2013).

Figures 1a and 1b illustrate the broad architecture of irrigation financing.



3.2 Toward Sustainable Irrigation Financing

Vicious Circles and Virtuous Spirals

Since the 1980s or earlier, observers of large surface irrigation systems, particularly but not exclusively those in Asia, have used the terms “vicious circle” and “downward spiral” to describe a process of neglect and decline. This description has become increasingly apt.

Many systems are locked in a circle of neglect and decline, resulting in deteriorating infrastructure, poor service, low charges, meager revenue collection, underfunded O&M, delayed essential maintenance, and system failures, which in turn further worsen the downward spiral. “Tail-end” irrigators bear the brunt of these failures. Without a reliable supply of water over which they have some control, farmers are unwilling to take the risk of planting more valuable crops. Many surface irrigation systems have actually shrunk in size, and, in most cases, the actual area under irrigation is less than the irrigation potential.

To replace this vicious circle with a virtuous spiral, infrastructure and services must improve so that farmers become more willing to pay more for their water and more funds flow back for spending on O&M, resulting in even better services and systems in a self-reinforcing process that creates momentum for change. Such a reformed irrigation system would be better able to attract new and market-based sources of finance.

The virtuous spiral can start within public irrigation agencies that adopt modern management practices and take a businesslike approach to irrigation services.⁶ In essence, these reforms emulate work practices commonly and successfully used in private companies (e.g., benchmarking, asset management planning, coupling of O&M with investment financing, use of targets, routine monitoring of the state of systems), including those involved in water supply and sanitation (ADB 2016).

Internal reforms do not necessarily entail direct private management or ownership, particularly where this would arouse strong political and social opposition. The least difficult measure would be contracting individual external specialists to work on specific functions within the I&D agency (e.g., information technology experts).

However, concerns about the performance of government agencies in running I&D schemes have led to increasing interest in introducing a third-party service provider between the irrigation authority and the farmers. The available options range from the management of I&D schemes by a reformed and financially autonomous government agency to the transfer of systems for management by a third party or by the water users themselves through their WUA (Dargouth et al. 2007). PPPs involving private management expertise and possibly financing are the most radical, and may be the most effective, type of third-party arrangement.

⁶ Madhya Pradesh in India exemplifies this move toward professionalized service-oriented irrigation, as described in Burton (2010). The Barind project in Bangladesh is another case in point (Zaman 2015).

Political Economy of Irrigation Financing: Why Does the Vicious Circle Linger On?

The vicious circle described has been known and written about for decades by leading specialists in this topic. The repetitive cycle of build, neglect, rehabilitate, neglect, and rehabilitate makes no sense from a rational economic perspective. In the long term, it is cheaper and more efficient for all parties to design infrastructure suitable for farmers' needs and ensure that it is properly maintained and remains fit for purpose.

It is vastly cheaper to spend an adequate amount each year on maintenance than to bear the cost of bringing forward the major rehabilitation of deteriorated assets (Burton 2010). The economic rate of return for adequate ("optimal") routine maintenance is much higher than that for major rehabilitation (Kikuchi et al. 2002).

Still, governments continue to seek funding for new irrigation systems, while allowing existing systems to deteriorate. In some cases, they succumb to pressures (from international lenders, among others) to reduce recurrent staff costs in public services in order to free resources for capital expenditure. Large new projects also offer greater opportunities for political kudos, patronage, and corruption than the activities involved in routine maintenance.

An extensive literature underpins the economic, financial, and environmental rationale for charging farmers an amount for using water that at least covers the cost of O&M, with some contribution to capital costs where feasible. However, there is a vast gulf between theory and practice in this topic. The gap between the value of water to farmers and what they actually pay for it has been characterized as "economic rent" of major proportions (Repetto 1986).

Historically, many I&D systems were set up to serve social, regional, and political purposes that make them impossible to justify under normal economic criteria and prevent them from being financially viable. Given these wider roles of irrigation, it may be argued to be unjust as well as impractical to levy water tariffs on users that would cover O&M, let alone recover their capital investment costs.

While this undoubtedly describes many systems, a more common factor is that, from the viewpoint of the irrigation authority, it is easier to obtain funds for the development or rehabilitation of infrastructure than to increase funds for O&M to an adequate level. There is a wide dichotomy in many countries between the financing of capital investment and the funding of annual O&M. Reducing the "bias" toward capital spending would involve more flexibility in national budgetary processes, as discussed later in this chapter and in Chapter 7.

Capital investment is funded mainly by central or state governments out of their investment budgets, with support from IFIs and external donor agencies. Maintenance and other O&M items, on the other hand, are covered by annual transfers from central and state governments, supplemented by charges from farmers. Mobilizing funds from these various sources entails different political processes and challenges. The fact that low irrigation charges are used by politicians as a potent lever against their rural electorate cannot be ignored.

Another inconvenient truth is that much of the recurrent budget for I&D is preempted by the administrative costs of the irrigation bureaucracy, which limits the funds available for adequate maintenance. The irrigation bureaucracy is itself a powerful force in maintaining the status quo.

Breaking Out of the Vicious Circle

A major theme of irrigation reform in recent decades has been participatory irrigation management, involving the decentralization of responsibility for key functions to farmers and their associations (WUAs or their local equivalent).

This is undoubtedly desirable in many situations (although, as argued in Chapter 5, the experience has been unsatisfactory in many cases). A measured conclusion about WUAs is that they are often part of the solution—a necessary but not a sufficient condition for irrigation reform.

Delegating power to WUAs and empowering them with human and financial resources will be incomplete, and may even fail, unless there are prior and complementary reforms in the irrigation authority itself. Making irrigation authorities more financially autonomous is an essential reform if the financial basis of this sector is to become sustainable, with less dependence on government subsidies.

A number of other proposals have been made for reforms of a more or less radical nature.⁷

Compartmentalization of Investment and Operation and Maintenance Funding

Effectively, the financing of the capital and recurrent costs of irrigation is treated separately in different political, administrative, and financing silos. In some parts of South Asia, the recurrent costs of staff salaries and maintenance are provided for under the nonplan part of the budget, while new capital expenditure is funded through the national plans. Even within the nonplan estimates, any savings made in staffing salaries go into a general consolidated fund, rather than being available for works such as maintenance (R. Sen and M. Burton, personal communications).

This compartmentalization lies at the heart of the problems described earlier, which make it easier so far to obtain funds for new investment than for essential routine maintenance. The practice runs counter to that observed in well-performing water utilities and companies, where coupling of annual and investment costs as part of asset management is routine for operational and financial purposes. In such undertakings, financial provision for future expenditure, whatever its nature, can be made as part of an integrated forward financial plan. While this would be possible in a financially autonomous irrigation authority, it is more difficult where the authority depends heavily on government subsidies.

⁷ For example, in papers presented at the Second Asian Irrigation Forum, Manila, January 2016. Also in Lankford et al. (2016).

The compartmentalization survives despite the symbiotic relationship between funding for O&M and investment in new or rehabilitated facilities. On the one hand, the neglect of sufficient spending on maintenance over a period of years causes the premature obsolescence and breakdown of systems, which means that major rehabilitation is required earlier than would otherwise be necessary. Thus, skimping on O&M is more costly in the long run:

On plausible assumptions about longevity and the rate of deterioration of schemes in Sri Lanka it has been estimated that spending on “optimal” levels of O&M can have economic internal rates of return of between 17% and 34% (Kikuchi et al. 2002, 12–14).

Conversely, new investment can reduce certain types of operating cost. For example, replacing old and inefficient diesel-powered pumps with electric units can save running costs, though the pumps may require more routine maintenance than before. Capital investment to modernize dilapidated infrastructure can start a virtuous circle of improved service and better cost recovery, provided sufficient spending on O&M is maintained (Box 1).

Box 1: The Amu Bukhara Project—Starting the Virtuous Spiral in Uzbekistan

In 2013, the Asian Development Bank (ADB) approved loans of \$220 million to the Amu Bukhara Irrigation System Rehabilitation Project in Uzbekistan. The project is aimed at providing a sustainable and reliable supply of irrigation (and also drinking) water in the irrigation command area of the Amu Bukhara Irrigation System Authority. Modernizing the irrigation infrastructure, specifically replacing old pumps with more functional and efficient ones, is intended to reduce the operating costs of the system and make irrigated farming more viable.

The deteriorating system and on-farm irrigation infrastructure has been using huge amounts of energy (20% of national power) and delivering progressively less water, at increasing pumping cost, to this key economic sector of cotton production.

The project will build one new pumping station, as well as modernize and rehabilitate four existing stations plus key regulatory and diversion structures. It also includes installing measurement gauges and radio communications systems, enhancing the capacity of all parties to adapt to climate change by introducing demonstration areas with model practices, and improving the management of supervision, procurement, and finances. Drainage channels will likewise be upgraded.

The recurrent budget of the Amu Bukhara Irrigation System Authority should improve on balance from reduced power consumption, the trading of carbon credits, which is being pilot-tested in the project.

Goal of Sustainable Finance for Asia's Surface Irrigation and Drainage

The principal aim of this report is to suggest conditions for creating greater financial sustainability for Asia's surface irrigation. These include the following:

- sustaining and increasing funding for investment from existing sources, mainly national governments and IFIs, by making I&D a more attractive and credible sector for public financing;
- diversifying the sources of investment financing by creating the conditions that will attract commercial sources, including private equity;
- improving the supply of reliable recurrent funding for MOM from water user charges and other sources, while reducing the relative size of public subsidies; and
- integrating investment and recurrent finance by coupling the planning of capital and O&M costs and provisions for covering these costs, thus minimizing future investment needs and ensuring adequate funds for essential ongoing maintenance.

The financial sustainability of irrigation is inseparable from the task of making irrigation agencies more efficient and accountable. This task includes the following:

- creating a sufficient degree of autonomy (financial and managerial) for the irrigation agency, which may necessitate a change in its status;
- introducing internal management systems conducive to greater efficiency and financial autonomy, including asset management planning;
- ensuring that existing infrastructure is adequately maintained so as to keep services to farmers at a satisfactory level and enable assets to operate for their full design lives; and
- creating a clear and functioning relationship between the irrigation authority and the farmers. A radical step would be vertical restructuring, whereby the irrigation authority would confine itself to being a bulk supplier of water, selling it to WUAs at an appropriate point of the system. Whether or not this happens, the solution may involve the creation of WUAs with adequate powers, capacity, and resources, or the formation of a third-party operator between the irrigation authority and the farmers. The latter may be a private company, though it could also be an empowered WUA or another kind of not-for-profit body.

4 Finance for Investments

Financing for surface I&D comes mainly from one of the following sources: national public funds, international public funds, commercial funds, and novel sources.

4.1 National Public Finance

Historically, the cost burden of developing irrigation in Asia has been borne almost entirely by public finance. A typical financing structure for investment in a large surface irrigation scheme would comprise some or all of the following:

- grants or loans from budgets of national governments;
- long-term loans on favorable terms, channeled through state-owned investment or infrastructure banks;
- bonds earmarked for irrigation, raised by national, state, or provincial governments;
- loans on concessional terms lent by IFIs to governments and on-lent to irrigation authorities;
- grants or concessional loans from bilateral donor agencies; or
- some contributions in cash or in kind from beneficiaries, either individual farmers or more usually local collective bodies such as local authorities or WUAs.

Projects typically include several of these sources in combination. This is particularly the case for large projects with several components.

Financing structures often include central (sovereign) government guarantees of various kinds to financiers to underpin borrowing and bond issues undertaken by subsovereign bodies such as state and provincial governments and irrigation authorities.

In large countries with a federal structure, the central government is likely to on-lend proceeds of its borrowing or bond issues to its state or provincial governments and to retain the foreign currency risk on these transactions. For instance, the World Bank's International Bank for Reconstruction and Development (IBRD) and International Development Association (IDA) loans for the Guanzhong Irrigation Improvement Project in 1999 were made to the Government of the PRC, which on-lent the funds on the same terms (but without foreign exchange risk) to the (provincial) Shaanxi Finance Bureau for disbursement to the latter's irrigation district project management offices (World Bank 1999).

All these aspects of public finance for irrigation have a cost to the central ministries of finance, and this growing fiscal burden lies behind their current interest in involving other, nonstate financial sources. The cost of subsidies for water and energy is also mounting and poses a serious fiscal and macroeconomic problem in many countries. Energy subsidies in Southeast Asian countries are estimated to have a fiscal cost of over \$50 billion annually (Coxhead 2014).

The size of these subsidies is magnified by the inefficiency of surface irrigation, with its high water losses and poor services, causing many farmers to supplement their supply with groundwater, which uses heavily subsidized electric power and diesel.

Long-term loans from publicly owned development and investment banks are more accurately regarded as “public” rather than “commercial” finance since they are not primarily commercially motivated and a sizable proportion of them are destined to be “nonperforming.”⁸

In the PRC, the China Development Bank lends to infrastructure projects for 10–20 years, extendable to 30 years for priority water projects, with a grace period matching their construction period. Among many other major water projects, the China Development Bank was a major funder of the giant Xiaolangdi multipurpose dam on the Yellow River, which supplies water to a large irrigated area. Irrigation is often a component of large multipurpose projects, which are able to tap into more widespread financing sources because of their size and the involvement of more financially profitable sectors (power, municipal water, industry) in the project (WWC and OECD 2015).

Turning Irrigation Authorities into Financially Autonomous Agencies

The case for creating financially autonomous irrigation agencies (FAIAs) rests on the fact that these agencies introduce administrative, managerial, and financial autonomy; increase accountability; facilitate contracting out and other forms of delegation to farmers; create less politicized procedures for fixing and collecting water charges; and mobilize new (nonstate) sources of finance for irrigation (Small and Carruthers 1991; Raju, Gulati, and Meinzen-Dick 2003).

FAIAs, despite their “financial autonomy,” may continue to receive government subsidies. For instance, the Korean farmland improvement associations, which started with the aim of being financially autonomous and raising all their funds from farmers, have received large government subsidies for the construction of new irrigation facilities. Despite this, if the subsidies given to FAIAs are based on objective criteria and do not vary according to revenues received from farmers, some of the benefit of financial autonomy may still be achieved (Small and Carruthers 1991, 104–106).

⁸ In arrears on debt servicing and repayment.

FAIAs can increase funding for irrigation under these two possible and necessary conditions:

- They enable central or state governments to exploit their borrowing powers more fully. The FAIA can, for instance, attract better financial expertise with knowledge of capital markets and use financial engineering to make bonds more financially attractive. Also, the “irrigation” label may attract more bond buyers than other types of bonds: some institutional investors, such as pension funds, are required to invest a portion of their assets in such infrastructure.
- FAIAs can produce reforms in their irrigation systems that create greater efficiencies, a more businesslike approach to operations, or more realistic tariffs and better collection rates: irrigation becomes “fitter to finance” through enhanced cash flows, the basis for raising commercial finance through loans, bonds, or equity.

Unless they can improve the cash flow into irrigation through management reforms, FAIAs are a short-term expedient for raising funds, leaving their sponsoring governments with contingent liabilities, which sooner or later become actual budgetary costs. FAIAs are not a sustainable solution unless they are the catalyst for genuine reforms in the way irrigation systems are managed and financed.

4.2 International Financing Institutions

IFIs, particularly ADB and the World Bank, have been key players in financing Asia’s I&D in recent decades. Their importance is due to a number of factors:

- Their willingness to lend for I&D, which differentiates them from international commercial banks. It is, however, relevant to note that IFIs’ exposure to the risks in this sector are indirect—their loans for I&D are almost invariably made to governments,⁹ which guarantee the loans and thus bear the credit and foreign exchange risk, and which on-lend the proceeds to their subsovereign agencies such as irrigation authorities.
- The volume of their direct lending. In the 1970s, it was said that “grants and loans from rich countries would continue to finance a large part—currently about 50%—of irrigation investment in South and Southeast Asia” (Wade and Chambers 1980, 1). This proportion is likely to have fallen since then. World Bank commitments to the I&D sector fell from \$2.3 billion in 1980 to \$0.5 billion in 2001 for a variety of reasons.¹⁰ ADB lending for I&D between 1969 and 2009 totaled \$5.25 billion (ADB 2009).
- The range of products they offer, which apart from loans can include policy advice, technical assistance, and capacity building. They can also provide guarantees against political and other types of risk to co-lenders, such as commercial banks and private equity holders, though this is not typical in I&D project finance packages.
- Their “halo effect”, which draws in cofinanciers (e.g., export finance and bilateral donor agencies).¹¹

⁹ In theory, the World Bank’s International Finance Corporation (IFC) could lend directly to, or take equity in, a special-purpose vehicle, such as a multipurpose dam with an irrigation component, but this has not yet happened in a single-purpose irrigation project in Asia.

¹⁰ Three-year moving averages in constant 2002 prices (Cleaver and Gonzalez 2003, 11)

¹¹ Such as the Japan Bank for International Cooperation in Pakistan and the Japan International Cooperation Agency in Uzbekistan.

- The terms and conditions of their loans: long term (in ADB's case, 20 or more years), with grace periods before repayments are due and international competitive tendering to ensure value for money. The poorest countries attract International Development Association terms for World Bank lending, with loans of 30–50 years at highly subsidized interest rates.
- Their ability to disseminate state-of-the-art approaches across their spectrum of borrowers. Both ADB and the World Bank have actively promoted irrigation reform, including the decentralization of management and revenue collection through WUAs and other local bodies (Box 2).

Box 2: Innovation in Irrigation Projects in the People's Republic of China Funded by International Financing Institutions

Qinghai Rural Water Resources Management Project. The Asian Development Bank (ADB) has supported this project, which includes developing climate-resilient irrigation infrastructure with flow-regulating and measurement structures, establishing 12 model water user associations (WUAs), creating service delivery organizations in each project county, and increasing the capacity of service delivery organizations and WUAs.

World Bank Water Conservation Project. As part of this project, farmers have formed WUAs to plan and operate irrigation services. Their objective is to reduce the consumptive use of water through evapotranspiration, as well as to increase farmers' incomes by using integrated agricultural, engineering, and management measures to adjust their crop patterns without further depleting the groundwater aquifer. Remote sensing is being used to estimate evapotranspiration in areas down to 30 x 30 meters.

Sources: ADB (2014a); World Bank (2013).

The future involvement of the major IFIs in Asia's irrigation sector on the scale seen in the past cannot be taken for granted. Their future involvement is increasingly likely to be in projects involving the adaptation of existing I&D schemes for greater climatic variability and for water and energy efficiency (ADB 2011, 27). IFIs are also showing a readiness to consider nontraditional forms of lending such as results-based lending. This will imply greater flexibility and adaptability, not to mention more radical changes, in their national counterparts.

4.3 Commercial Finance, Equity, and Project Finance

Commercial finance, consisting of loans, bonds, and equity has as defining feature, it must be repaid in debt service or dividends at a rate that matches the market-based expectations of lenders and investors.

Few, if any, Asian irrigation authorities have the financial solvency to borrow on their own account, except for short-term working capital. Therefore, medium- or long-term commercial bank loans would have to be made on the credit of central or state governments and repaid from their resources. In theory, irrigation authorities could raise loans directly from the World Bank's International Finance Corporation (IFC), other IFIs, and some bilateral agencies that offer such subsovereign lending without taking guarantees from the central government, but this is very unusual in this sector. Likewise, financially autonomous irrigation authorities may issue irrigation bonds, but, unless the irrigation authorities make a surplus, these rely on guarantees and repayments from state governments. As for equity, this is feasible only for autonomous corporations or SPVs with prospects of good financial returns. This condition is rarely fulfilled in I&D.

Project Finance

All three types of commercial finance depend on having a creditworthy borrower or bond issuer, or a profitable project on which the money is used (Winpenny 2014). Governments may borrow on behalf of irrigation authorities and pass on the proceeds, but these then become a form of public finance. Irrigation authorities themselves are rarely creditworthy for commercial finance.

In project finance (Box 3), funds are provided against the security of the cash flow arising from the creation of the project's assets, plus the realizable value of the assets themselves. This presupposes that the assets being financed are "ring-fenced" by the creation of an SPV so that the cash flow from the project is available for debt service and dividends.

Most cases of project finance involve the creation of an SPV. This is a legal entity created specifically for the purpose of funding a project. The sponsor (e.g., the irrigation authority) would create the SPV to ring-fence the rest of its assets from the new project and to protect the project's revenues in order to service debts and pay dividends to shareholders in the SPV.

Figure 2 illustrates the basic structure of the project company or SPV, with governments issuing concession agreements, sponsors (which could be irrigation agencies) owning the company, and financiers providing loan funding. In the simplest arrangement, customers or public offtakes provide revenues for the project company, that are paid to the financiers as debt service and as dividends back to sponsors. However, in some structures, revenues are ring-fenced (e.g., into escrow accounts) for debt servicing.

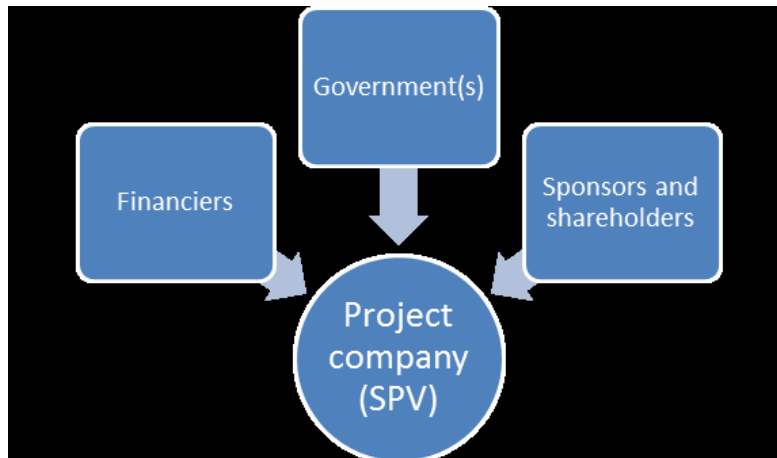
Box 3: Project Finance—“Cash Is King”

Project finance

- uses the project’s assets and future cash flows as the basis for raising funds, rather than the balance sheet of its sponsors, for which it represents “off-balance sheet” finance;
- requires the creation of a special-purpose vehicle owning the assets and the cash flow arising from them;
- is all about understanding, using, and enhancing the economic appeal of a project in order to attract suitable finance—its focus is the project’s “free” and “dependable” cash flows, and managing the risks and shocks (both internal and external) to which these are subject;^a and
- is nonrecourse finance since the lender or investor has no legal claim on the general assets or balance sheet of the borrower (or sponsor) in the event of repayment difficulties.

^a “Free” meaning not committed for other purposes and available for servicing debt and paying dividends; “dependable” meaning reliable and sustainable in the future period over which the project’s financial obligations arise.

Figure 2: The Project Company (Special-Purpose Vehicle)



SPV = special-purpose vehicle.

Project finance can potentially raise large sums for major infrastructure projects (including multipurpose schemes) through the financial options created by SPVs. It is also suitable for large new projects, especially those of a stand-alone nature, where there is no established parent body or where the project is large in relation to the sponsor’s existing operations. However, legal and banking costs as well as other due diligence fees add up to a heavy transaction cost for project finance, creating a high minimum threshold (over \$100 million) for such deals to be feasible.

Public authorities with good credit standing could opt to raise funds in the bond market or use their good credit standing to provide financial guarantees to subnational bodies like irrigation authorities. In some countries, loans (e.g., from IFIs) are not accounted for in the normal annual budget statements and part of their political appeal is that they appear “off balance sheet.” Governments with weaker fiscal status may find it expedient to use project finance to raise the money, subject to constraints imposed by existing creditors including the International Monetary Fund.

For a national government, the choice between conventional borrowing, bond issue, and project finance will rest partly on its own creditworthiness, partly on borrowing constraints imposed by the International Monetary Fund and other major creditors, and partly on project-specific factors such as the following:

- Is the project likely to have a robust cash flow that would support loan or equity finance?
- Is it feasible to set up an SPV? Are the assets of the project suitable for securing repayable funding?
- Can the economics of the project be improved by redesign, risk mitigation, and credit enhancement measures?
- Is there scope for involving private investors or operators in the project? Is this feasible under national legislation?
- What are the realistic financing options for project finance? What kind of support is available from the national government, IFIs, and partner agencies? Are project bonds feasible?
- Is the legal and commercial environment sufficiently robust and stable to ensure the sanctity of commercial contracts?

4.4 Novel Sources of Finance

In the last few years, a number of new financing opportunities that are potentially relevant to irrigation have arisen. These include green bonds, the Green Climate Fund, the Clean Development Mechanism (CDM), and the Adaptation Fund.

Green Bonds

Green bonds are intended to raise finance for projects that help the transition to low-carbon and climate-resilient development. Reengineering irrigation schemes could, in principle, qualify.

The global market for green bonds has grown rapidly from a very low base to \$10 billion in 2013 and \$33 billion in 2014 (*Economist* 2014 [5 July]; *Financial Times* 2014 [30 January], 30). Initially, IFIs (e.g., World Bank, African Development Bank, and European Investment Bank) were the largest issuers, but now corporate issuers (e.g., Unilever, GDF Suez, Toyota) are of similar importance. The World Bank’s green bond is the market leader and its standards of eligibility and governance set the tone in the market.

Green bonds are typically of investment grade to attract institutional investors. In order for irrigation authorities to gain access to this type of finance, they would have to be financially autonomous and achieve investment-grade credit ratings.

Green Climate Fund

The incipient Green Climate Fund will become potentially important in funding the creation and adaptation of existing and new irrigation systems to make them more climate resilient, such as for more extreme climatic fluctuations. The next generation of irrigation projects will also need to be more energy efficient than the current stock.

For both reasons, irrigation will be eligible to tap into the various kinds of climate finance that are becoming available (Climate Funds Update [access date: June 2016]). In December 2014, the meeting of the Conference of the Parties (COP) in Lima, Peru, ended with a further pledge of contributions to the Green Climate Fund, bringing the total so far to \$10.2 billion. Further pledges were also made to the existing Adaptation Fund (Shamsuddoha and Haque 2015; Nakhoda et al. 2014).

Irrigation has so far been a minor user of climate finance. However, its transition to a more energy- and water-efficient mode of operation presents financing opportunities. The Green Climate Fund is aimed at striking a rough balance between projects intended to mitigate climate change and those involving adaptation to it. Irrigation would tick both boxes.

Clean Development Mechanism

The CDM allows emission reduction projects in developing countries to earn certified emission reduction (CER) credits, each equivalent to 1 metric ton of carbon dioxide. These credits can be traded and sold, and used by industrialized countries to meet a part of their emission reduction targets under the Kyoto Protocol. The irrigation project in Uzbekistan referred to in Box 1 could potentially generate carbon credits that could be sold under the CDM.

Adaptation Fund

The CDM is the main source of income for the United Nations Framework Convention on Climate Change (UNFCCC) Adaptation Fund, which was established to finance adaptation projects and programs in developing countries. The Adaptation Fund is financed by a 2% levy on CER credits issued by the CDM.

4.5 Conclusions

- So far, the cost burden of investing in irrigation in Asia has fallen almost entirely on public finance from national and international sources.
- Broadening the range of public financing instruments, to include bond issues by autonomous irrigation agencies, for example, is not feasible without serious reforms in I&D management and financing.

- IFIs such as ADB and the World Bank have been, and are likely to remain, important sources of long-term loans. Their range of products, including advice, capacity building, and guarantees, as well as loans, ensures them a central part in most major project financing structures. However, their future involvement will increasingly be in projects involving the adaptation of existing I&D schemes to rapidly evolving circumstances. This will call for evolution in the technical, institutional, managerial, and financial structure of their national counterparts.
- Attracting commercial lending will depend on the transformation of irrigation authorities into financially autonomous and commercially oriented undertakings, generating revenue streams sufficient to service their own debt. This is still some way off in most cases.
- Project finance, using commercial loans and private equity, involves the creation of an SPV owning and developing the irrigation assets and able to generate sufficient cash to repay debt and dividends. While commercial finance has been drawn into PPPs, for new irrigation projects in Brazil, Morocco and a few other cases, such schemes normally call for heavy public (and IFI) cofinancing and guarantees to attract private partners.
- Several recent developments in climate finance present future financing opportunities for I&D. These include green bonds, the Green Climate Fund, the CDM, and the Adaptation Fund.

5 Funding for Management, Operation, and Maintenance

Funding for the recurrent annual costs of MOM comes mainly from a combination of budgetary transfers from government bodies and revenues raised from user charges in the form of ISFs. There are other secondary sources, which vary from one situation to another. These include revenues from nonfarm beneficiaries of irrigation infrastructure, such as fisheries, recreation, and hydropower, and in-kind input, such as labor.

The most pressing concern in this context is ensuring adequate funding for maintenance.

5.1 Preliminaries

Which Costs?

Determining which of the costs of irrigation infrastructure should be allocated to farmers, rather than to other beneficiaries of this infrastructure, is an important policy issue. In Asia, about 90% of dams built primarily for irrigation are multipurpose (Easter and Liu 2005). Many canals have value for transport and fisheries, and irrigation structures can be important in flood risk management. The allocation of joint costs between different classes of users is not straightforward. Farmers should not have to shoulder an unfair share, and irrigation budgets should not be charged with costs that more properly fall to other government departments (Easter and Liu 2005; Malik, Prathapar, and Marwah 2014).

Within the irrigation subsector, a further issue is whether tariffs should aim at full cost recovery, including capital charges, or only annual recurrent costs. For most Asian irrigation systems, the full recovery of all capital investment charges is a distant goal. Governments have traditionally provided funding for capital investment as a grant, or, in case of a long-term loan, have effectively written it off as nonrepayable. This practice may be justified if irrigation infrastructure has elements of a public good or if it is reckoned to be part of a government's food, social, or regional policy.¹² Even so, some capital cost recovery may be warranted on economic and financial grounds.

A choice also has to be made concerning which parts of the network should be costed out for recovery through tariffs. Asian countries variously include O&M for the entire irrigation system, for main canals only, for branch and tertiary canals, or for combinations of these in different projects. Some countries (Sri Lanka) and projects (in Nepal) do not seek any cost recovery of O&M (Malik, Prathapar, and Marwah 2014).

It could be argued that management should be regarded as a separate category, since it is a fixed overhead expense, unlike O&M, which varies according to activities undertaken. Management represents a fixed contractual commitment of payment to public officials, which governments cannot shirk. It is therefore hardly surprising that the management portion takes the lion's share of recurrent budgets for MOM and preempts these budgets when resources are scarce. According to a report on one recent survey.

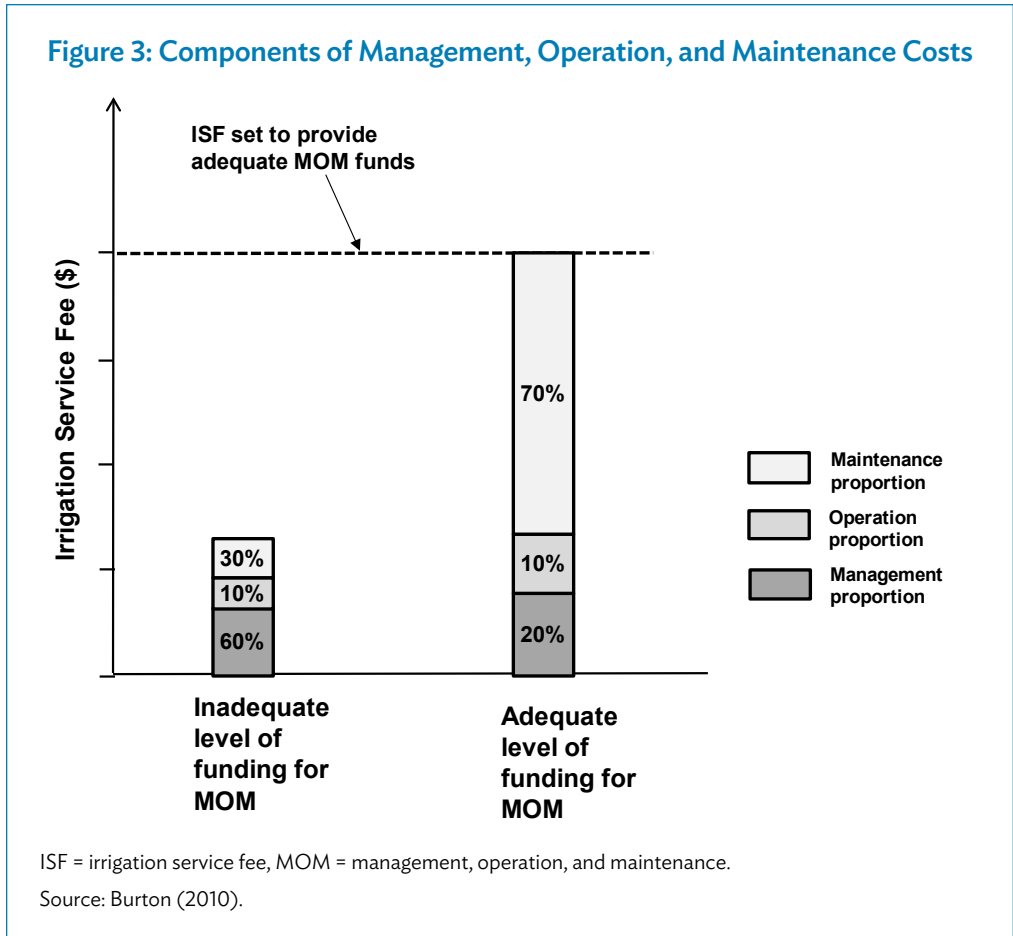
...public sector irrigation agencies are typically overstaffed and most of the funds allocated for O&M activities actually go towards paying the salaries of staff, leaving very little money for the actual maintenance of the system.

The situation described, though quite common, is by no means universal. A number of central and state governments have taken steps to reduce their irrigation bureaucracies (typically by announcing freezes on recruitment or offering early retirement), producing the opposite problem of staff shortages, particularly in middle and senior cadres requiring greater qualifications and experience (R. Sen, personal communications).

However, the situation reported may be due to an inadequate total budget for MOM rather than an excessive absolute level of management costs. From an analysis of the MOM costs of a number of irrigation and drainage systems, Burton (2010) found that in well-performing, well-maintained gravity-fed systems, the maintenance funding component composed around 70% of the total MOM costs.¹² When the total MOM funds are insufficient, the proportion of staffing costs (the management element in MOM) appears high relative to the total MOM costs and the expenditure on maintenance (Figure 3). However, when adequate MOM funds are provided for the actual maintenance needs, the same management costs are in reasonable proportion to the other components and the total MOM costs.¹³

¹² A good or service that must be provided collectively, since charging for the full cost of its supply is not feasible, and therefore private provision is also not feasible.

¹³ Approaches to calculating realistic values of maintenance costs are discussed later in this report.



Proper Measurement of Operation and Maintenance Costs

Even where a fair allocation and definition of costs is agreed to in principle, difficulties often arise in measuring and estimating these costs for the purpose of fixing central budgets and setting rates for the ISF. Many irrigation authorities lack a full understanding of the O&M costs involved in each case. The following observation (in a report for the World Bank on project cost recovery covenants) is pertinent (McPhail, Locussol, and Perry 2012, 7).

...we typically do not know how much is spent on O&M, and we do not know how much should be spent, and the gap is likely to be a political problem. The process will thus inevitably be iterative, and the first estimates will in all probability be “wrong.”

Some governments set the levels of budgetary support for irrigation O&M in a top-down manner that is arbitrary and remote from what is actually needed. This matter is discussed further in section 5.2.

There is a strong case for the use of life-cycle management plans (including optimal MOM budgets) by irrigation authorities to more accurately assess and make financial provision for the full costs of their assets over time (Burton, Kingdom, and Welch 1996).

5.2 Budgetary Allocations

The situation in many large Asian surface irrigation schemes has been summarized as follows:

In the absence of any systematic procedures for estimating the actual O&M requirements of the systems, the budgetary allocations are made on an ad hoc basis determined generally on the basis of financial resources available with the government and not on the basis of actual requirements. The funds allocated for O&M by the government and those collected from water users in the form of cost recovery are determined independently of each other (Malik, Prathapar, and Marwah 2014, 16).

The upshot of these budgetary conventions is that many Asian irrigation systems lack sufficient funds for adequate O&M.

5.3 Revenues from Irrigation Service Fees

Experience with Irrigation Tariffs

There is extensive literature on irrigation tariffs to substantiate the view that ISFs mostly fail to cover even the O&M costs of these services, and this result is a product of low nominal charges and poor collection rates (Box 4) (Bosworth et al. 2002; Molle and Berkoff 2007).

Box 4: Empirical Estimates of Operation and Maintenance Cost Recovery in Irrigation

Cleaver and Gonzalez (2003) quoted typical operation and maintenance (O&M) cost recovery rates of 20% in the People's Republic of China, below 20% in the Philippines, and 15% in Pakistan (K. Cleaver and F. Gonzalez. 2003). In only 30% of World Bank irrigation projects were O&M costs recovered.

Low collection rates reduce revenues even further.

Easter and Liu (2005) discovered the following picture in their sample of countries (costs recovered as a percentage of O&M costs): (K.W. Easter and Y. Liu. 2005) Argentina 12%, Botswana 35%–45%, Colombia 52%, Jordan 50%, the Philippines 46%, Tunisia 70%, Turkey 32%–50%. The authors cited a number of reasons for these low cost recovery rates:

- absence of a link between revenues collected and funds retained or allocated to the irrigation project concerned;
- lack of farmer participation in project planning and management;
- poor communication and lack of transparency between farmers and irrigation authorities;
- poor water service delivery;
- absence of penalties for nonpayment of charges;
- low priority given to collection of fees, efficient use of water, and O&M;
- small size and poverty of irrigated farms; and
- corruption of irrigation officials.

In an analysis of 75 cases (mixture of country averages and of individual projects) by Molle and Berkoff (2007, 65), only nine achieved O&M cost recovery of 100% or more, and of countries outside the Organisation for Economic Co-operation and Development (OECD) only Colombia, India (tubewells in Gujarat), Mexico, Morocco, and Peru (F. Molle and J. Berkoff, eds. 2007). The median rate of cost recovery of O&M for all others was 20%; In four cases, it was 0%.

Appraisal reports carried on for recent Asian Development Bank projects broadly support the view that the revenues from irrigation charges remain below cost recovery levels for O&M (Varma, Dhingra, and Raghu Rama Swamy 2013, 24).

Sources:

^b G.A. Cornish and C.J. Perry. 2003. *Water Charging in Irrigated Agriculture: Lessons from the Field*. Report OD 150. Wallingford, United Kingdom: HR Wallingford.

^c F. Molle and H. Berkoff, eds. 2007. *Irrigation Water Pricing: The Gap between Theory and Practice*. Wallingford, United Kingdom: Centre for Agriculture and Bioscience International. p. 16.

^f H.A. Varma, A.S. Dhingra, and D.T.V. Raghu Rama Swamy. 2013. *Exploring Public–Private Partnerships in the Irrigation and Drainage Sector in India*. Manila: ADB. p. 24.

The situation has been summarized in the following terms:

...water tariffs are consistently far below the cost of supply of irrigation water. The tariffs once fixed are not revised for years with the result that the gap between cost of supply and revenue realisation keeps on increasing (Malik, Prathapar, and Marwah 2014).

Different Roles of Irrigation Charges

Discussions about irrigation charges often confuse their different purposes. Irrigation charges have several functions:

- **Economic.** Set at a meaningful level, an ISF signals the economic value (scarcity, opportunity cost) of water to encourage its most efficient use (crop per drop).¹⁴ It would also provide the truest price for the purpose of appraising investment alternatives (e.g., different types of irrigation, different crop mixes, economic returns from irrigation versus municipal water services).
- **Environmental.** A volumetric ISF set at a level that influences the use of water would discourage its wasteful use in conditions of scarcity, to the detriment of other water users, natural aquatic systems, and the long-term sustainability of lakes and aquifers.¹⁵
- **Financial.** The proceeds of ISFs raise revenues for rehabilitating, operating, and maintaining irrigation water services in a sustainable manner.

Much of the academic debate about the efficacy and feasibility of the more active use of irrigation charges has revolved around their economic role (Perry, Rock, and Seckler 1997). It has been strongly argued that most irrigated farmers would not respond sufficiently to an increase in the current level of charges to achieve any economic purpose (in economic parlance, demand is price inelastic at current tariff levels) and that to raise charges to levels where they might start to affect farmers' behavior would require increases that are not feasible in political or social terms (Molle and Berkoff 2007, 65).

Other factors would also militate against the more active use of tariffs. They presuppose that the use of water can be measured and regulated so that charges could be applied volumetrically or other proxies for the actual use of water could be used. These conditions are quite limiting. There is even skepticism about the very notion of volumetric pricing, irrespective of tariff levels: the conclusion of one wide-ranging literature survey is that "[t]he price response to volumetric water charging is widely shown to be minimal (Bosworth et al. 2002, iv)".

Farmers operate in input and product markets that are often highly distorted by taxes, price controls, and subsidies, the combining to dilute any incentive effect from irrigation water prices per se. Ultimately, there is the realpolitik of politicians' use of price subsidies as a widespread form of patronage. It is often said that farmers may be willing to pay but politicians are invariably unwilling to charge for their own electoral reasons (Malik, Prathapar, and Marwah 2014, 21).

¹⁴ The value of the water in its best alternative use.

¹⁵ A complication arises in the case of higher prices for surface water would encourage farmers to exploit groundwater unsustainably where this is available free or subsidized through cheap diesel or electricity.

Both the economic and environmental roles of irrigation charges depend on a reduction in the use of water by farmers in response to higher charges. If no such reduction occurs, or if sufficiently high tariffs are not feasible, other means may have to be taken to achieve the economic and environmental objectives.

However, none of this invalidates the use of irrigation charges to defray O&M costs. In most cases, tariff revenue may be the most sustainable source of funding for these costs.

Affordability

ADB economic appraisals typically demonstrate that farmers' incremental incomes from irrigation projects normally greatly exceed any existing or proposed increase in irrigation fees (Table 4).

Table 4: Full Operation and Maintenance Cost Recovery as Share of Incremental Income in Recent ADB Irrigation and Drainage Projects (%)

Project Name	Cost Recovery from Project
Orissa* Integrated Irrigated Agriculture and Water Management Investment Program	3%–6% for major and medium-sized schemes, 9%–17% for minor lift schemes
Irrigation Management Improvement Investment Program	Farmers would pay <i>less</i> with the project, as a result of switch to electric pumping (and pilot testing of solar power); proposed new tariff to cover management, operation, and maintenance for irrigation levels 2 and 3 would be 30% of incremental incomes
Federally Administered Tribal Area Water Resources Development Project	Average operation and maintenance costs to be covered by farmers: 12% of incremental financial benefits
Lao People's Democratic Republic: Northern Community-Managed Irrigation Sector Project	Average farm expected to have cost-recovering irrigation service fee of less than 10% of incremental benefits
India: Chhattisgarh Irrigation Development Project	Full operation and maintenance costs covered "many times over" by incremental benefits

* In 2011, the Government of India approved the renaming of the state of Orissa to Odisha.

Molle and Berkoff (2007) cite a 1990 study of 150 systems showing that in all but one case water charges were less than 10% of net farm income excluding water charges.

According to another study (Malik, Prathapar, and Marwah 2004, 31), irrigation charges represent a small percentage (2%–14%) of the net value of output, 0.7%–6% of the gross value of output, and 0.8%–12% of total operating costs. The authors conclude: "...there is

no lack of ability of the farmers to pay for the irrigation water.... It is the lack of willingness-to-charge rather than lack of ability or willingness to pay that is keeping the irrigation water tariffs at low levels.”

All recent new irrigation projects involve some development or renovation of infrastructure that will improve service and enhance willingness to pay. A number of recent ADB projects contain complementary components—transport, extension services, marketing, and other features of “holistic” and “integrated” projects—that are likely to boost farm productivity and willingness to pay for water.

Finally, unaffordable irrigation charges may signal a badly designed project (Sagardoy, Bottrall, and Uittenbogaard 1986).

Collection Rates

Subeconomic tariffs are often combined with a low collection rate of amounts due, compounding the funding shortfall (Molle and Berkoff 2007, 36–37). In Pakistan, the national average of collections compared with amounts due over the period 2000–2010 varied from 46% to 71%, with wide variations between years and across the four national provinces, and no obvious trend over time (Malik, Prathapar, and Marwah 2014, 26).

The rate of collection partly reflects the institutional arrangements in place. In Pakistan, tariffs are collected in some cases by the provincial irrigation and power departments and sometimes by the provincial revenue wings. The village heads are often involved in collection and are allowed to retain a certain percentage of the amounts collected. In certain projects in the Kyrgyz Republic, Nepal, and Tajikistan, WUAs are responsible for collection.

While institutional arrangements may help explain differential rates of revenue collection in different areas, these are better understood as part and parcel of the same problem as low tariffs. A low willingness to pay is likely to be expressed in resistance to collection (reluctance to be collected from). Other factors are also present; these include logistical difficulties faced by collectors, bribery (or the opposite, intimidation) of collectors, fraud, and measurement problems (see next section). In some cases also, where central or state revenue departments make collections, any improvement in the collection rate does not necessarily filter down into more funding for irrigation O&M.

Collection rates tend to be higher in the following circumstances (Molle and Berkoff 2007, 37):

- under authoritarian governments;
- if water supply can be, and is, cut off for nonpayment;
- if charges are low, are recovered along with other taxes, or [not “and/or”] are collected before the crop season;
- where users have some control over the use of the revenues; or
- when water supply is reliable.

A survey conducted by Malik, Prathapar, and Marwah (2014, 31) found consensus among the majority of farmers on several propositions. Cost recovery is more likely where

- the crops to be irrigated have a higher unit value;
- irrigation infrastructure is adequately maintained;
- there is transparency over how tariffs are fixed and what revenues are used for;
- dependence on surface water is high (compared with situations where groundwater is also an option); or
- WUAs are involved in water allocation, tariff setting, bill collection, and system maintenance.

Fraud and Corruption

The amount of revenue collected from ISFs depends on accurate measurement either of the amount of water used or on proxies for this, such as acreage actually irrigated. It is also affected by the degree of fraud and corruption involved in the collection process. In the absence of metering (which itself can be tampered with), charges depend on other kinds of monitoring or self-reporting, both of which are prone to fraud. The problem is compounded where charges depend on the type of crop, as in Pakistan's *abiana* system (Box 5).

Box 5: Leakage of Revenues in Pakistan's Irrigation Systems

Revenue generation is deficient, not because users are unwilling to pay for the services but because the system lacks good governance and accountability. As recently as the 1970s, the irrigation revenue generated by the government of Punjab was sufficient to finance the entire annual budget of the province. Today it is insufficient to pay for the expenses of the irrigation department. Moreover, local communities traditionally paid for the operation and maintenance of many local projects and even shared in their capital cost. Even today, communities willing to share in the staff costs of public sector employees provided they receive a certain level of service.

Considerable leakages occur in the collection of the revenue. There is room for considerable discretion in the assessment and collection of the *abiana* (water rates) that are levied. Leakages in the form of under-booking and recording of higher *abiana* crops as lower *abiana* crops are no longer a mere notion. By conservative estimates, "33 percent of revenue leakage can be saved if data handling is controlled at the first stage, and another 5% at the second stage." International Irrigation Management Institute research has found that in one watercourse command, the cropped area in *kharif* (summer) was 45% greater than that shown in the official *khasra* (cadastral map) for that season (1988).

Source: Hussein and Parvaiz (2000), 10–11.

Developments in satellite imagery present new opportunities for the objective monitoring of irrigation systems, as in the PRC (Box 6).

5.4 Secondary Sources of Revenue

Irrigation agencies that have sufficient financial autonomy may generate income from nonirrigation sources. Small and Carruthers (1991) cite the following:

- In the PRC, “sideline economic activities” generating income used to finance irrigation services include fishing, livestock and poultry production, the processing of agricultural products, the recreational use of irrigation reservoirs, and the production of nonagricultural goods in small factories.
- In Indonesia, village officials involved in the management of irrigation water are allowed to cultivate or rent out parcels of land in the village and keep the income from these as compensation for their work on local irrigation.
- In the Republic of Korea, income arises from interest on funds left on deposit, the sale of water for nonirrigation purposes, and the rental of assets.
- In the Philippines, part of the funds financing the O&M activities of the National Irrigation Administration comes from the rental of equipment, interest on unspent financial balances, and fees from managing the construction of new irrigation projects.
- In Taipei, China, irrigation authorities in urban areas have been able to sell land on which redundant canals were sited and use the interest income from the proceeds to cover the cost of irrigation O&M.
- In the United States, WUAs in the western states have been able to fund their activities with income from the leasing of land for grazing and farming and with the net profits from hydropower generation.

At certain times and in some places, secondary sources are important in providing funds for O&M, while leaving basic ISFs at “affordable” levels. In the Republic of Korea in 1983, the farmland improvement associations earned W33 from other activities for every W100 they earned in irrigation fees. This enabled them to cover the full cost of O&M while covering the cost of repaying government loans for the capital cost of irrigation projects (Small and Carruthers 1991, 150).

Regarding contributions in kind, the labor input of farmers is important in carrying out maintenance in some countries (e.g., the *ashar* system in the Kyrgyz Republic) and would be revealed as a major source of “funding” if properly monetized (M. Burton, personal communications).

From a different perspective, irrigation contributes to the wider economic and social goals of society and could make legitimate claims on other national budget lines, such as those for poverty reduction, food security, flood risk management, and the unemployment relief.

5.5 Irrigation Management Transfer and the Role of Water User Associations

Burton (2010, 248) noted:

The top-down government-led technically-driven developments of the 1970s and 1980s are giving way to bottom-up institutionally driven initiatives, which seek to fully involve the water users in the acquisition, management and use of water for irrigated agriculture.

Irrigation management transfer (IMT) became the paradigm of this movement, defined as "...the relocation of responsibility and authority for irrigation management from government agencies to non-governmental organisations, such as water users associations. It may include all or partial transfer of management functions. It may include full or only partial authority. It may be implemented at subsystem levels, such as distributary canal commands, or for entire systems of tubewell commands" (FAO 1999, quoted in Burton 2010, 248).

Transfer of ownership of infrastructure is rarer than that of managerial responsibility (Vermillion 1997). IMT involving ownership transfer has occurred in the Kyrgyz Republic, Mexico and a few other cases.

IMT is a stronger form of participatory irrigation management (PIM), another recent paradigm in which governments retain an important role in the management of I&D.

There is an extensive literature on PIM, IMT, and the role of WUAs or their local equivalents in the management (including maintenance) of irrigation systems (Vermillion 1997). This report does not delve in any depth into this issue, being concerned primarily with the impact of delegated forms of management (of which WUAs are taken as representative) on mobilizing sustainable funding for O&M.

IMT could increase funds for O&M, indirectly or directly, through several possible routes:

- Indirectly, through the role of farmers' collectives in improving the local sense of ownership of irrigation services, the state of irrigation infrastructure, and the efficiency of irrigation services.¹⁶ All these factors would be likely to increase farmers' willingness-to-pay for their water;

WUAs may be more effective conduits for government budgetary transfers than the alternative of direct transfers through unreformed irrigation departments. To the extent that this occurs, governments may be more willing to make the transfers, with less risk of underspending. They may also be more inclined to allow well-functioning governments

¹⁶ Though not necessarily in the literal legal sense of ownership of assets.

may be more willing to allow well-functioning WUAs to retain all or a proportion of the revenues they collect from farmers, rather than having to return the funds to the finance ministry; or

- Directly, by making farmers better disposed to pay higher ISFs and encouraging them to be more efficient in collecting the amounts due (thus increasing collection rates and the total amount of revenues from this source).

WUAs also have a potential role in mobilizing the “beneficiary contribution” to the capital cost of projects, as commonly required by IFIs such as ADB, to complete the funding package for such projects.

On the other hand, the formation of WUAs could conceivably have negative impact on the funding of O&M, for instance, by creating an extra layer of administrative overhead that would have first claim on revenues collected. Also, collectors (such as village heads) are at times allowed to retain some of the proceeds for their own purposes, thus reducing funds for field operations. There is the further possibility that any delegation of revenue collection to WUAs would lead to an offsetting reduction in government budgetary transfers for I&D, leaving no net improvement in the sector’s finances (see further discussion in later paragraphs on this point).¹⁷ It is also conceivable that, after transfer, farmers may introduce excessive cost-cutting in O&M, worsening the deterioration of infrastructure.

Is there evidence for this possible impact, positive or negative? Vermillion (1997) came to these conclusions following a comprehensive review of evidence available at the time:

- In Indonesia, Mexico, the Philippines, and Sri Lanka, IMT led to clear reductions in irrigation subsidies paid by governments.
- Generally, where subsidies continued after IMT, the transfer was likely to have led to a decrease in the financial costs of irrigation to farmers. However, where subsidies fell, the overall financial costs to farmers were just as likely to have risen as to have fallen. High-cost schemes such as lift irrigation were likely to be “financially vulnerable” after transfer (Vermillion 1997, 7).
- After transfer, the staff size of irrigation agencies tended to fall, at either at the system or the administrative level. Some staff members affected were rehired by district agencies, but there was usually a net saving in human resources.
- The rate of collection of irrigation fees greatly increased in practically all cases. This was variously attributed to the involvement of farmers’ organizations in collection, for which they received performance-based incentives; the sheer necessity of replacing reduced government subsidies; a stronger voice in how revenues were spent; greater farmer satisfaction with the irrigation service received; etc.
- After transfer, secondary sources of revenue for irrigation tended to increase as the devolved entities sought to make up for the reduction in public subsidies. The counterbalancing process was particularly marked in projects in the PRC, the Philippines, and Sri Lanka.

¹⁷ Or even a worsening, if the reduction of budgetary transfers exceeded the revenues collected through the WUAs.

- The amount and quality of maintenance under IMT showed no clear trend: there were as many cases of deterioration of infrastructure as of improvement, and where improvement occurred it was just as likely to be due to physical rehabilitation or repair done as part of the process of transfer, as of subsequent changes in management.

More recently, the experience with IMT and WUAs has continued to be checkered.

In Pakistan's Punjab, strong demand by farmers for the formation of farmers' organizations in the Lower Chenab Canal East program led to improved collection rates for *abiana* and more effective O&M. ADB's experience with irrigation projects in Pakistan reinforces the view that farmers' willingness to pay for water depends on several key factors: visible improvements in irrigation services, especially for tail-end irrigators; capacity development of water user and farmers' organizations in the design, operating protocols, and management of O&M for local infrastructure; and a share of the proceeds of *abiana* for their own local use (PAKa).

In Punjab, the local form of ISF is the *abiana* paid by farmers to their farmers' organizations, which pay a service charge to the area water board, which in turn pays a service charge to the national irrigation and power department and the provincial I&D authorities. A high proportion (65%) of the budget of the Punjab irrigation and power department goes to the salaries of its 50,000 established officials, leaving only a minor part to be passed on for the direct expenses of field activities.

In some Asian countries, PIM has to be seen in the wider context of political transition from highly centralized and "statist" regimes toward more decentralized responsibility for the management and financing of infrastructure.

In the PRC, there is an official policy of encouraging the spread and increasing the efficacy of WUAs as the precondition for more effective O&M and better cost recovery. However, the prevailing political and administrative structures pose obstacles to PIM since WUAs tend to be based on administrative districts and are headed by government officials. In these circumstances, the absence of effective WUAs hampers sustainable O&M.

The Kyrgyz Republic in 2007 was in the throes of transferring irrigation infrastructure from local authorities (*aiyl okmotu*) to WUAs. Whereas the former depended on government budgetary transfers, the latter recovered costs through ISFs levied on farmers. The ADB project document noted that "the existence of well-managed and financially sustainable WUAs is critical to the rehabilitation process and the sustainability of rehabilitated systems (ADB 2013)". However, the project was based on the optimistic assumption that WUAs would not only repay the government 25% of project costs but also finance their own overhead and fully fund O&M costs—all of this requiring an increase of 47% in the ISF and a 90% collection rate.¹⁸

Viet Nam is another regime in transition, where reforms are aimed at lessening the irrigation system's reliance on government subsidies for the irrigation management companies, which are insufficient to cover full O&M costs. One ADB project in Viet Nam seeks to build the capacity of irrigation management companies and water user groups, which together

¹⁸ The realism of these assumptions was not tested, since the project was prematurely terminated (in 2009).

would form the basis of sustainable financing for O&M. The intent is to have the water user groups acquire the legal status necessary for them to enter into contracts for the construction and O&M of facilities in their service areas. The water user groups would be involved in the design of tertiary systems and provide local labor for the works.

In irrigation regimes with smaller systems, such as those typical of hilly areas of Nepal, Sri Lanka, and Southeast Asia, there tends to be a greater degree of management by communities and individual farmers.¹⁹

In the Lao People's Democratic Republic (Lao PDR), the Northern Community Managed Irrigation Sector Project had the promotion of viable community organizations as a central feature. The government's policy of IMT includes full O&M cost recovery through an ISF, the level of which is set by each WUA according to its own specific needs and which is collected by the WUA. At completion in 2011, the project was rated successful. In this case, the spread and general effectiveness of the WUAs were supported by other components of the same project that included building new small-scale weirs in permanent materials and improving canals. These were easier to maintain and have released labor for directly productive farmwork rather than for O&M. The small size of each individual project subcomponent makes it easier to create a sense of community, "ownership" which is often the key to boosting revenue collections.

ADB's Evaluation Study of Irrigation and Drainage (2009) portrays a very mixed and, on the whole, disappointing experience with WUAs in the 18 projects subjected to in-depth analysis (ADB 2009, Appendix 4). In the majority of cases, where the formation or strengthening of WUAs was a component of the project, the outturn was unsatisfactory. The WUAs failed to materialize in various ways, were ineffective, or were only partially successful. In only a few cases did WUAs clearly improve the quality of O&M, and in even fewer instances were they associated with adequate funding for these functions. This suggests that the hypothetical positive impact set out at the head of this section was not borne out by the experience of this sample of ADB projects. However, experience as well as learning is continuing to increase, and it is not possible to make definitive judgments on this matter.

The following tentative conclusions may be warranted. There are many situations where the existence or formation of a WUA or similar local farmers' organization may be a necessary but not a sufficient condition for mobilizing more funding for O&M, either from budgetary transfers or from revenues (ISFs) raised from farmers. To serve this purpose, WUAs need to be properly empowered in the following respects:

- **Legitimacy.** Legal status and powers to carry out its functions; status vis-à-vis other official administrations and agencies; "ownership" by farmers; democratic validity (not dominated by local self-interested parties, representative of minorities, gender balanced etc.).
- **Clearly defined scope in relation to other responsible authorities in I&D.** Adequate arrangements for O&M in higher levels of infrastructure (primary and secondary)

¹⁹ The tribal and autonomous areas of Pakistan, where it is more usual for irrigation services to be managed by state or provincial government departments, are exceptions.

on which the performance of tertiary systems depend; condition of infrastructure satisfactory for performance of functions.

- **Capacity to perform allotted duties.** Sufficient personnel with adequate ability and training.
- **Financial resources.** Proportionate to responsibilities; ISF sufficient for O&M in the infrastructure for which WUA is responsible, including periodic repairs and replacements; WUA allowed to retain an adequate amount of revenues collected in order to carry out its functions and to cover its own overhead costs.

5.6 Results-Based Financing and Output-Based Aid

There is growing interest in the use of results-based financing to encourage more efficient implementation and operation of irrigation schemes. Insofar as it is successful in this, results-based financing would pave the way for sustainable O&M finance and eventually for the greater use of commercial finance in this sector.

Nanyao and Bayi, two irrigation districts in the PRC's North Plain, have used the results-based financing principle to create financial incentives for the irrigation districts and their staff to perform against defined criteria for managing O&M and collecting irrigation revenues (Box 6).

Box 6: Results-Based Finance in the North Plain of the People's Republic of China

In the 1980s, irrigation systems in the north of the People's Republic of China were in transition from heavily subsidized irrigation services managed by people's communes toward a devolution of responsibility to autonomous irrigation districts. The early impact of this transition was damaging to the infrastructure and the services it provided, and further reforms were introduced to improve the sustainability of the new institutional setup. Irrigation districts became responsible for managing the top two levels of canal irrigation, while village irrigation management groups were created to handle the third and lower levels. Village irrigation management groups would maintain their infrastructure, allocate the water among farmers, and collect water charges on behalf of the irrigation districts.

The districts received financial incentives at three levels. Provincial government funding of the irrigation districts was linked to their performance against pre-agreed goals for the building and rehabilitation of irrigation infrastructure. In turn, the irrigation districts used performance-based incentives (both bonuses and penalties) for their internal divisions and for individual staff members. The triggers for payment included the rate and timeliness of fee collections, water distribution, and the quality of maintenance work.

Irrigation districts became fully responsible for routine operation and maintenance (O&M) costs: central and provincial funds would be provided only for construction and rehabilitation work. In 1992, the annual income of Nanyao and Bayi, the two irrigation districts, was almost entirely (96% and 93%, respectively) from irrigation fees. In two-thirds of the villages within Nanyao district, the village irrigation management groups collected water fees from individual farmers. In the rest of the villages, enough off-farm collective income was produced to pay the water fees to the village committee.

This system depended on the regulatory framework created in 1985, requiring that revenues for O&M should be provided mainly from irrigation fees collected from water users, determined locally with maximum fee ceilings. These fees comprise both fixed and volumetric elements. A parallel regulation encouraged the creation of enterprises in fisheries, recreation, food processing, and so on to create additional revenue to cross-subsidize irrigation.

Source: Rodriguez et al. (2014), pp. 31–34.

The system described in Box 6 rests on transparent, accurate, and honest monitoring of the performance of irrigation authorities. At the lower levels, this is difficult, and at all levels there are strong incentives to falsify data.

Another example of results-based financing is the project being implemented by Jain Irrigation Systems in Karnataka to provide microirrigation technologies to 7,000 smallholder farms. Seventy percent of the \$63 million capital cost of the project is to be recovered from the state government, and the remaining 30% to be recouped once the prespecified performance targets are achieved. The company will also be responsible for O&M over a 5-year period (GPOBA 2014).

Output-based aid is similar to results-based financing, being a disbursement technique used by donor agencies and IFIs whereby releases of the funds (typically grants) are conditional on the compliance by the project sponsor or beneficiary with specified

performance criteria, usually quantifiable output measures. The aim of output-based aid is to build in incentives to encourage sponsors and borrowers to implement projects quickly and efficiently, since funds are disbursed only when there is some measurable result. By the same token, recipients of the funds must bridge the gap between project start and first disbursement using their own financial resources, hence incurring exposure to financial risk.

A study sponsored by the World Bank's Global Partnership on Output-Based Aid (GPOBA) of the potential for using output-based aid in irrigation, focused on its application to small-scale irrigation farmers (GPOBA 2014). Output-based aid was not considered appropriate for large-scale surface irrigation schemes, though it was deemed potentially suitable for using external donor funding of private intermediaries involved in the supply of microirrigation technologies to smallholders. However, this would still entail important financial risks because of the length of the implementation period typical of this sector, difficulties in measuring irrigation services, problems in recovering their costs through irrigation charges, and difficulties in getting reimbursed by state governments as part of the latter's cofinancing pledges.

5.7 Conclusions

General

- Inadequate funding of MOM, and especially maintenance, is a crucial factor in the widespread deterioration of surface irrigation systems across Asia.
- Currently, the main sources of funds for MOM are government subsidies, revenues from ISFs, and other secondary revenue sources. Governments are keen to reduce the fiscal burden of subsidies and raise the amounts generated by charging farmers.
- In some countries, subsidies are provided on the basis of centralized top-down estimations of needs, which are often way off the mark for actual local requirements. The bulk of many MOM budgets goes to administrative overheads, leaving little for essential field operations.
- Irrigation tariffs are generally grossly insufficient to cover MOM, a situation aggravated by the low rate of collection of the amounts due. This is not primarily due to poverty and a lack of affordability on the part of farmers, but rather to the unwillingness of political leaders to charge the required amounts. Corruption, intimidation, and other problems with collection contribute to the shortage of funds.
- IMT and the associated formation and empowerment of WUAs have arisen over recent decades to unburden governments of their financial responsibilities for I&D and achieve better MOM at local levels. Results have been highly mixed, but understanding of the conditions on which IMT and WUAs can contribute to greater financial sustainability is growing.
- Results-based financing has some selective potential, but output-based aid does not seem to have much application to large surface schemes.
- A key precondition for improving recurrent cost financing in irrigation is a much better understanding of the actual costs and financial requirements for MOM in specific localities.

- Public budgeting for MOM needs to be more flexible and responsive to local requirements. Irrigation authorities need to adopt modern business practices toward life-cycle asset costing, management, and funding.

Regarding Irrigation Tariffs

Certain key factors will favor the successful use of irrigation charges to recover the costs of O&M in large public surface schemes (Brabben et al. 2004):

- involvement of farmers at an early stage in planning new, and rehabilitating existing systems;
- clear understanding between irrigation authorities and farmers about the costs to be recovered from water charges, on the one hand, and from land and property taxes and other sources, on the other;
- better quality of service, especially more reliable and predictable water supplies as and when needed by the farmer;
- farmers' control over their water supply, either collectively through WUAs or individually by means of on-farm controls;
- use of prepayment mechanisms, such as cards for use in pressurized systems;²⁰
- delegation of responsibility for O&M and revenue collection to local management organizations—typically, WUAs will be effective only if WUAs are fully empowered with adequate capacity and where there is likely to be a reasonable match between their incomings and outgoings;
- arrangements whereby all or a high proportion of the revenues from irrigation charges are returned to local irrigation managers, such as WUAs, to instill a greater willingness to pay among farmers, and a direct incentive to the local management authority to collect the amounts due; and
- incentives given to revenue collectors to maximize collected dues.

²⁰ This is similar to a scheme for the use of prepaid cards in Shangdong, PRC. This scheme is also used in the Barind project in Bangladesh and is being tested in ADB's Muhuri project in the same country.

6 Public–Private Partnerships

PPP arrangements generally entail the sharing of management, operational, and financial risks between public sector authorities and private partners. This chapter reviews the main forms such arrangements take and presents the pros and cons of each option. After a brief examination of the international experience with PPPs in irrigation, the chapter concludes with observations about the relevance of PPPs to Asian conditions and what needs to be done to create an appropriate policy and institutional environment for these arrangement to succeed.

6.1 What Public–Private Partnerships Can Offer: A Conceptual Framework

Asian governments may have several reasons for involving private partners in publicly managed surface irrigation schemes. Prompted by internal staffing constraints, they may seek to supplement their own internal staff resources by seconding or contracting outsiders. They may want to tap into state-of-the-art expertise in specific areas and subcontract these matters to external companies. The drive and momentum that an external private body can bring to manage a process of change and take unpopular measures may be attractive. Or the governments may want to shed part of the financial burden of subsidizing existing operations and securing funds for new investments. In essence, a PPP spreads risk between the partners by transferring a significant amount of risk to the private partner. The more governments succeed in acquiring expertise and sharing risks with private partners, the easier it will become for them to draw more financing into this sector.

Public agencies can acquire private expertise without going through the trouble of developing a PPP through direct hiring of specialists on short-term contracts. These can be used to bring new or stronger skills into the existing hierarchy when the host organization is prevented from permanent recruitment by budgetary constraints, embargoes on hiring, or uncompetitive public sector salaries.

Consulting contracts are another option for obtaining scarce expertise and may be the most expedient method of obtaining skills in information technology, financial transactions, state-of-the-art remote sensing, and other vital and sought-after skills. Although more expensive in one-off terms, these contracts get around the lengthier process of revising salary structures and hiring through public bureaucratic processes. However, they do not automatically lead to a permanent transfer of skills to established personnel.

Main Models of Public–Private Partnerships

A range of models for involving private sector management and financial expertise in public infrastructure provision is available. These models differ mainly according to

- ownership of the capital assets at different stages of the project;
- the private and public partners' responsibility for investment;
- allocation of the various kinds of risk between the parties;
- length of the contract; and
- contract coverage—whether the contract applies to existing infrastructure or to new (greenfield) projects.

A distinction may be made between *public* contracts (in which the service provider is paid a fee by the public client commonly depending on performance against specified criteria), and a *public service delegation* (PSD) contract (rewarded according to operational results, such as by revenues collected from customers or the volume of output, e.g., water, provided to public offtakers) (Dargouth et al. 2007). A third category of PPP is full divestiture, in which ownership of the assets and the income they generate is transferred fully and permanently to the private party.

While retaining this broad distinction, one important category of contract—build–operate–transfer (BOT) and similar “greenfield” forms—normally includes a guarantee of demand (e.g., a “take-or-pay” clause), which removes demand risk from the partner. A more telling distinction may be made between arrangements in which the private partner collects its revenues from the public sector client and those where it collects from individual customers. The latter option normally entails a higher level of demand risk.

The broad categories of PPPs in (roughly) ascending order of risk incurred by the private partner, are as follows:²¹

- public contracts
 - » service and management contracts
 - » engineering, procurement, and construction (EPC) and turnkey contracts
- public service delegation
 - » leases
 - » concessions and BOTs
- divestiture—transfer of asset ownership and all income from it therefrom to the private party.

In the following section, the pros and cons of the various forms of contracts are discussed from the point of view of the public sector client, whether government or parastatal agency.

²¹ The term “private” may also refer to external parties that are publicly owned or not-for-profit. For instance, a major PPP for Ghanaian water services was recently awarded to a consortium of two publicly owned companies from the Netherlands (Vitens) and South Africa (Rand Water).

Service and Management Contracts

These involve the operation or management, or both, of a public enterprise or other publicly owned assets by the private partner, with the public client retaining ownership of the facility and equipment. The private contractor has specified responsibilities, for which it receives a fee, generally performance related. The typical contract is short, between 2 and 5 years. Pros and cons are listed in Table 5.

Table 5: Pros and Cons of Service and Management Contracts*

Pros	Cons
Can be implemented quickly	Limited efficiency gains or incentive for private partner to invest
Least complex type of PPP	Almost all risks borne by public sector client
Often politically and socially more acceptable than other types of PPP	Applicable only to existing infrastructure assets
	Specification and monitoring of the performance criteria and benchmarks can be complex and liable to dispute

PPP = public-private partnership.

* Examples in irrigation: Bangladesh Muhuri Project, Ethiopian Megech-Seraba Project.

Engineering, Procurement, and Construction and Turnkey Contracts

An EPC contract is a contract to design and engineer a project, procure or manufacture the plant or equipment, and construct the project or important parts of it. A large and complex project may entail several EPCs covering important discrete components of the project. Pros and cons are listed in Table 6.

A turnkey contract covers the delivery of a complete project, fully equipped and ready for operation. Such contracts are commonly fixed price and specify a completion date (“date-certain”).

EPC and turnkey contracts are traditional public sector procurement models for infrastructure in which a private contractor is selected following a bidding process to design and build the facility for an agreed lump sum. The contractor bears risks during the design and construction phases, e.g., the risk of a cost overrun or an extended period of construction. Unless a specific performance incentive is included (e.g., bonus for early finish), there is no explicit incentive to finish the work early. However, the contractor can normally retain cost savings on the bid price unless the contract requires these savings to be shared with the client.

Table 6: Pros and Cons of Engineering, Procurement, and Construction and Turnkey Contracts*

Pros	Cons
Well-understood traditional model	Extra risks of turnkey contract carried by contractor usually reflected in higher (typically 20%+) contract price, compared with traditional public procurement for specific items
Contract is less complex than some other types	Only limited innovation likely
In fixed-price “date-certain” contracts, private partner has incentive for timely completion	
Contractor guarantees performance of subcontractors	

* Examples in irrigation: Typical of projects funded by ADB and the World Bank.

Lease and Affermage

In these basically similar contracts, the operator (leaseholder) operates and maintains the asset, which remains in public ownership. The operator is not required to make any substantial investment, but may be required to spend to keep the asset in good order. In return for the payment of a fee (rent or royalty), the operator is allowed to retain the revenues collected from customers and users. The *affermage* is a French version of this contract, with a difference; revenues are shared between the operator and the contracting authority. Pros and cons are listed in Table 7.

Table 7: Pros and Cons of Lease and Affermage*

Pros	Cons
Can be implemented quickly	Little incentive for private partner to invest unless stipulated in contract; therefore no transfer of financing risk to the private partner
Often more legally and politically acceptable for high-profile, strategic projects	May require substantial regulatory oversight
Demand risk borne by private partner	Scope for dispute about level of maintenance and periodic repair needed to keep infrastructure in good working condition
	Applicable only to existing assets

* Example in irrigation: Bangladesh Muhuri Project working toward this in its second phase

Concessions, Build–Operate–Transfer, Etc., Contracts

In common parlance, a concession is a right, granted by the government to a private agency, to use public assets such as land or other property or facilities, for private gain, in return for a fee, rent, or royalty.

The crucial difference between a concession and a lease is that the former usually entails some investment in the asset, for which the private partner has to provide finance.

Depending on the contract, financing may be shared between the government and the private partner.

Generally speaking, a concession relates to an existing asset or ongoing service, whereas the build-operate-transfer (BOT) type of contract applies to investment in new (greenfield) infrastructure.²² The exceptions are ROTs and TOTs which cover rehabilitation and/or operation of existing (brownfield) assets.

There are many variants of these contracts, distinguished mainly according to who owns the assets at particular points in time (Yescombe 2014; World Bank, ICA, and PPIAF 2009). The basic form of contract can be varied to suit the specific needs of the public client and the private partner (Box 7).

Box 7: The Alphabet of Concession Contracts

Build-operate-transfer (BOT). The project company builds the project and has the right to earn revenues from its operation, but never owns the assets.

Design-build-finance-operate (DBFO) or design-build-operate (DBO). Similar to a BOT.

Build-transfer-operate (BTO). Similar to a BOT, except that the contracting authority takes over the ownership of the project only when construction is completed and allows the private partner to operate the asset for the duration of the contract.

Build-own-operate-transfer (BOOT). The project company constructs the project and owns and operates it for the period of time set down in the contract, at the end of which ownership reverts to the contracting authority. For infrastructure projects, a concession period of 20 years or more is typical.

Build-own-operate (BOO). Ownership of the assets remains with the project company throughout the project's life, so that the project company keeps the benefit of any residual value.

Rehabilitate-operate-transfer (ROT). An ROT, the asset is an existing one, owned by a public authority, but in need of rehabilitation. The project company takes it over, invests in its rehabilitation, and operates it for the contract period. Depending on the nature of the contract, ownership of the asset may rest with the project company during the concession period or may remain with the contracting authority.

Transfer-operate-transfer (TOT). As in an ROT, an existing asset in public ownership is transferred to the project company, which operates it for the duration of the contract before handing it back to the contracting authority.

To complicate the picture, in some of these contracts, the private partner transfers ownership of the asset back to the public client and then leases it back, as in a build-lease-transfer (BLT) contract.

Sources: Yescombe (2014); World Bank, ICA, and PPIAF (2009).

²² As opposed to brownfield projects involving demolition or reconstruction of existing infrastructure.

The ownership of the asset can be a crucial legal issue for the government sponsor, but from an economic and financing standpoint, ownership is a secondary issue to the private partner. The key factor is ownership of the cash flow arising from the operation of the asset during the contract period. Because a discount rate is applied, the residual value of the asset transferred to the public sector at the end of a build–own–operate–transfer (BOOT) contract (typically 20–30 years) will have little bearing on the terms of finance for the project. Pros and cons are listed in Table 8.

Table 8: Pros and Cons of Concessions, Build–Operate–Transfer, Etc., Contracts*

Pros	Cons
Private partner bears a substantial share of risks	Complex to design and implement
Involves a high level of private financing	Long-term fiscal costs to governments may not be transparent
Potential for efficiency gains and innovation in project development and implementation	Negotiation and deal making may be time-consuming and expensive
	Requires close regulatory oversight

* Examples in irrigation: Morocco Guerdane, Egypt West Delta (now aborted), publicly sponsored concessions proposed in Northeast Brazil

A common feature of BOT and similar contracts is the inclusion of long-term sales agreements with public authorities.²³ Offtake contracts are of two main types. A take-or-pay contract requires the offtaker (e.g., the irrigation authority) to buy the product or service (e.g., irrigation water delivered to a certain field level) or make a payment in lieu of purchase, in both cases at an agreed tariff. In a long-term sales contract, on the other hand, the offtaker agrees to take specified quantities of the product or service, but only at the prevailing price at the time of sale. In the latter case, the project company has no physical demand risk but does have a price risk on its sales.

Irrigation PPP contracts must include some provision to protect the project company in the event that the supply of the raw water resource falls short of that envisaged, because of natural climatic fluctuations or a force majeure event established by authorities (e.g., diversion of water to other users during a drought). The Guerdane (Morocco) PPP (see section 6.2) contained such provisions.

Concession agreements are normally subject to monitoring and control by a regulatory authority.²⁴ Charges levied on users are always closely monitored. A maximum user charge may be set and is usually a key criterion of the bidding process. This may be indexed to local inflation and/or foreign currency movements (e.g., where energy imports make up a high proportion of costs). Some contracts include a revenue-sharing clause, providing for the division of revenues in excess of expected levels between the contracting authority and the project company.

²³ Some authors (e.g., Dargouth et al. 2007) make a distinction between concessions, on the one hand, and BOTs, etc., on the other, on the grounds that the former entail full demand risk for the operator, whereas the latter mitigate demand risk through long-term sales agreements such as “take or pay.”

²⁴ Which may be created for the specific purpose of regulating a major project (e.g., for the West Delta scheme in Egypt).

Outright Private Ownership (Divestiture)

In this model, the government sponsor, from the outset, is divested of ownership of existing infrastructure and other assets, which is transferred to the private partner. In a variant, the build-own-operate (BOO) contract, the private company is allowed to design, build, and operate a new project, and to own the assets outright and indefinitely. IMT, in cases where it involves transfer of ownership of infrastructure to local farmers' groups such as WUAs, is the closest analogy in Asia to private divestiture.

The divestiture of existing public surface irrigation systems into private ownership is not feasible in most Asian countries and will be disregarded as an option in the rest of this report.

6.2 International Experience of Public-Private Partnerships in Irrigation

International experience with PPPs in irrigation has been limited. This section reviews the results of a comprehensive survey of the situation carried out a decade ago; and assesses ongoing or recent projects in Bangladesh, Brazil, Egypt, Ethiopia, Morocco, and Peru; and discusses the relevance of projects in France and Spain.²⁵

World Bank Review (2005–2007)

The results of a comprehensive data assembly and analysis of PPPs in I&D were presented at a seminar sponsored by the International Network on Participatory Irrigation Management (INPIM) in Tarbes, France, on 8–13 May 2005.²⁶ These cases were analyzed in greater detail in a World Bank discussion paper in 2007 (Dargouth et al. 2007).

The sample comprised 21 cases, 16 of which were ongoing and 5 in the planning stage. Of the 21, 4 were in Europe, 1 in Australia, 4 in sub-Saharan Africa, 2 in South and East Asia, 2 in Latin America, and 8 in the Middle East and North Africa. Since 2005, several of these projects have been abandoned and some have been modified.

The World Bank paper (Dargouth et al. 2007) draws the following conclusions from the analysis of these 21 cases:

- Except for two or three cases, PPP in I&D is a recent phenomenon and lessons are still emerging.
- In most cases, PPP was a government initiative to curb recurrent operation subsidies and scale back government involvement. In such cases, which formed the majority, the private sector's response was passive at best. A minority of PPPs arose from a desire by farmers through their WUAs to obtain better irrigation services.
- Most PPPs (90%) were in operation, maintenance, and management (OMM), either with investment (8 cases) or without (7 cases).²⁷

²⁵ Or in the case of Egypt's West Delta project, proposed and eventually abandoned.

²⁶ International Seminar on Emerging Trends in Public-Private Partnerships in the Irrigation Sector, sponsored by the Government of France, the World Bank, and INPIM.

²⁷ In this report, the term "MOM" is preferred, though the two expressions are synonymous.

- A minority (4) of the contracts were for services only, the rest being public service delegation.
- The level of risks, of various kinds, was high. This was particularly true of public service delegation contracts where the contractor had to recover costs directly from farmers.
- The overall result of the ongoing PPPs has been an improvement in water services but at a higher price to the farmer (efficiency gains do not fully make up for the reduction in government subsidy).

The authors caution, however, that

...each PPP situation is unique and should be treated accordingly... Arrangements involving private participation in I&D investment...all look like special cases. (Dargouth et al. 2007, 26).

Moreover, PPPs can be viewed initially as a potential source of expertise and are not necessarily direct sources of finance per se:

...lessons from experience to date are that, subject to risk management, private investors are prepared to come in to PPP arrangements, and that they can assist in mobilizing financing. However, governments typically have to source most of the financing themselves and also to assume much of the risk, so that the involvement of a private provider may not relieve the financing burden very much (Dargouth et a. 2007, 38).

Update (2015)

The Guerdane Project in Morocco was the first, and still practically the only, delegated public service irrigation PPP in a developing country.²⁸ The Egyptian West Delta Project was eventually aborted at the tender stage. Both projects relied heavily on advice from the World Bank (through the IFC and the Public–Private Infrastructure Advisory Facility [PPIAF], respectively) and incorporated state-of-the-art thinking about the design of PPPs in this sector.

In October 2015, the World Bank Group had 29 irrigation PPPs on its database,²⁹ but since its involvement in the preparation of the West Delta project, it has been actively involved in financing only two of these. The Guerdane scheme was the first undertaken by IFC, and the ongoing Ethiopian Megech–Seraba project is the first implemented by the World Bank.

²⁸ Reported at an International Commission on Irrigation and Drainage (ICID) workshop on PPPs in Montpellier, France, 15 October 2015.

²⁹ Presentation by J. Bisbey at the ICID workshop (footnote 28).

Bangladesh

The Muhuri Irrigation Management Improvement Project was approved for ADB financing in 2014 (ADB 2014b). The financing package includes a sovereign loan for investment in modernizing the Muhuri Irrigation Project (MIP) in Chittagong Division, completed in 1986. And involving a closure dam (barrage) and regulator, from which water enters channels and canals by gravity, and is then lifted by low-lift diesel pumps to farms. The project also includes financing for a performance-based management contract, and feasibility and design studies for the modernization of the Ganges-Kobadak and Teesta irrigation projects (ADB 2015; Clark 2015).

In the Muhuri region, a shortage of water in the dry season leads farmers to use groundwater sources, which are affected in many areas by arsenic contamination and other aquifer limitations. Dam storage is not feasible. Land has low productivity because unreliable water supply, poor extension services, and poor access to inputs, markets, and credit. Paddy rice is the main crop.

The project's aim is to realize the full production potential of large-scale irrigation schemes by addressing the lack of sustainable MOM, and to increase water productivity by transferring MOM to private operators and introducing innovative modernization of infrastructure. The proposed system of water delivery (pressurized, with volumetric charging using prepaid meter cards) has been successfully used in the publicly operated Barind Multipurpose Development Authority in the northwest of the country (Box 8).

Box 8: Contract Features of the Bangladesh Muhuri Irrigation Management Improvement Project

The project provides for the recruitment through competitive selection of a private consulting company or consortium to enter into a 5-year management contract for the construction phase. The company will be responsible for delivering efficient service and revenue collection, and will supervise the construction of civil works, undertake the participatory design of a modernized tertiary irrigation system, and develop pilot agricultural demonstration and income-generating activities. The fee for this contract will be performance based.

After 5 years, a consultant will be recruited for the subsequent management phase, to maintain the management, operation, and maintenance (MOM) levels established during the first 5 years of the project, under a 15-year lease contract. This contract will be awarded through competitive tender based on either a fixed fee for the lease, with bidders presenting a financial offer for the water charge or on a predetermined water charge, and a financial offer for the lease.

Source: ADB (2014b, 2015).

Brazil

The private sector has become involved in I&D financing and management in this region in response to the poor performance of publicly owned and managed schemes in recent decades (Arrobas and Enei 2009). In the northeast states, irrigated agriculture is the linchpin of rural development, and the efficient management of the region's scarce water resources is of high importance. Elsewhere in the country, privately owned and managed irrigated estates have been very successful and account for 90% of the country's total irrigated area.

Several irrigation PPP projects have recently been promoted by the regional development agency CODEVASF in different parts of the valley of the River Sao Francisco in northeast Brazil have been suspended. The specific form of PPP contract being promoted is the publicly sponsored concession, which includes provision for a public counterpayment (subsidy) to the concessionaire. This is in recognition of the belief that most irrigation projects in this region cannot be wholly self-financing and need public contributions to investment costs and O&M expenses.

In three specific recent projects, part of the investment in infrastructure had already been made by the state and the bidder was expected to invest in its completion and take over its operation (CODEVASF 2009). In these projects, the main bidding criterion was the minimum size of counterpayment required from the government. These projects were largely concerned with the creation of new irrigated areas by completing partially developed schemes. Bidders were responsible for selecting suitable farmers, through land auctions or other means. Several of the projects being promoted were in or close to the Petrolina–Juazeiro hub, a thriving fruit production and exporting center.

Concessionaires were encouraged to involve commercial agribusiness companies in their schemes, for several reasons: to guarantee stable demand and willingness to pay for the water, to promote efficient use of scarce water in this semiarid region, to integrate agriculture with effective marketing and processing chains, and to obtain credit and financing at competitive rates. It is understood that the complexity of these contracts, particularly their requirement to involve promotion of land sales, was a deterrent to bidders, and these schemes have been abandoned, at least for the present.

Egypt

The West Delta is a former desert area of about 107,000 hectares to the west of the Nile Delta, which is irrigated by groundwater. It's flourishing agricultural economy supports 500,000 people and serves both domestic and export markets. However, there has been excessive depletion of groundwater resources. To address this problem, the project would create a new source of surface water, piped and on-demand to farmers. An initial area of 25,200–37,000 hectares was chosen. The precise extent and number of farmers was to be determined during project design (Box 9).

Box 9: Contract Features of the Egypt West Delta Project

The public-private partnership (PPP) model was chosen with the assistance of the Public-Private Infrastructure Advisory Facility (PPIAF), a facility hosted by the World Bank. Its objectives were to transfer key risks to the private partner, aim for cost recovery and financial independence from government, mobilize long-term financing to allow affordable tariffs, and harness private expertise in design, construction, and operation.

Under the 20-year design-build-operate (DBO) contract, the concessionaire, participating farmers, and the government contributed investment capital. The World Bank and Agence Française de Développement made loans available, and the Government of the Netherlands was to provide a grant for institutional and capacity building in the project management unit, the regulatory office, and water user associations (WUAs).

The DBO contract form was chosen over the concession or build-operate-transfer (BOT) type. The following risks were assigned to the partner: demand, planning and design, construction, operational and commercial, and regulatory. But, unlike concession or build-operate-transfer (BOT) contracts, the DBO contract left the foreign currency, financing, and credit risks to the government (World Bank 2007b, 38-42).

The private partner's concession fee, in local currency, reflected these costs. The concessionaire was required to contribute some equity finance.

Sources: Warner, Kahan, and Lehel (2008); World Bank (2007b); Abdel-Dayem (2015).

Despite the contract's many positive features, and the favorable circumstances at the start, a number of adverse factors eventually led to the cancellation of the project in 2011:

- Tendering and procurement were set back by the slow passage of the government's PPP act, a 2-year delay in getting the project ratified by parliament, changes in the contract design following the initial disappointing bidding response, and other factors.
- The contract features that were intended to mitigate demand risk could not fully ease the concerns of risk-averse bidders.
- Several ministerial changes during preparations for the project cast doubt on the government's commitment to the scheme. In addition, the project management unit was weak, and the transaction advisory team, inexperienced. Consultations with key stakeholders were inadequate.
- The international financial crisis of 2008 and the subsequent political turbulence in Egypt in 2011 affected lender and investor appetite for this type of "high-risk, high-return" project in emerging markets and elsewhere.

The World Bank drew up the following key “lessons learned” (Box 10).

Box 10: Lessons Learned from the West Delta Project

- **Readiness for implementation.** Both the World Bank and the Government of Egypt should have been more realistic about the time required to design a sustainable public–private partnership (PPP) structure. Procurement should have been further along before project approval. More time should have been allowed for considering all technical, social, and environmental risks. More attention should have been given to the management of key risks.
- **Risk allocation.** Demand risk being difficult to quantify in irrigation, the government should have provided strong guarantees to bidders from the outset.
- **Project implementation team and governance structure.** The project needed to have a strong and well-staffed implementation agency with suitable decision-making authority, as well as the assistance of a qualified and experienced consulting firm should have assisted. It lacked both.
- **Coordination.** The Ministry of Finance (PPP central unit) and the Ministry of International Cooperation were insufficiently involved in the early stages of project design and preparation.

Source: World Bank (2012).

Ethiopia

Ethiopia’s mostly rain-fed agriculture makes the country vulnerable to serious food insecurity (PPIAF 2012; footnote 4). Despite its irrigation potential of about 3.7 million hectares, only 5% of arable land is currently irrigated. Since 2006, the government has involved the PPIAF in exploring suitable ways of leveraging public resources to attract private sector expertise in agricultural water management.

In 2012, the Government of Ethiopia contracted BRL Ingénierie of France to provide O&M services for the Megech–Seraba irrigation project in North Gondar Zone. This project involves the construction of a surface water conveyance system to take water from Lake Tana and distribute it to farmers in the Seraba area.

This is the first PPP transaction for the construction and management of a new, large-scale (4,040 hectares) irrigation scheme for the benefit of smallholder subsistence farmers. Its features are summarized in Box 11.

Box 11: Contract Features of the Ethiopia Megech-Seraba Project

The capital investment is being funded entirely by the government, with \$30 million in credit support from the International Development Association (IDA) credit.

A management contract of \$8 million, also funded by the IDA, was awarded to the French company BRL Ingénierie on the basis of the lowest acceptable bid. The company will supervise construction, establish and build the capacity of water user associations, and handle operation and maintenance (O&M).

The management contract has some unusual features. The operator will provide oversight, commentary, and supervision of the construction program and share cost savings with the construction company. The operator's remuneration will be related to key performance indicators, without demand risk to the operator. Farmers will be charged an irrigation service fee covering the full cost of O&M, including energy.

Sources: PPIAF (2012); Varma, Dhingra, and Raghu Rama Swamy (2013).

France

Much of the irrigation development in Southern France has been done through three regional development companies—*les sociétés d'économie mixte* (public limited companies governed by private law, the main shareholders being public authorities) with long-term concessions to develop and exploit the water resources of their respective regions.³⁰

Although these companies are predominantly owned by public administrations, they operate in a quasi-commercial manner and have achieved a high degree of financial autonomy from public fiscal sources. The companies owe their nature to the special historical, geographic, and political circumstances in southern France and cannot easily be replicated elsewhere. Keys to their success include their ownership of multipurpose infrastructure, with a balance of revenues from different sectors; their long-term territorial vision; their ability to integrate socioeconomic, environmental, and other viewpoints; and, above all, “patient” investors (national, regional, and local governments).

Morocco

The irrigation perimeter of Guerdane in southern Morocco covers about 10,000 hectares and produces 50% of the country's citrus crops. A long period of private withdrawals of water was seriously depleting the Sousse aquifer, leading to a drop of around 2.5 meters yearly in the underground water table. This was causing citrus farming to become unsustainable, and the irrigated farming area to shrink.

³⁰ “Bas-Rhône- Languedoc (BRL), Compagnie d'Aménagement des Coteaux de Gascogne (CACG), and Société du Canal de Provence (SCP, covering Provence and the Côte d'Azur).” Details presented in this section are drawn from “French Regional Development Companies,” a paper presented at the ICID workshop (footnote 28).

To solve this problem, the regional water management plan allocated 45 million cubic meters of water each year from the Mohamed Mokhtar Soussi–Aoulouz dams about 60 kilometers away. The project involved seeking a private partner to build, finance, and operate a 90-kilometer canal and a 300-kilometer distribution network to deliver the water to farmers. The new surface water system was expected to meet half of the requirements of the citrus farms on the Guerdane perimeter.

The IFC was invited by the government to advise on PPP structuring and implementation. The chosen transaction was a 30-year public service delegation concession to build, cofinance, and manage the new infrastructure, and then return it to the government at the end of the contract period (Box 12).

From the standpoint of PPP feasibility, the following have been positive features of the Guerdane scheme:

- ample public co-funding of the investment, on favorable terms;
- evidence of adequate willingness to pay among farmers producing a cash crop with export potential;
- an irrigation charge that was less than the amount that farmers were paying for pumping their own groundwater; and
- an acceptable level of mitigation of water and demand risks faced by the concessionaire.

Box 12: Contract Features of the Morocco Guerdane Project

- The concessionaire would provide 44% of the capital cost of the project (about \$37 million) from its own resources, and the government would contribute 24% as a grant and the rest as a long-term loan at 1% with a 20-year grace period.
- The sole bidding criterion was the lowest water tariff to charge the beneficiary farmers.
- The concessionaire would bear the construction risk.
- Risk of water shortage was allocated between the concessionaire (up to a maximum revenue loss of 15%), farmers (through a maximum tariff surcharge of 10%), and the government (through financial compensation to the concessionaire for more serious losses).
- Demand risk was ultimately borne by the concessionaire, but mitigated in several ways. Farmers paid an initial subscription fee covering the average cost of on-farm connection. The concessionaire's construction obligation did not begin until subscriptions were received for 80% of the water available.

The bid was won by a consortium headed by Omnium Nord-Africain (ONA), a Moroccan industrial conglomerate, in collaboration with Fonds Igrane Morocco and Infra Man from Austria. The concession was awarded in July 2004 and a 100% connection rate was achieved by 2009.

Source: IFC (2013).

Peru

Peru is using concessions to develop a number of its coastal desert areas. The largest of these is Olmos, for which the Brazilian construction giant Odebrecht is the concessionaire for the construction of water transfer and new irrigation infrastructure to serve 43,500 hectares of former desert. The project is controversial, partly because most of the newly irrigated land will be owned by large commercial farmers and agribusiness companies.

Spain

The Canal Segarra-Garrigues (70,000 hectares) and Canal de Navarra (40,000 hectares) projects are being implemented through a PPP concession for the supply of bulk water, with the investment cost financed jointly by the government, the concessionaire, and irrigators. The concessionaire (Aguas de Barcelona, a company holding water supply concessions for Barcelona and elsewhere) collects irrigation charges from farmers and remits the funds to the government, which uses part of the proceeds to reimburse the concessionaire over a 20-year period. The typical farmer has around 10 hectares and produces fruit and vegetables for sale in the Greater Barcelona region. There are three parcels of land with the same concession model in each—one has been completed and two are still being implemented. The contractor is exposed to payment risk, not least from market fluctuations for the irrigated farms' produce over the lengthy concession period.

Summary of International Experience

- There are very few ongoing and successful cases of surface irrigation PPPs in any region of the world. Of this handful, arguably only two (Ethiopia's Megech-Seraba and Bangladesh's Muhuri projects) are directly relevant to the conditions typical of Asian countries.
- Morocco's Guerdane project has relied on generous public cofinancing for investment and measures to mitigate hydrological and demand risk. There was adequate willingness to pay among farmers producing a cash crop with export potential.
- The PPP contract for the Egyptian West Delta project was carefully crafted and the initial circumstances appeared favorable. Yet, delays, institutional and governance shortcomings, and economic and political turmoil dampened any risk appetite among potential partners.
- The few irrigation PPPs in northeast Brazil are currently in suspension: because bidders, probably put off by the requirement for contractors to promote land sales, have shown little interest.
- Peru is using concession contracts for a series of new irrigation schemes in its coastal desert regions.

6.3 Implications for Asia

Asian countries are likely to approach PPPs as a means of:

- generating new and additional sources of finance for investment in new projects and for the major rehabilitation and adaptation of existing schemes; and
- tapping commercial expertise and business acumen to transform existing irrigation schemes. The aim would be to make the schemes more efficient, improve internal cost recovery for MOM, and reduce the need for government subsidy. Attracting new finance for investment would also be easier in the long run.

Different types of PPPs would address these aims in different ways.

Attracting investment finance, by issuing concessions or BOT-type contracts. The essential feature of a concession is the use of a public service asset for a specified period by the contracting partner which retains all or part of the revenues it earns, in return for payment to the public authority. The concession contract can take a number of possible forms, the details of which will vary depending on key factors such as

- whether the assets are already existing or are still to be created, or whether existing assets require major rehabilitation;
- how much of the investment must come from the contractor and how much from the client authority;
- whether the contractor will collect revenues directly from users and retain them or whether it will be paid directly by the public authority for services provided (in an intermediary form, the contractor collects revenues on behalf of the authority and hands them over to the latter after deducting its share); or
- who owns the assets at specific points during the contract period. In some cases, ownership of the assets remains at all times with the public authorities; in other cases, the contractor takes over the newly created assets or retains ownership for the duration of the contract and then hands them back at the end.

Such factors determine the risks to be shared by the public and private partners in a PPP contract.

Most irrigation projects in Asia would require investment in the modernization and adaptation of existing infrastructure. The most realistic form of PPP would be for the assets to remain in public hands, and the private partner to be responsible for works and O&M during the contract period, retaining all or part of the revenues from irrigation charges collected from farmers. In this arrangement, the contracting partner would pay a concession fee and agree to invest new money in the system. The agreement could include cofinancing from the public client. The concessionaire would fulfill the role of “third party” between the irrigation agency and the farmers and WUAs—a desirable stage in the process of irrigation reform, some would argue (Dargouth et al. 2007, 9).

Some projects would, however, be greenfield and would involve the creation of assets involving newly created assets (e.g., a new irrigated area or a new bulk water source, dam, or main canal) for which a range of BOT-type contracts would be appropriate, offering various ownership options. In a BOT arrangement, ownership remains with the public authority throughout the contract period; in a build-transfer-operate (BTO), ownership is initially held by the contractor, and then transferred to public hands after construction; in a BOO, ownership is always with the private partner; and in ROTs and TOTs, ownership is optional. Countries where the private ownership of public assets is politically controversial have contractual forms that might sidestep this problem. For instance, ROTs where asset ownership remains in public hands would be appropriate for rehabilitating existing irrigation systems.

The Moroccan Guerdane project uses a 30-year public service delegation concession contract of the BOOT variety for investment in the creation, and then the operation and maintenance, of a new bulk water source and new distribution network. The abortive Egyptian West Delta project was based on a 20-year design-build-operate (DBO) contract, also involving investment, operation, and management of new irrigation infrastructure, with ownership of the new assets resting with public authorities.

For these types of PPP to be feasible in the context of Asian irrigation, three key elements must be present:

- public financial support, in the form of cofinancing for the investment cost or continuing subsidy for the recurrent annual MOM, or both;
- prospect of cash flow from user charges, supplemented if necessary with guaranteed public subsidies; and
- public guarantees against hydrologic, demand, and other major risks entailed for the private partner.

Tapping commercial expertise for ongoing operations, which can be covered by service and management and lease or *affermage* contracts. Service and management contracts can be used for institutional reforms in irrigation departments or for the operation and maintenance of specific parts of the irrigation infrastructure. The latter could be at headworks, main or secondary canals, or tertiary distribution levels. Contractors would typically be engaged on performance-based terms, with remuneration depending, wholly or partly, on their results against predefined benchmarks. They would not bear demand risk and would not be required to make a financial contribution to the enterprise.

Leasing contracts do not normally entail major financial contributions from private partners beyond the rental fee and spending on maintenance and upkeep during the leasing period.

PPP contracts could be feasible under these general conditions:

- The incumbent irrigation authority must be prepared to delegate the key functions—O&M and possibly others—to the external agency.

- The contractor should have sufficient managerial and operational freedom to carry out its tasks as stipulated in the contract.
- The state of the I&D infrastructure at initial handover should be adequate to enable the contractor to perform its tasks, subject to any improvements to be made by the irrigation authority.
- The government must be able to fulfill its financial obligations under the contract, such as to the infrastructure improvements and any recurrent subsidies to the operator as specified in the contract
- For lease contracts, ISFs should be adequate to cover the O&M costs incurred by the operator, plus a margin for the leasing fee.
- The arrangements should be workable and acceptable to the farmers and their WUAs.

The Ethiopian Megech–Seraba project is an example of performance-based management contract, with an added twist: It is performance based, but with the added twist the contractor would supervise construction and share any cost savings in this, as well as manage O&M and help in the capacity building of WUAs. The first phase of the Bangladesh Muhuri project would be of a similar nature, with the contractor taking over the supervision of construction and the performance of O&M functions.

Lease or *affermage* contracts are exemplified by the second phase envisaged for the Bangladesh Muhuri Irrigation Management Improvement Project. This project would be a 15-year lease arrangement requiring the contractor to maintain levels of O&M established during the first phase. In return for retaining revenues collected from farmers, the leaseholder would pay a fee.

Management and lease PPPs succeed in reforming the management aims and style of their host agencies and they can usher in new kinds of commercial finance. A solvent and financially autonomous irrigation agency could attract loans and even raise bonds with suitable public support. If the abovementioned contracts eventually lead to full public service delegation through a concession or BOT-like contract, further finance may be expected from concession fees, equity, and IFI or commercial lending.

Against this background, a recent review of the scope for using PPPs in India's irrigation sector came to the conclusion that they had limited potential (Box 13).

The authors of this study also reported on the Visakhapatnam Industrial Water Supply Project, which involved a PPP for the development of infrastructure for a range of industrial, power, and municipal users. The canal with its augmented capacity also supplied water to irrigated farms along its route. In some peri-urban settings such as this, it may be feasible to include irrigation in large multipurpose water schemes, which can lend themselves to PPP contracts. In India, PPPs have made some progress in industrial water supply and wastewater projects, but not yet in urban water supply.

Box 13: The Scope for Public–Private Partnerships in Irrigation in India

A thorough review of this topic in 2013 concluded that “In the Indian context, there have been virtually no examples of PPP in the I&D sector for the provision of services on a long term basis” (p. 50). It reported that several states (Maharashtra, Andhra Pradesh, Karnataka, and Uttar Pradesh) had taken initiatives to promote public–private partnerships (PPPs) in irrigation, but with no concrete outcomes evident at the time of the study.

The main conclusions from this scoping study were as follows:

- Irrigation projects in India typically have a good economic return but are not financially viable on a stand-alone basis. One basic reason for this is that the typical farmer is very small and poor.
- In India, it is preferable to structure PPPs so that asset ownership remains with the government at all times. “Within the Indian context, an integrated BOT contract model which encompasses the tasks of designing, building, finance, operation, and transfer... does not seem to be possible” (p. 104).
- “Understanding and managing PPP contracts would involve significant capacities at the implementing agency...I&D sector would need significant implementing agency capacity building” (p. 103).
- The most promising structure for a PPP would entail heavy capital investment by governments or international financial institutions, with private partners having a role in operation and maintenance (O&M).
- Future PPPs are likely to rely on the wider synergies created by irrigation development, such as the reuse of wastewater, energy generation through hydropower or solar power, the replacement of energy-inefficient pumps, and the development of irrigation assets for multipurpose use.
- “To promote PPP in the I&D sector, an enabling environment will need to be created, with sufficient scope for generating revenues” (p. 103). This is largely lacking at present. There would need to be policy changes, governance and institutional reforms, regulation of groundwater use, the further spread of WUAs and their capacity development, a reduction in water and power subsidies, and a different approach to cost recovery to at least cover O&M. This is an ambitious and comprehensive agenda needing political will and the expenditure of political capital.

BOT = build–operate–transfer, I&D = irrigation and drainage, WUA = water user association.

Source: Varma, Dhingra, and Raghu Rama Swamy (2013).

6.4 Creating an Enabling Environment for Irrigation Public–Private Partnerships

Promoting an “enabling environment” for PPPs has implications for many areas of national government (Delmon 2014; World Bank, ICA, and PPIAF 2009). Where a government already has a policy for PPPs, and if there are successful cases of PPPs in other infrastructure sectors, then only minor modifications may be necessary to include them in the I&D sector.

Nevertheless, the involvement of private agents in the operation and temporary ownership of public irrigation schemes does raise difficult issues in many countries.

A recent practical guide produced by the World Bank and PPIAF (World Bank, ICA, and PPIAF 2009) discusses the creation of a PPP framework under five general headings: legal, institutional, transactions, public support, and local currency finance (Box 14).

Box 14: Creating a Framework for Public–Private Partnerships

Legal Framework

Addressing key legal constraints, e.g., ultra vires, government obligations and support, creation of limited liability companies, procurement, land rights and acquisition, tariffs, penalties, sanctions and bonuses, security rights over assets, dispute resolution, sovereign immunity, employment, tax, regulatory frameworks, trusts, agencies, currency.

Institutional Framework

Coordination of public–private partnership (PPP) program, fiscal support, project selection, project preparation, demonstration projects, preparation of contracts and bid documents, value for money, approval process.

Procurement and Implementation of Transactions

Inception/prefeasibility/preliminary viability study/outline business case, viability/feasibility study/full business case, direct negotiations and unsolicited proposals, prequalification, bids, single bids, preferred bidder, management and monitoring of implementation (including project team), operations manual, performance monitoring, refinancing, equity sell-down, dispute resolution and renegotiations, expiry, termination, and handover.

Public Support

Funded instruments (grants and capital contributions, payment for services rendered, loans, equity), contingent support (government guarantees, contingent debt/equity, contingent contributions, bilateral and multilateral guarantees), and management of government liabilities.

Local Currency Finance

Sources of long-term, local currency funding, government actions to facilitate access to these, through an intermediary.

Source: Delmon (2014). Annex 2 of this guide contains 29 useful and practical aggregate key messages for decision makers.

6.5 Conclusions

The following observations summarize the lessons learned from this international review of the main PPP options used in irrigation and of their relevance to Asia:

- PPP contracts are used by public authorities to share the management, operational, and financial risks of infrastructure with private sector partners. PPPs are way of gaining access to both expertise and finance. In many cases the former is the more important outcome.
- There are various forms of PPP contracts: management and service contracts, leasing of infrastructure, concessions, and various forms of “greenfield” contracts (BOTs, etc.). These involve different degrees of risk transfer, ownership arrangements, and financial commitments.
- The full divestiture of the ownership of public assets to private parties is unusual, especially in irrigation. In most cases of PPP where the assets are in private ownership, this arrangement is temporary and the infrastructure reverts to public hands at the end of the contract.
- There is very limited international experience with the use of PPPs in irrigation. Projects in Brazil, Egypt, Ethiopia, and Morocco have important lessons for Asia. In the Asian region, the only ongoing PPP is the Bangladesh Muhuri scheme, a management contract that could eventually turn into a leasing arrangement.
- Most Asian countries have some way to go in developing the “enabling environment” for the successful use of PPPs in public surface irrigation projects. Adjustments in their legal, institutional, policy, procurement, and other domains will be required.

7 Toward Sustainable Financing for Asia's Irrigation

The future of Asian surface irrigation will involve progress toward greater efficiency and greater financial sustainability. The two aims are interlinked and mutually supportive. This final chapter considers how these twin aims can be approached. It identifies the elements of reform, as well as the choices, opportunities, and pathways available to governments, and concludes with a brief discussion of the financing opportunities for IFIs such as ADB.

7.1 Elements of Financial Reform

Previous chapters identified a number of elements that can contribute to the twin aims of greater efficiency and financial sustainability for irrigation. These elements would increase the irrigation sector's ability to attract adequate funding and to absorb and use it most effectively.

The various elements of reform can be grouped into three categories: structural and institutional, financial, and efficiency reforms (Figure 4).

Figure 4: Elements of Financial Reform

Structural and Institutional	Financial	Efficiency
<ul style="list-style-type: none"> • Independent status for irrigation authority • Financial autonomy for irrigation authority • Vertical restructuring • Third-party operator • Irrigation management transfer and water user association (WUA) 	<ul style="list-style-type: none"> • Budgeting for irrigation and drainage • New investment • Tariffs • New sources • Better use of existing sources (e.g., results-based financing) 	<ul style="list-style-type: none"> • Managerial reforms in irrigation authority • External support and capacity building for irrigation authorities and WUAs • Public-private partnerships

Structural and Institutional Reforms

Independent Status for Irrigation Authorities

In those cases where the irrigation department is still run as a department of the central or state government, there is a strong case for giving it some autonomy, with delegated powers over key managerial and operational functions. This would be conditional on the irrigation authority's having, or acquiring, appropriate capacity in human resources and skills to take on this enhanced role.

Splitting off an irrigation department from a national or state administrative hierarchy and reforming it as a separate agency, with its own identity, is a first step toward creating greater transparency and accountability in irrigation services. Although still accountable to a minister (of agriculture or water), the head of the irrigation agency would have greater freedom of action over appointments, allocation of resources, and day-to-day operating decisions. The irrigation authority would produce an annual report explaining and accounting for its performance, including its financial income and outgoings.

Financial Autonomy for the Irrigation Authority

Giving the irrigation authority financial autonomy would be the logical extension of granting it managerial and operational independence. Effectively, it would turn the irrigation authority into a parastatal enterprise, with its finances ring-fenced from those of its sponsoring ministry. This solution is consistent with continuing government subsidies to the irrigation authority, but these would be predictable, accountable, and conditional on certain performance benchmarks. Subsidies could taper off over time.

Financial autonomy renders the irrigation authority accountable for its use of government transfers, IFI loans, irrigation charges, and other sources of funds. The agency would have a strong and direct interest in the choice of the most efficient project and in the efficient O&M of its existing systems. This strong interest in efficiency drives it to collect adequate revenues from farmers and repay loans from central and state government agencies. In contrast, in a situation of financial dependence, the irrigation authority lacks such incentives, as it is fully or largely dependent on government for its funding and typically does not even retain revenues collected through irrigation charges.

Financial autonomy for irrigation authorities could trigger a more robust attitude to debt by all parties concerned, thus:

...imposing a repayment obligation for new irrigation and rehabilitation investments on each level of financial authority from national governments to international financing agencies, from provincial governments and irrigation agencies to the national treasury, from water user associations to irrigation agencies, and finally from individual farm beneficiaries to their water user associations. If an agency must repay funds transferred to it from a higher level of authority and pay for services it has received, then – like it or not – it must exert pressure on agencies below to do the same (“Repetto 1986”).

A financially autonomous irrigation authority generating its own sustainable cash flows would be able to attract commercial lending and even raise bond finance, subject to receiving an investment-grade rating from credit rating agencies.³¹

Full financial autonomy would need to be achieved progressively. The transition could be eased by such measures as cancellation of past debt owed by the irrigation authority (or its conversion into publicly owned equity) so that the reformed agency could start with a clean slate. To start with, it would probably be necessary for the government to guarantee an initial, and possibly tapering, level of budgetary subsidies, subject to a performance contract with the irrigation authority specifying progress toward certain operational and financial targets. The government would have to allow the irrigation authority to retain all or most of the revenues from ISFs, subject to agreements with WUAs about the share the latter retain.

The Korean experience with financially autonomous irrigation agencies, originally based on the Japanese model, illustrates this approach. In this case, as in others (e.g., the Philippines), government subsidies for investment continued, though autonomy improved the quality of the investment decisions taken by the irrigation authorities (Small and Carruthers 1991; Raju, Gulati, and Meinzen-Dick 2003, 20–27).

Vertical Restructuring

In some circumstances, the presence of monolithic irrigation organizations, responsible for the full gamut of services from headworks to field distribution, might be inefficient and militate against financial sustainability. In such cases, the solution might lie in vertical disintegration, which confines the irrigation authority to the supply of bulk water for sale to lower levels of service operators (such as WUAs or third-party operators). This solution would require the reformed irrigation authority to ring-fence, and fully recover, the costs of the primary and secondary networks for which it was responsible. The evolution of irrigation authorities into bulk water suppliers is exemplified in the Kyrgyz Republic.

Vertical restructuring could, in appropriate cases, improve efficiency, accountability, and transparency of costs—leaving delegated bodies to recover the specific O&M costs of tertiary and lower irrigation levels. Conversely, in other cases, splitting the vertical structure of the sector in this way might destroy economies of scale and administration, and thrust responsibilities onto WUAs for which they were unprepared, professionally and financially.

Pakistan's experience is instructive of the difficulties of reforming a century-old irrigation governance system (Box 15).

³¹ Different credit ratings would apply to bond issues in domestic currencies, compared to those targeting international issues denominated in foreign exchange.

Box 15: Formation of Provincial Irrigation and Drainage Authorities in Pakistan

The architecture of reform was established in the late 1990s, forming the basis for a three-tiered structure for the management of irrigation and drainage. The (central) Water and Power Development Authority's Water Wing was to become a planning body, dealing with interprovincial issues, and new provincial irrigation and drainage authorities (PIDAs) would be created in each of the four provinces. The provincial authorities would have autonomy from central and provincial governments. Below the provincial irrigation and drainage authorities would be area water boards, and below these farmers' organizations. The farmers' organizations would be responsible for operating and maintaining distributaries and minor canals and for collecting of abiana (the irrigation service fee), 40% of which they could use for local operation and maintenance.

The reforms were unevenly implemented across the four provinces, and, even where new institutions had been created, these were not given sufficient authority. New bodies tended to be staffed with officers from the original institutions. Farmers' organizations were not empowered (particularly in the crucial area of finance) in the way envisaged in the Punjab Irrigation and Drainage Authority Act of 1997. A major obstacle was opposition from existing cadres due to a combination of concerns about career prospects, confusion and uncertainty over the reforms, and demoralization.

Source: World Bank (2007a).

Third-Party Operators

The introduction of a third-party operator between the irrigation authority and the farmers or their WUA could be desirable in many cases (Dargouth et al. 2007). This operator, which could be private, public, not-for-profit, or even an enhanced WUA, would be responsible for maintenance, working as a subcontractor to the irrigation authority (or even the WUA, where the latter has resources for the necessary oversight) with remuneration based on performance against targets. Where the third-party operator is private, this option coincides with the PPP option discussed below.

Third-party operators are likely to be most useful for I&D functions that can be clearly identified and subcontracted, and are currently being poorly performed. Asset maintenance is a clear case in point. Disentangling a specific function such as maintenance from other functions of the irrigation authority could give greater focus to a key activity, enabling greater transparency in the way it is carried out and providing external skills lacking in the parent organization.

Defining the performance criteria to be used as the basis for remuneration is critical. So is monitoring the performance of the contractor against these benchmarks. Payment could come from the irrigation authority or from collections from farmers, made directly by the irrigation authority or through an empowered WUA. A further option would be for payment to be received from an empowered WUA, which in turn would collect charges from its member farmers.

Irrigation Management Transfer and Water User Associations

The delegation of responsibility from irrigation authorities to farmers and their WUAs is widely seen as an important part of the solution to the problems of inadequate O&M and insufficient irrigation fees collected from farmers. WUAs must be involved in decisions about the planning of facilities, the allocation of water, and the maintenance of local infrastructure to give farmers a sense of “ownership” of the facilities and of government responsiveness to local needs. Allowing WUAs to collect charges from their members and to retain a sufficient portion to pay for their maintenance duties is a further and necessary step in their empowerment.

It is clear from experience (Chapter 5), however, that the performance of WUAs has been uneven and has often disappointed their proponents. Too often, WUAs are expected to carry out functions for which they are unprepared and underresourced. They cannot be expected to raise water tariffs and collect revenues if the irrigation infrastructure as a whole does not deliver good-quality services for which the WUA members are willing to pay. Many WUAs lack financial resources to carry out the required O&M because the ISFs do not cover the costs of the necessary work.

Empowering WUAs will not fully succeed if the irrigation authorities that control the “upstream” parts of the infrastructure remain unreformed. Improving tertiary and on-farm asset maintenance depends on the adequate functioning of primary and secondary systems.

Financial Reforms*Budgetary Allocations*

As long as the irrigation sector depends on government subsidies, it will remain subject to national budgetary processes, which are typically inflexible, and inconvenient for I&D in several important ways:

- Funds for capital investment are provided from a budgetary category different from that for the annual costs of MOM, with little or no possibility of transfer between categories. In practice, the former are often more freely available.
- Allocations for MOM are typically based on top-down estimates bearing little relation to actual local needs.
- In some countries, the different components of MOM are provided from separate budget headings, meaning that savings in one component cannot be transferred for use elsewhere.

The first issue, accounting for the alleged bias toward new investment, will be solved only through coordinated treatment of capital and recurrent expenses for the I&D sector, where “...both components of the revitalisation package – rehabilitation of worn-out systems and regular maintenance of the systems once rehabilitated – are considered concurrently as a suite... (Malik, Prathapar, and Marwah 2014, 39)”

New Investment

Getting the virtuous spiral in motion would be easier if the difficult policy and institutional changes required were accompanied by investment in the rehabilitation of assets. This is essential where infrastructure is badly rundown and dysfunctional or where it is costly and inefficient to operate.

However, new investment raises a “chicken-and-egg” issue: How far are financiers (including finance ministries) willing to continue to “throw good money after bad,” as investment in this sector is sometimes characterized? At various times in the past, irrigation has suffered from donor fatigue and elements of this continue to linger. IFIs, donors, and potential sources of commercial finance would be more willing to finance these investments if the various elements of the enabling environment, including cost recovery tariffs and collections, were already in place. For their part, farmers would be more willing to pay their ISFs if the assets had been rehabilitated and were being properly maintained, and if the level of service was satisfactory. For best effect, these various elements of reform need to be synchronized.

National governments may need to review the balance between their support for capital investment vis-à-vis the annual costs of MOM and insist on greater conditionality for grants and long-term loans toward irrigation. Allowing greater financial autonomy for irrigation authorities would help to improve the quality of investment decisions. IFIs should build their future pipeline of projects that promote efficiency and resilience, and incorporate technical assistance for the necessary elements of reform as identified in this paper.

Tariff Setting and Revenue Collection

To ensure revenues sufficient to at least cover O&M costs, reforms should include a review of tariffs (levels, structure, basis of estimation, etc.) and ways of increasing the level of revenue collection.

If a primary purpose of charging for irrigation water is raising enough revenues to fund O&M, the first step must be to identify the level of these costs in each irrigation district. This information is typically lacking, and, as a result, budgetary transfers to cover these costs tend to be based on benchmarks set remotely by central government agencies.

The next step would be to determine how the irrigation charges should be levied (e.g., by area, cropping pattern, or other proxies for water use) and whether it is feasible for usage to be directly measured (metered). A pragmatic approach based on the ease and feasibility of monitoring and collection is desirable. The cost of water use monitoring and of collection, and the scope for fraud...and collection, should be borne in mind.

Regarding the level of charges, the willingness of farmers to pay often exceeds the willingness of politicians to charge, provided levels of service are satisfactory. Most project feasibility studies demonstrate that any net increase in charges to the farmer is a minor part of the expected net benefits. In some cases, the target farming group would even save money compared with current arrangements. The key factor in affordability and willingness to pay is the likelihood of real and tangible improvements in service.

There is evidence that rates of collection of ISFs would improve if more of the revenues were returned to local organizations to fund local works such as maintenance. This would depend on how much more of the ISF proceeds WUAs were allowed to keep, and in turn on how much autonomy is delegated to the WUA and—in some measure—removed from the irrigation authority. The cost of collection and scope for corruption would be reduced if modern technology such as remote sensing and geographic information system (GIS) mapping were used for assessing cropped areas and other proxies for water use.

Questions on tariff reform include the following:

- Should tariff increases precede or follow visible improvements in the state of irrigation infrastructure and services?
- What should be the basis and structure of charges, and the mode of assessment and collection?
- Who should set the tariff: governments, the irrigation authority, or the WUA? The answer would depend on the delegation of responsibilities down the chain. In a vertically monolithic system, the government or irrigation authority would set charges; with delegation or IMT, the lower-level organizations would set and collect tariffs, while paying a fee for the bulk supply of their water.
- Should farmers pay for the administrative overhead involved in the supply of irrigation water? In the case of IMTs, the administrative overhead of the irrigation authority would in theory be covered by the bulk water charges levied by the irrigation authority on the WUA. In addition to the bulk water fee, WUAs would cover their own MOM through the ISF they levy on their farmer members. Governments may decide to subsidize the overhead of the irrigation authority for wider social and economic reasons such as food security, flood management, or employment generation. From the standpoint of ensuring adequate maintenance, the crucial point is that the ISF payable by farmers should at least cover maintenance needs at the level of management for which they are responsible.
- Do irrigation authorities and WUAs have information about their actual MOM costs to provide a rational basis for setting the tariff? The answer is no in many cases, hence the need for more work on this.

Tapping New Sources of Finance and Maximizing Use of Existing Sources

This approach would focus on

- maintaining and increasing funding from existing sources (national governments and IFIs, plus the new funds such as the Asian Infrastructure Investment Bank), through project selection and design and the inclusion of reforms and capacity-building components;
- making better use of existing money (e.g., instituting internal managerial and financial reforms in irrigation authorities, preparing asset management plans and costing, coupling recurrent and capital costs);
- laying the groundwork for future access to commercial finance (loans, bonds, project finance, and private equity) by focusing on improving cash flows and creditworthiness; and

- selecting components of projects that match the funding criteria of the new climate funds.

All these areas undoubtedly present opportunities. However, making a gradual change in the inflow of finance will depend on serious reforms in the irrigation sector, to improve efficiency and generate more cash flow through increased revenues and reduced outflows. Even access to finance at current levels from national governments and IFIs will require a degree of reform and acceptance of new lending modalities (e.g., results-based finance) and conditions. Any serious access to commercial finance will depend on major changes in the creditworthiness of irrigation authorities.

Efficiency Actions

Introducing Business Management Practices

Introducing modern business methods into the management of irrigation authorities is desirable, regardless of the status of the irrigation authority, but these would be easier to implement if the agency had a degree of autonomy and if it were unshackled by public bureaucratic procedures. The tasks in this regard are described in Box 16.

Box 16: Management Practices for Irrigation Authorities

- Adopting business management practices, including defining strategies and scheme objectives, setting targets, managing performance, monitoring and evaluating performance, and rewarding good performance;
- Modernizing data collection, processing, analysis, and reporting procedures by developing and using modern information and communication technology, such as remote sensing, geographic information system (GIS), management information system (MIS)-based decision making, and short messaging service (SMS) reporting;
- Developing and adopting procedures for benchmarking performance of schemes;
- Developing and adopting procedures for asset management planning, with identification of required levels of maintenance funding to provide the level of service needed by the water users;
- Discarding the perception of farmers as beneficiaries and adopting and building a service delivery ethos focused on meeting the needs of the farmers as customers; and
- Moving from supply- to demand-side management in the setting of cropping patterns and scheduling irrigation water.

Sources: ADB (2016); Burton (2010).

The success of internal reforms will depend on the drive and farsightedness of senior staff, backed as necessary by IFI lending and technical assistance.³² All these actions will make the irrigation service more efficient and its customers more willing to pay. The promotion of asset management planning (predicated on more accurate estimates of the costs of O&M and of periodic replacement and modernization) is a prerequisite for tariff setting at

³² As in the World Bank's Water Sector Restructuring Project in Madhya Pradesh, India, and the capacity-building components of a number of ADB irrigation projects.

cost-recovering levels. (Asset management planning is routine practice among the best-performing public and private water supply utilities.)

These managerial reforms in irrigation authorities, and the corresponding enhanced responsibilities in WUAs, will entail substantial training and capacity building, for financial officers and other personnel (Burton 2010, chapter 8).

The abovementioned practices may lack bite and fail to generate momentum if they are not driven by staff incentives of various kinds, which derive ultimately from the financial performance of the entire organization. If the irrigation authority has insufficient financial autonomy, bureaucratic inertia may prevail over the spirit of reform.

External Support for Managerial Reforms

Irrigation authorities could co-opt and hire private expertise to facilitate internal managerial reforms in the following ways:

- using external trainers;
- co-opting individual specialists to perform specific roles within the irrigation authority (e.g., information technology);
- employing consulting companies as subcontractors for certain stand-alone tasks; or
- using a private company to provide institutional support to the irrigation authority, such as management expertise, technical support, and training.

None of the above involves the actual performance of line managerial functions by outside agents, who, in this sense, are therefore nonthreatening to incumbent staff. On the other hand, a more efficient, performance-oriented, cost-conscious, and financially driven irrigation authority would find it easier to raise finance from all quarters (and would probably need less of it and deploy it more effectively).

Enlisting Private Expertise through Public-Private Partnerships

PPPs take the involvement of private expertise a stage further than the methods described earlier by bringing in private partners to share operational or financial risks. Various types of PPP are available. They range from service and management contracts, leasing and operation of existing assets, and concessions for the operation of systems (including investment), to greenfield contracts (BOTs and the like), the extreme being the full divestiture of assets from public to private ownership. These variants involve different degrees of delegation of risk and responsibility.

The processes, incentives, and mind-sets that private partners bring would facilitate internal managerial reforms and enable the irrigation authority to raise commercial finance in the future.

At present, there is only one case of a PPP prospect in Asian irrigation: the Muhuri project in Bangladesh, where a private company has a performance-based management contract to create the foundation for an eventual asset leasing agreement. PPPs presuppose the existence of a legal framework allowing private management and ownership of public facilities, which does not exist in all countries or in all states within them. PPPs also need effective and independent regulation.

International experience shows that promoting PPPs in irrigation calls for various kinds of incentives for the private partners to allay the risks in this sector. These inducements typically take the form of cofinancing by the state, public guarantees of loans raised in new projects, and/or continuing public subsidy for operations (e.g., through viability gap funding).³⁴

7.2 Choices and Pathways

Reform requires a number of strategic choices regarding its drivers (top-down or bottom-up), the advisability of comprehensive versus piecemeal solutions, the extent of autonomy to be given to the irrigation authority, the need for vertical restructuring of the irrigation sector, the extent to which the private sector should be engaged in management and financing, among others. National circumstances will dictate the choices made.

Top-Down or Bottom-Up Drivers?

Irrigation reform will demand political will and the expenditure of political capital. Where there is political willingness, change can be imposed from the top. In some political systems, this may go with the grain; in others, a more consensual and democratically determined outcome may be more appealing, and in these circumstances more enduring.

The bottom-up viewpoint draws on the actual experience of the Kyrgyz Republic, Mexico, and elsewhere, pointing to the impact of IMT on effective and empowered WUAs, which gradually take over upstream activities and responsibilities from the irrigation authority.

Although the formation and empowerment of WUAs has been a leading theme of recent irrigation reform and a standard component of IFI-supported projects, its record has been mixed. Does this represent the “cart before the horse” in reform, without serious change upstream in the irrigation authority? It may be unrealistic to expect serious reform to occur at lower levels without corresponding changes in the main body of the irrigation authority.

³⁴ The process wherein private contractors bid on the basis of the least public subsidy they would require to build or operate the facility.

Comprehensive or Piecemeal Solutions?

The interrelatedness of I&D issues would favor the adoption of comprehensive and simultaneous solutions, in a “big-bang” moment. Synergies would quickly be established, leading to the creation of the virtual spiral. In “normal” times, a comprehensive solution might not be able to attract enough political support to overturn vested interests. If it were to come in response to a crisis (e.g., looming food shortage leading to a surge in imports, a spike in food prices, or a shortage of water in a major irrigation system), however, a comprehensive package might be considered feasible. Crises present opportunities that are to good to waste.

The opposite viewpoint would give more weight to the difficulties incurred by comprehensive reform—and probably lead to further delays. In contrast, piecemeal changes, especially if they were below the political radar would have a better chance of success. The pragmatic attitude of “we have to start somewhere” is therefore more realistic than attempts to intervene across a number of fronts and could create momentum and synergies, making other reforms easier to implement later on.

Status of Irrigation Authority: Department, Parastatal, or Full Financial Autonomy?

Where irrigation is still run from within a government department, delegating I&D functions to a separate, semiautonomous parastatal corporation, with day-to-day operating flexibility and with powers over staffing, managerial, and certain financial domains, could realize gains. The benefits to be expected are those from standard management theory: efficiency, accountability, flexibility, visibility, etc.

Some early advocates of reform have gone further and insist on a change in the status of the irrigation authority to give it (eventual) full financial autonomy. A financially autonomous irrigation authority would drive financial discipline throughout the whole system, involving repayment of debts and full recovery of costs from farmers. In this mode, reforms at lower levels would be incomplete and lack momentum without top-down pressure.

Vertical Restructuring

A monolithic vertical structure may be inefficient. According to this view, irrigation management would comprise the following:

- policy-making body (e.g., ministry) exercising oversight of the irrigation authority is through a formal performance contract governing aims, level of financial support, and conditions;
- irrigation agency, with sufficient managerial and financial autonomy and potentially with full financial autonomy, to be a bulk supplier potentially an eventual aim. It would be a bulk supplier of water to lower-level management units;
- third-party operator between the irrigation authority and farmers—possibly an empowered WUA (e.g., under full IMT), a commercial company, or some other organization—to buy bulk water from the irrigation authority and distribute it to farmers, recovering the cost of bulk purchase and its own MOM costs from charges to farmers; and

- WUAs, or federations of them, having delegated rights and responsibilities (consultation, participation in decision making, lower-level managerial roles, ISF collection, O&M, etc.).

While this kind of structure would provide accountability and transparency, it could also destroy economies of scale, besides reducing enthusiasm in and weakening the professional cadre.

Public-Private Partnerships

PPPs involve private partners in the operational and financial risks of irrigation. They can take various forms, such as management and service contracts, irrigation asset leases or concessions for the use of the assets, or concessions for the use of such assets to earn revenues involving some investment, and contracts for creating new stand-alone assets (BOTs, BOOTs, etc.), some of which involve temporary ownership of the asset by the private partner and its eventual transfer back to the public client.

There is also full divestiture of assets from public to private ownership, but this is so rare, and so unlikely in Asian irrigation, that it can be dismissed as a feasible option. A special case is IMT, in which the ownership, as well as the management, of irrigation assets is transferred from public authorities to local associations of farmers. This is best regarded as divestiture to local collectives, instead of than “privatization” in its normal sense.

The key feature in all these variants is transfer of risk. There are other ways of engaging private expertise that do not involve significant risk transfer, such as secondment of personnel, use of consultants, and outsourcing of certain specialized functions. Where genuine risk transfer is involved, its main impact is often felt through the acquisition of expertise, rather than the attraction of major new funding.

On this pragmatic view, the main argument is likely to be about the predominance of PPP solutions over more rather than relying on more “organic” and internally generated forces in irrigation reform. There are few international examples, however, and practically none in Asia. The conditions for a successful PPP involving leasing, concessions, or greenfield contracts are currently largely absent in most Asian countries. That said, the urgency and intractability of the problem may lead some countries to shift their formerly hostile and skeptical stance on PPPs and adopt a more open-minded and pragmatic view on this matter.

7.3 Where Should Reforms Start?

Where the problems are complex and interrelated, identifying the starting places for reform is difficult. Policy measure A, desirable in its own right, may depend on implementing action B, for which the precondition is progress on C, and so on.

Creating a virtual spiral involves taking a number of interrelated actions. It has been said that “Piecemeal interventions are unlikely to be successful, or to address the scale of the

problem” (ADB 2016). Some of the reforms discussed in this report depend on radical and difficult changes, requiring political will on the part of governments and behavioral change in all parties involved. However, contemplating the scale of the difficulties could easily become a recipe for inaction.

Change must start somewhere, and identifying the “low-hanging fruit” is critical. The current state of Asian irrigation, normally couched in terms of “intractable problems” and, “lost potential,” could be viewed in a positive light as “opportunities for enhancing performance” or of closing a “performance gap” between the best and the worst agencies (ADB 2016, 5).

Once the virtual spiral is underway, changes will become self-reinforcing. Higher revenues, plowed back into local maintenance, will be seen as raising the standard of services, leading to more willingness to pay among farmers. When a financially autonomous irrigation authority prepares to raise bond finance, it will fall under the scrutiny of a credit ratings agency and be forced to work on both costs and revenues to maximize its cash flow and receive the most attractive credit rating. The same measures would also magnify its appeal to IFIs and donor agencies, as well as make it easier for national finance ministers to favor I&D when making budgetary allocations.

For the purpose of setting priorities between different reform elements, it may be useful to break down the aims of irrigation financial reform into three different stages:

- most urgently, to increase funding for essential maintenance of infrastructure;
- to implement reforms in the management of irrigation authorities that will lead to greater efficiency and make the agencies more “fit for purpose”; and
- over a longer time frame, to make irrigation authorities more financially autonomous.

The options and elements discussed in section 7.1 of this chapter will contribute to these aims in varying degrees. A strategic goal should be set, and institutional and policy reforms should conform to it. In the short term, priority could be given to measures that fit the following criteria:

- Are they preconditions for other essential actions?
- Are they low-hanging fruit—providing quick wins and relatively easy to implement?
- Are they no-regret actions—worth doing (robust) irrespective of future possible scenarios?
- Do they preserve options for future decisions, unlike actions that preempt and exclude future actions?

Some options will score well against all, or a majority, of these criteria. Others will not, but will still be important to undertake if they are unavoidable part of reaching the goal. With this reservation stipulated, the following options, among others, would score well on several of these criteria:

- adoption by irrigation districts of modern business practices, particularly asset management planning, costing and financing, and the freedom to make necessary forward provision for maintenance and renewal;

- selective co-option of private expertise to assist in the transformation of irrigation districts;
- closer estimation and monitoring of actual financial requirements for MOM in specific irrigation areas, to provide a firmer basis for setting cost-recovering irrigation charges; and
- WUA retention of a share of the proceeds of irrigation charges earmarked for local expenditures on MOM where these associations have sufficient delegated responsibilities and the capacity to implement these.

7.4 Roles for International Financial Institutions

IFIs such as ADB, the World Bank, and the new Asian Infrastructure Investment Bank will have an important continuing role in financing Asian irrigation for the next decade and beyond. In the absence of term commercial lending, the IFIs and national governments are in effect the only sources of long-term loans on which irrigation investment relies.

Because of their “halo effect,” the IFIs often find themselves anchoring irrigation finance packages. Their access to grant facilities and trustworthy funds enables them to associate policy advice, institutional and capacity building, and funding for feasibility studies and the preparation of financing transactions with their loan finance. In these respects, IFIs have an influence that is disproportionate to the volume of their finance. IFIs should recognize their unique role and capitalize on their position to make as much a difference as they can with their operations in order to make the necessary changes.

As demonstrated in Chapter 2, the annual investment requirement for Asian irrigation is an elastic figure. If future requirements are taken to be about \$10–\$15 yearly, there would appear to be ample scope for IFI lending within that range and potential for “crowding in” rather than “crowding out” other lenders.³⁵

The following are the implications for IFIs that wish to “go with the flow” of trends identified in this report:

- Preference for projects that
 - » prioritize more efficient use of water, where possible, releasing water for use by other sectors;
 - » involve greater energy efficiency, e.g., by substituting for groundwater pumping or introducing more efficient energy sources, thereby creating eligibility for climate funds;
 - » are of a multipurpose character, giving more financing options and creating secondary sources of income; and
 - » create “quick wins” by restoring rundown infrastructure relatively quickly to its productive potential, without the need for costly major new installations.

³⁵ ADB would fund about 10% of this on current plans (30% of its total water lending of \$3.5 billion–\$4 billion after 2017).

- A willingness to go the extra mile in driving policy and institutional change in national partners through such means as
 - » funding studies on financing for and with national partners;
 - » funding data collection on MOM costs in specific irrigation districts;
 - » providing technical assistance for promoting managerial innovations in irrigation authorities and for national capacity building;
 - » arranging peer-to-peer visits and dialogue to encourage the spread of good practice;
 - » building conditionality into project financing agreements, and
 - » initiating greater use of performance-based lending modalities such as results-based finance in order to provide incentives to borrowers for effective implementation.
- Actively seeking to involve other financing partners in project financing packages such as
 - » cofinancing, including collaboration with other IFIs, donor agencies, and commercial banks;
 - » selective use of risk-sharing products such as guarantees where appropriate and feasible; and
 - » identification of promising situations where PPPs, in their various possible forms, might be feasible and preparing the ground for these initiatives.

7.5 Overall Conclusions

The following observations, based on an extensive study of multiple irrigation projects around the world, may contribute to building greater financial sustainability for the future of Asian surface irrigation:

- Financing is more than just finding the money for the cost of investment and operations of I&D. The means of finance chosen, and the effort involved in attracting it, have far-reaching implications for the I&D sector.
- Securing sustainable finance for irrigation goes hand in hand with structural and managerial changes that will be necessary in any future scenario for this sector. Building a sustainable financing system will enable these changes to happen more quickly and easily. Financing can be a powerful agent of reform.
- Creating the sustainable financing structure involves a number of elements, and there is no iron law governing the content or sequence of a reform program.
- A strategic goal should be set, and institutional and policy reforms should be aligned with this. In the short term, priority could be given to measures that fit the criteria of whether they are preconditions, low-hanging fruit, no-regret actions, and option-preserving actions.
- Much can be done within existing structures and institutional arrangements lay the groundwork for the necessary changes and adaptation of infrastructure. These will all make future financing easier.
- However, more radical measures will be needed to produce a step-change in the volume of funding, for recurrent or capital investment purposes. Ensuring adequate funding for maintenance is an absolute priority.

- IFIs are crucial agents of change by virtue of their ability to offer long-term loans for I&D, their influence on cofinanciers and national governmental partners, and their ability to mobilize important related elements in the total financing package (technical assistance, studies, capacity building, risk sharing, etc.).
- IFIs can enhance the prospects for financial sustainability in I&D through their choice of projects, the resources they bring into play, technical assistance and other “added-value” components, and their efforts to enlist the support of cofinanciers.

APPENDIX 1

Area Equipped for Irrigation in Asia

Country	Total Area Equipped for Irrigation ('000 hectares)	Value Year
Afghanistan	3,208	2002
Bangladesh	5,050	2008
Bhutan	31.91	2010
Cambodia	353.6	2006
China, People's Republic of	69,860	2014
India	70,400	2013
Indonesia	6,722	2005
Japan	2,500	2010
Kazakhstan	2,066	2010
Kyrgyz Republic	1,023	2012
Lao People's Democratic Republic	310	2005
Malaysia	380	2009
Mongolia	84.3	1993
Myanmar	2,110	2004
Nepal	1,168	2002
Pakistan	19,990	2008
Philippines	1,879	2006
Korea, Democratic People's Republic of	1,460	1995
Korea, Republic of	806.5	2009
Sri Lanka	570	2006
Tajikistan	742.1	2009
Thailand	6,415	2007
Timor-Leste	34.65	2002
Turkmenistan	1,991	2006
Uzbekistan	4,198	2005
Viet Nam	4,585	2005
TOTAL	207,938.06	

Source: FAO (2016).

APPENDIX 2

Yardsticks for Unit Costs of Irrigation Development in Asia

Food and Agriculture Organization of the United Nations (2011)

The following average unit costs (Table A.2.1) were used as the basis for estimations of investment requirements in the 2011 investment methodological framework of the Food and Agriculture Organization of the United Nations (FAO) (only Asian data are reproduced here).

Table A.2.1: Average Unit Costs per Hectare for Irrigation (\$ 2009)

Region	Large-Scale Irrigation Development	Large-Scale Irrigation Rehabilitation	Small-Scale Irrigation Development	Small-Scale Irrigation Rehabilitation
South Asia	4,704	1,552	1,757	580
East Asia	4,794	1,582	1,806	596

Sources: FAO (2011); Inocencio et al. (2007).

The research team drawn from the International Water Management Institute, the African Development Bank, the World Bank, and an independent research institute analyzed 314 irrigation projects that were completed between 1965 and 2003 in all regions of the developing world. Of these, 290 were funded by the World Bank, and the rest by the African Development Bank and the International Fund for Agricultural Development. The exercise was aimed at identifying differences in project performance and costs between regions, and suggesting explanatory factors.

The following factors were discovered to be important in the performance and cost of projects: project size; government contribution to investment cost; share of software components in investment cost; countries' level of development; purpose of project (new construction or rehabilitation); type of project (single purpose or multipurpose/multisector); type of system (river diversion, dam, tank, surface/groundwater, lift, flood/drain, etc.); implementation (cost overrun and sizing error); water availability (rainfall and conjunctive use); and farmers' participation.

Table A.2.2 shows the average regional unit cost data resulting from this exercise.

Table A.2.2: Unit Cost per Hectare of Irrigation Projects by Region
(\$, at 2000 prices)

Region	No. of Projects	New Construction	Rehabilitation
South Asia	91	3,393	1,008
Southeast Asia	68	9,709	1,840
East Asia	18	8,221	1,990
Middle East and North Africa	51	8,780	4,582
Latin America and Caribbean	41	4,903	3,432
Sub-Saharan Africa	45	14,455	8,233

Source: Inocencio et al. (2007).

Food and Agriculture Organization of the United Nations (2003)

In its 2007 magisterial comprehensive assessment, the International Water Management Institute used the following unit cost parameters developed in a separate and earlier study by FAO (Table A.2.3).

Table A.2.3: Unit Cost per Hectare of Irrigation Investments in Asian Regions
(\$ per hectare)

Region	New	Rehabilitated
East and Southeast Asia	2,900	700
South Asia	2,600	900

Source: Molden (2007), p. 368.

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