

City University of New York (CUNY)

## CUNY Academic Works

---

Student Theses

Baruch College

---

1-1-2001

### Public-private partnerships for infrastructure delivery : a study of water and wastewater treatment, and irrigation sectors

Vanita Gangwal  
*Baruch College*

[How does access to this work benefit you? Let us know!](#)

More information about this work at: [https://academicworks.cuny.edu/bb\\_etds/22](https://academicworks.cuny.edu/bb_etds/22)

Discover additional works at: <https://academicworks.cuny.edu>

---

This work is made publicly available by the City University of New York (CUNY).  
Contact: [AcademicWorks@cuny.edu](mailto:AcademicWorks@cuny.edu)

# **PUBLIC PRIVATE PARTNERSHIPS FOR INFRASTRUCTURE DELIVERY: A STUDY OF WATER AND WASTEWATER TREATMENT, AND IRRIGATION SECTORS**

**by Vanita Gangwal ©**

**April 30, 2001**

Research report prepared by Vanita Gangwal under the supervision of Dr. E.S. Savas for submission to the Committee on Undergraduate Honors at Baruch College of The City University of New York in partial fulfillment of the requirements for the degree of Bachelor of Science in Public Affairs with Honors.

---

## **TABLE OF CONTENTS**

### INTRODUCTION

CHAPTER 1. INFRASTRUCTURE PRIVATIZATION  
CHARACTERISTICS OF INFRASTRUCTURE ACTIVITIES  
ALTERNATIVE INSTITUTIONAL ARRANGEMENTS  
COMPETITION & REGULATION: KEYS TO SUCCESSFUL PRIVATIZATION  
CONCLUSION

CHAPTER 2. WATER AND WASTEWATER TREATMENT  
CHARACTERISTICS OF WATER SUPPLY AND WASTE WATER TREATMENT  
WATER AND WASTEWATER TREATMENT SYSTEM COMPONENTS  
CONDITIONS FOR SUCCESSFUL PARTICIPATION OF THE PRIVATE SECTOR  
THE MAIN PRIVATE SECTOR OPTIONS  
CONCLUSION

### CHAPTER 3 IRRIGATION

CHARACTERISTICS OF IRRIGATION SECTOR  
PUBLIC SECTOR MANAGEMENT OF IRRIGATION  
PRIVATIZING IRRIGATION SECTOR  
CONCLUSION

### REFERENCES

### TABLES

TABLE 1-1 CHARACTERISTICS OF WATER SUPPLY, WASTEWATER TREATMENT AND IRRIGATION

TABLE 1-2 DIVISION OF FUNCTIONAL RESPONSIBILITIES FOR VARIOUS INSTITUTIONAL ARRANGEMENTS

TABLE 1-3 SECTORAL STRATEGIES FOR COMPETITION AND REGULATION

TABLE 2-1 COMPETITION AND MONOPOLY IN WATER AND WASTEWATER TREATMENT

TABLE 2-2 THE MAIN OPTIONS FOR PRIVATE SECTOR PARTICIPATION IN WATER SUPPLY AND WASTE WATER TREATMENT

FIGURES

FIGURE 2-1 CHARACTERISTICS OF PRINCIPAL GOODS AND SERVICES OF THE WATER SECTOR

FIGURE 2-2 MAIN COMPONENTS OF WATER AND WASTEWATER TREATMENT

FIGURE 3-1 CHARACTERISTICS OF PRINCIPAL GOODS AND SERVICES OF THE IRRIGATION SECTOR

FIGURE 3-2 SHARED WATER RESOURCES MANAGEMENT IN LARGE CANALS

## INTRODUCTION

In his landmark book, **The Wealth of Nations**, written over two centuries ago, economist Adam Smith made the most famous observation in all of economics--Households and firms interacting in markets act as if they are guided by an "invisible hand" that leads them to desirable market outcomes. And he was right! As a mechanism for delivering goods and services(1) to the people at the lowest possible prices by making the most efficient use of society's scarce resources, the market has yet to meet its match.

Smith's insight laid the intellectual framework for capitalist economies all over the world in which private individuals and business firms carry on the production and exchange of goods and services through a complex network of prices and markets. However, even in capitalist economies, public sector involvement has traditionally been considered not just appropriate but required to prevent market failure due to monopolies or externalities and to provide public goods and goods that are deemed worthy or merit goods for society.

By and large, much of the infrastructure (for example, water supply, electricity, and irrigation) was thought to have characteristics that make it unsuitable to be provided solely through competitive markets. The features that lead to market failure in infrastructure include economic and technical conditions that create natural monopoly, lumpy investment requirements, externalities, and the fact that many of these goods are public goods by nature. Moreover, it was believed that infrastructure is so important to promote economic growth and production that it could not be left to the private sector. Therefore, government-run monopolies were conventionally justified by low production costs associated with large-scale operations and by the need to protect consumers from private monopolies.

There is, however, a growing recognition that the private sector, which is disciplined in part by competitive market forces, is often better in efficiently and effectively providing infrastructure. In fact, in many cases the risks of poor performance due to possible market failure are less serious to the economy than the risks of government failure. Some of the well-known features of government failure are (2):

- Rent seeking, either economically, in the form of direct bribes and corruption, or socio-politically in the form of empire building, high costs, and excessive supplies.
- The divorce of incentives from performance, indeed, a seemingly an inverse relationship that often leads to operational inefficiency, lack of technological dynamism, and poor service to consumers.
- Capture of public agencies and funds by politically powerful interests and their clients. Administrative operations "by the book" rather than management in terms of objectives and results.

It is also being realized that although market failure creates a legitimate public interest in infrastructure, it does not necessarily warrant government involvement in all aspects of providing the service. For example, in railways, only the imbedded rail infrastructure has monopoly features, while operation of the railway equipment (rolling stock) does not. Although water supply has characteristics of a natural monopoly, it also has a key characteristic that makes it potentially viable commercial enterprise for the private sector - it is feasible to charge users of the service and to exclude non-payers.

Due to all of these reasons infrastructure privatization is becoming commonplace throughout the world. It encompasses many options for enlisting private sector participation, ranging from management by non-profit entities or user organizations to management contracts and leases to concessions and full divestiture of state-owned enterprises. "Transportation facilities, water supply systems and waste water treatment plants, telecommunications systems, electricity generation and distribution systems, solid waste and hazardous-waste disposal facilities are being built, expanded, rehabilitated, operated and maintained around the world through privatized arrangements. The distinguishing characteristic of such facilities is that, being toll goods, they lend themselves to user charges, because users can pay directly according to usage. Therefore, market forces can come into play: private capital can be raised and operating costs can be paid by the users."(3)

One very important factor that gave momentum to infrastructure privatization all over the world is that the need for infrastructure, particularly in developing countries, has far outstripped the supply of conventional public funds. Involving private sector in infrastructure not only promises increased efficiency in investment, management, and operation but also provides access to much needed private finance for investment through capital markets. It can reduce government overstretch; generate government revenues; develop local capital markets, and stimulate foreign investment.(4)

This literature review is an exploration of the various institutional arrangements that can be used for the provision of water and wastewater and irrigation services. A review of these two sectors reveals major differences in institutional arrangements. While use of commercial private sector in water supply and wastewater treatment through leases, concessions and service or management contracts is increasingly becoming commonplace in both developing and developed countries, irrigation reform is focused primarily on the use of cooperative or participatory irrigation management (PIM) model, that is, privatization through nonprofit user organizations.

Chapter One of this paper presents some general economic theory to determine the public and private roles in infrastructure based on the nature of the goods and services involved, the conditions of production, and externalities. This chapter also outlines the basic functions involved in providing infrastructure and general rules for assigning these functions to either the public or private sector. The final section of the chapter includes a brief discussion of the various institutional arrangements that represent different degrees of public and private sector responsibility.

Chapter Two and Chapter Three focus specifically on water supply and wastewater treatment, and irrigation respectively. These chapters discuss the characteristics of the various activities in these infrastructure areas and the appropriate functions to be performed by the public and the private sector. They also include brief discussions of ways to reform these sectors that were formerly monopolized by the government, by using different institutional arrangements. The review shows that there is no unique institutional solution for any infrastructure activity in all contexts. A variety of institutional arrangements are discussed with reference to specific examples in developed and developing countries.

## NOTES

1. Henceforth, the terms "good" and "service" will be used interchangeably in this paper.
2. Perry, C.J., Rock and D. Seckler. 1997. Water as an Economic Goo & A Solution or a Problem- Research Report 14. International Irrigation Management Institute, Colombo, Sri Lanka.
3. Savas, E. S. 2000. Privatization and Public-Private Partnerships. Chatham House Publishers, New York. 237.
4. Kerf, Michael and Warren Smith. 1996. Privatizing Africa's Infrastructure: Promise and Challenge. World Bank Technical Paper No. 337. World Bank, Washington D.C.

## **CHAPTER 1** 1

# **INFRASTRUCTURE PRIVATIZATION**

This chapter discusses the various issues involved in infrastructure privatization. The first issue is whether a particular good can be privatized- Is it a marketable commodity- If a good is marketable, the second issue is to identify the best possible institutional arrangement for the supply of that good. The second section discusses various alternatives with different degrees of public/private participation and different functional decomposition. The challenge is to take advantage of the relative strengths of the public and private sectors and assign the functions of planning and policy-making, ownership, regulation, financing, operation and maintenance, and managerial authority to the sector that is best suited to perform it. The final section discusses some strategic issues to ensure the success of these arrangements.

## **CHARACTERISTICS OF INFRASTRUCTURE ACTIVITIES**

Do market conditions exist for an infrastructure activity- Public finance theory offers three grounds on which the marketability of any infrastructure sector and its underlying activities can be determined.

### **THE NATURE OF THE GOOD**

According to economic theory, goods and services can be distinguished by whether they are consumed individually or jointly, and by whether non-payers can be excluded or not. In fact, all goods fall somewhere along the continuum between individual and joint consumption and along the other continuum between feasible and infeasible exclusion. Goods and services are subject to exclusion if individual consumers can be excluded from using them unless they meet the conditions set by the supplier, and they are available for joint consumption if the marginal cost of another person consuming it is zero. Based on these two criteria, we can classify the vast array of goods and services into four categories:

**Individual Goods.** These goods are individually consumed goods for which exclusion is completely feasible. Most of the ordinary goods and services that are bought by consumers in the marketplace, such as, food, clothing, and furniture, can be considered individual goods. These goods are commonly known as private goods because they can easily be supplied in efficient quantities by the private market, which functions on the cues of supply and demand.

**Toll Goods.** Toll goods are jointly consumed goods for which exclusion is completely feasible. Like individual goods, toll goods can be supplied by the marketplace because exclusion is readily possible. Some toll goods present problems that require collective action. These toll goods are natural monopolies, where the cost per user decreases as the number of users increases. The result is that it is most economical to have a single supplier, as in water supply and wastewater treatment service.

Nevertheless, collective action with respect to individual goods and toll goods is primarily limited to overcoming market failures, establishing ground rules for market

transactions, ensuring the interests of consumers, and regulating the means of supplying those toll goods that are natural monopolies.

**Common-pool Goods.** Goods and services that are subject to individual consumption but for which exclusion is completely infeasible are known as common-pool goods. Unlike individual and toll goods, common-pool goods pose a supply problem. Since it is not possible to identify consumers and charge a fee, the market place is not willing to supply it. Hence, some government regulation is usually necessary to ensure that these goods are used efficiently and equitably. Examples of common-pool goods include natural resources like air, wilderness areas, rivers, and oceans.

**Collective Goods.** These goods are characterized by joint consumption and infeasible exclusion. When one individual benefits from a collective good, its availability to others is not diminished, and it is practically impossible to charge individuals for its use or to exclude non-payers. Therefore, people have an incentive to be "free-riders", that is, to use such goods without paying for them. The private sector, therefore, tends to produce less than socially optimal levels of these goods. These goods are more commonly called public goods; however, calling them public goods almost prejudices the question of whether they ought to be provided by the public sector; hence the term collective goods is used in this paper.

The purer private goods and services require the least government intervention, although the establishment of standards and regulations to ensure safety, and transparency in competition are required. The nearer the good is in nature to collective goods on the continuum, the more government involvement is justified. Nevertheless, even for these common pool and collective goods and services, public ownership of direct production is not required; rather some form of government intervention to organize or regulate private activities may be adequate.

## **THE NATURE OR CONDITIONS OF PRODUCTION**

**Natural Monopoly.** The most general economic characteristic of modern infrastructure is the supply of services through a networked delivery system designed to serve a multitude of users, particularly for public utilities such as piped water, sewerage and rail services. The delivery system is in most cases dedicated to only one type of good or service. Investments in the delivery systems, such as underground water pipes, are mostly irrecoverable because they cannot be converted to other uses or moved elsewhere. Once paid, these costs are said to be sunk or irrecoverable<sup>2</sup>.

The efficiency of a private market depends on the existence of effective competition, which is precluded for goods, which entail natural monopoly in production, i.e., the fixed costs of their production are much higher than the variable costs, and production is subject to important economies of scale. The main deterrent to competition is the element of the fixed production costs or sunk costs. Capital costs are sunk to the extent that they cannot be recovered for other uses, which is generally the case for specialized equipment and fixed location specific installations, such as roads and sewer pipes. Where production

of a good requires no sunk costs, it is said to be perfectly contestable. These high costs and risks may discourage private production, and even if a private producer does emerge, it is not likely to face direct competition and is therefore able to charge high prices. Moreover, lack of competition may blunt incentives for efficiency and quality control. Hence, where there is market power due to natural monopoly, the conditions for a purely free private market to achieve efficiency do not hold. Public involvement is required to allocate monopoly rights to a private party that makes the investment, to regulate prices in the public interest, to establish and monitor performance standards, and to finance investments if the private sector cannot raise the necessary capital.

The scope for competitive supply of infrastructure varies greatly across sectors, within sectors and between technologies. Where the unit costs of serving an additional user decline over a wide range of output, economies of scale are created—an important source of natural monopoly. But sectors differ greatly in the range of declining costs. Even within sectors, different production stages have different characteristics. Activities also differ in the importance of sunk costs. In railways and ports, for example, sunk costs are less significant for investments in rolling stock or freight-handling equipment than for the fixed facilities. It is easier for firms to enter and exit activities with a relative absence of sunk costs. Such activities are said to be contestable. Technological and economic differences in production create the possibility of unbundling the components of a sector that involve natural monopoly from those that can be provided more competitively.

**Coordination.** Due to "the interlocking networks involved in much of infrastructure and the fact that flows along these networks, whether of water or vehicle traffic, need to follow some explicit rules, formal coordination is required to some degree, at least in the planning of investment, technical operation, and setting of minimum standards of equipment and operation."<sup>3</sup> Because the delivery system is networked, coordination of service flows along the system is critical to its efficiency. This interconnectedness also means that the benefits from investment at one point in the network can depend significantly on service flows and capacities at other points.

## **EXTERNALITIES AND SOCIAL OBJECTIVES**

Externalities occur where the benefits or costs of producing or consuming a good affect persons other than the individuals involved in these transactions. When externalities are positive, the benefits to society are greater than those perceived by the individuals, and the resources allocated to such goods will be less than socially optimal. When externalities are negative, the marginal costs faced by individuals understate the true cost to society, and such goods will be overproduced. Because markets often fail to internalize these externalities, their management usually falls to government.

Infrastructure often has widespread indirect impacts, which can be beneficial or harmful. Irrigation infrastructure can reduce pressure on land resources by permitting greater intensity of cultivation on existing plots, but it can also promote excessive water usage, resulting in groundwater salinization and land subsidence. In infrastructure, negative externalities include pollution from motor vehicle traffic, power generation and irrigation, while positive externalities include the public health benefits gained from water and

sanitation infrastructure. Collective goods can be viewed as a special kind of externality because their consumption has positive impacts on the society.

### **TABLE 1-1**

See the : **TABLE 1-1 CHARACTERISTICS OF WATER SUPPLY, WASTEWATER TREATMENT AND IRRIGATION**

These three criteria discussed above are normally considered covering the conditions for market failure. These characteristics of each of the infrastructure activities being discussed in this paper are summarized in Table 1-1. "The conclusion can be drawn that, contrary to the common assumption that most of infrastructure concerns largely public goods, in fact, the major share of services of these sectors can be characterized as closer to private goods."<sup>4</sup>

Once the basic marketability of each activity has been identified on the basis of above mentioned criteria, it becomes possible to assign the responsibility for specific functions to the public and private sectors: owning the assets, providing capital financing, providing working capital, making additional capital investments, operating and maintaining the facility, day to day management, and bearing commercial risk. The strength of the private sector is that it is usually able to deliver marketable services and products more efficiently than the public sector because it operates in a competitive environment. The public sector's area of competitive advantage lies in carrying out those activities that the private sector cannot perform and in stimulating private interest in economically desirable activities that otherwise would not be taken. In general, this includes correcting for externalities, protecting common pool resources, and organizing or regulating natural monopolies.

For any service involved in infrastructure, if all the conditions for a competitive market are met, then it is unquestionably preferable from an efficiency standpoint to leave its provision to the private market. Government intervention is justified in, and should be limited to, cases where the potential costs of market failure are greater than those of government failure. Kessides in her book, **Institutional Options for the Provision of Infrastructure** suggests the following least interventionist policy in order to minimize the risks of government failure.

- For activities involving collective goods, natural monopoly, or capital with high sunk costs, typically, the provision of network, trunk-type facilities, there is a case for public planning and policymaking as well as public financing and ownership. An alternative would be private financing and ownership under public regulation. For other activities that do not involve high sunk capital costs (e.g., road freight transport), there is generally no justification for policies that impede entry by the private sector. The government should mainly be responsible for ensuring fair competition in such activities.
- Since the activities involved in operating such facilities are normally contestable in nature, there is no reason why the public sector should operate such facilities. Operation and maintenance could be allocated on the basis of competitive bidding

- for the right to the monopoly. The government's responsibilities in this case are to issue the contracts, to ensure fair conditions of access to other providers, and to protect users from other possible abuses of the monopoly.
- Externalities such as environmental impacts of infrastructure can be addressed by regulations (e.g. on zoning, technical standards) or fiscal transfers (taxes, fees, or subsidies to influence private investment or operation). Social objectives such as universal service obligations can be met by regulation, investment planning and/or public financing of non-remunerative services.
  - Significant requirements of coordination among facilities and services may justify regulation of investment or operating standards.

## **ALTERNATIVE INSTITUTIONAL ARRANGEMENTS**

The analysis above helps to narrow the range of public policy options to be considered for particular activities, but does not lead to one unique institutional solution for a given type of infrastructure in all contexts. There are various options of institutional arrangements, which range from the extremes of completely public to various forms of public/private partnerships to the other extreme of completely private sector. The private member of the public-private partnership can be a simple user association as is the case in irrigation, or a complex consortium of firms and advisers, including design engineers, construction companies, bankers, investment bankers, lawyers, operations specialists, equipment manufacturers, technology suppliers, real estate developers, financial consultants, marketers, and public relations specialists in case of leases or concessions.<sup>5</sup>

**Government Department:** The traditional method of providing infrastructure-based services is directly through government departments. The government, which owns the facility, is responsible for designing, financing, building, and operating it. A common example is a municipal water department or irrigation departments.

**Public Authority:** In both developed and developing countries public authorities are common for power, water, and transportation. These are being reformed by commercialization (managerial and financial autonomy and separate budgets based on user charges) and corporatization (legal company status with separation of ownership and management).

**Cooperative or Community Provision:** A nonprofit, voluntary, cooperative association assumes responsibility for the service. Community and user provision is most common for local, small scale infrastructure, such as access roads, water supply, and distribution canals for irrigation, serving a well-defined user group or residential area, and it often complements publicly provided services. In many developing countries, irrigation management transfer is taking place, whereby water user associations (WUAs) take over and operate local irrigation works.

"Successful community provision requires user involvement in decision-making, especially to set priorities for expenditure so as to ensure an equitable and agreed sharing of the benefits and costs. Technical assistance, training, and compensation of service

operators are also very important."6 When these elements are present, community self-help programs can produce good results at low cost, as in the case of Orangi Project in Karachi, Pakistan, which mobilized a low income neighborhood to construct, finance, and maintain waterborne sewers7.

**Service Contract:** Specific services associated with infrastructure may be contracted out to private firms, such as, ticketing, cleaning, and food catering for railroads; meter reading, billing, and collection for water. The public agency retains overall responsibility for operation and maintenance of the system except for the particular contracted services and it bears all commercial risk. It must finance fixed assets and provide working capital. Compensation to the contractor may be on the basis of time, lump sum, fixed fee or cost plus, or on the basis of a physical parameter such as number of water bills sent out. Service contracts are generally for periods of less than five years.

Contracting out services is becoming popular with public infrastructure providers because it provides a flexible and cost-effective tool for increasing responsiveness to users at the same time gaining access to the expertise of the private provider. It also permits competition among multiple providers, each with short and specific contracts. Railways in Pakistan have contracted out such activities as ticketing, cleaning, and auditing. In Chile, meter reading and fee collections in the water supply and wastewater treatment are handled through service contracts since the 1970s.

**Management Contract:** A private firm manages the operations of a state owned enterprise with the freedom to make day-to-day management decisions, without committing its own investment capital or accepting full commercial risks for tariff collection or other matters. Compensation is usually proportional to physical parameters. A profit-sharing arrangement, under which the private firm would bear a part of the commercial risk, is possible but unusual. The duration of management contracts is generally about five years.

Management contracting works better when a contractor is granted significant autonomy in decision-making and compensation is based, at least in part, on performance. In France, where management contracts are common in water supply and wastewater treatment, the incentives for productivity improvements links the contractors' payments to such indicators as reduced leakage and increased connections.

**Leases:** Under a lease, a private firm operates and maintains the state-owned enterprise at its own commercial risk, with income derived directly from tariffs. Except for agreed-upon maintenance obligations, however, the lessee has no obligation to invest in the future. Leasing thus requires the government to commit to tariffs that cover at least operating and maintenance costs, and gives the operator strong incentives to ensure that tariffs are collected and operating costs are minimized. The duration of this type of arrangement is usually from six to ten years, with the possibility of renewal up to twenty years. In France, leasing has been used for decades in urban water supply and wastewater treatment, and the same model was adopted in Guinea.

**Concessions:** This arrangement goes a step further than the lease contract in that the concessionaire must also finance investment costs. The private operator manages the infrastructure facility, operates it at its own commercial risk and accepts investment obligations, whether to build a new facility to expand or rehabilitate an existing facility. Compensation is through tariff revenues. The concession is a common model for water, ports, airports and toll roads, where governments desire private investment but do not wish to relinquish rights to ownership of sector assets in the long term. Such contracts are usually for a longer period than service, management, or lease contracts to allow the firm to recoup capital costs. For example, Buenos Aires Water Concession. There are many different types of concessions:

- **Lease-Build-Operate (LBO):** A private firm is given a long-term lease to develop (with its own funds) and operate an expanded facility. It recovers its investment plus a reasonable return over the term of the lease and pays a rental fee.
- **Build-Transfer-Operate (BTO):** A private developer finances and builds a facility and, upon completion, transfers legal ownership to the sponsoring government agency. The agency then leases the facility back to the developer under a long-term lease, during which the developer operates the facility and has the opportunity to recover his investment and earn a reasonable return from user charges and commercial activities.
- **Build (Own)-Operate-Transfer (BOT or BOOT):** A private developer is awarded a franchise to finance, build, own, and operate a facility and to collect user fees for a specified period after which ownership of the facility is transferred to the public sector. This is perhaps the most common form of public-private partnership for building new infrastructure. In contrast to a sale or a permanent concession, government retains strategic control over the project, which is often a political plus.
- **Wrap-Around Addition:** A private developer finances and constructs an addition to an existing public facility, and then operates the combined facility either for a fixed period or until he recovers costs plus a reasonable return on his invested capital. He may own the addition. The objective of this arrangement is to expand the facility despite the government's lack of resources or expertise to do so entirely on its own.

**Divestiture:** Divestiture or the sale of the government's shares in a state-owned enterprise constitutes the strongest form of commitment to private sector provision of infrastructure. In addition to other benefits of private participation, divestiture may be used as a source of government revenues to pay down debt or other government obligations and may also be used to distribute share ownership broadly across the population. This approach is increasingly popular with telecommunications, energy utilities, and airlines around the world, and has also been applied to water and railway companies and ports.

- **Buy-Build-Operate:** An existing facility is sold to a private partner who renovates or expands it and operates it in perpetuity under a franchise. The first

sale in recent history of a wastewater treatment plant in the United States was carried out in Franklin, Ohio, using this arrangement.

- **Build-Own-Operate:** A private developer finances, builds, owns and operates a facility in perpetuity under a franchise, subject to regulatory constraints on pricing and operations. The long-term property rights provide a significant financial incentive in the facility. Examples of this model are private toll roads in California, and the "Chunnel" under the English Channel.

Arrangements in which the contractor assumes the commercial risk offer the advantage that the contractor is motivated to improve the efficiency of the system. Therefore, lease contracts and concessions are more likely to lead to the "least cost output" (for example, per cubic meter of water) than are service or management contracts in which the contractor's compensation is not linked to revenues. However, management and service contracts are seen as an attractive option when government commitment to fuller privatization is weak, or where it is expected that a management contractor can help to improve information about the enterprise and its market before more ambitious private options are considered.

#### **TABLE 1-2**

See the : **TABLE 1-2 DIVISION OF FUNCTIONAL RESPONSIBILITIES FOR VARIOUS INSTITUTIONAL ARRANGEMENTS**

Concessions may be preferable to lease contracts because there are some obvious advantages to assigning responsibility for investments to a commercial entity that is also responsible for operations. The operator is well placed to forecast demand and make investment decisions that will satisfy consumer demand in a commercially viable fashion. Inappropriate investments often result when decisions are made in isolation from commercial considerations. In addition, the owner of physical assets has a stronger incentive to maintain them than does a lessee. However, concession arrangements are not always feasible. If the cost of an investment exceeds the borrowing capacity of the private sector, or if the political and economic situation makes the private sector reluctant to invest, the public sector might have to assume responsibility for planning and investment. In such cases, a lease contract is the appropriate commercial arrangement, but mechanisms should be incorporated into the lease contract to ensure that adequate investment will be carried out. Once most of the costly investments have been completed, or the political and economic situation has improved, it may be possible to convert a lease contract into a concession under which the private company makes limited future investments and pays a rental fee on completed investments. Lease contracts allow for the involvement of professional private companies in the technical and commercial operations of public services. These have a built-in incentive to improve efficiency, but without the burden of capital expenditures.

These arrangements entail different functional distribution between the public and the private sector. Table 1-2 summarizes this functional decomposition.

## **COMPETITION AND REGULATION: KEYS TO SUCCESSFUL PRIVATIZATION**

Successful public-private partnerships have two important elements-fair and transparent competition, and effective regulation.

### **COMPETITION**

Technological change and, even more important, regulatory innovation are making competition possible in many forms. Regulatory innovation has made possible the unbundling of activities -- the separating of activities in which economies of scale are not important from those in which they are.<sup>8</sup> By isolating the natural monopoly segments of an industry, unbundling promotes new entry and competition in sectors that are potentially competitive. Failure to unbundle can constrain an entire sector to monopoly provision even when numerous activities can be undertaken competitively.

A sector may be sliced vertically, delinking those who provide intermediate inputs from those who serve the customer. An example of vertical unbundling is to separate track management from railway operations. The second type of unbundling separates activities by markets--either geographically or by service categories. In Japan, the national railway was reorganized and split into six regional passenger operators and one freight operator that rents track time from the regional railways. Horizontal unbundling creates the possibility of competition by comparison. In such competition, also referred to as "benchmark" or "yardstick" competition, the regulator uses information on all providers to determine price and performance levels<sup>9</sup>.

Unbundling does involve trade-offs. Where economies of scale exist, it may be cheaper for a single provider to produce and deliver two or more services jointly than for separate entities to provide the services individually. A bundled sector, where all services are organized under one umbrella, allows exploitation of economies of scale and eases coordination among intermediate input suppliers and final service providers. However, even in such cases, gains from economies of scale need to be weighed against benefits of cost minimizing due to competitive pressures.

Sir Edwin Chadwick, a Victorian social reformer, proposed a franchise solution to problems of natural monopoly. Chadwick distinguished between competition "Within the field" and competition "for the field." In case of competition within the field, multiple providers compete directly with each other, while government regulator control ensures fair competition. Where competition is not possible within an industry, competition for the right to be natural monopolist might be an adequate substitute. Governments can create competitive conditions through leases or concessions, and firms compete not for individual customers in the market but for the right to supply the entire market. The essential idea is that monopoly franchises could be auctioned off to the bidder offering the most attractive terms<sup>10</sup>.

### **TABLE 1-3**

See the : **TABLE 1-3 SECTORAL STRATEGIES FOR COMPETITION AND REGULATION**

## **REGULATION**

One of the arguments for introducing private involvement in the delivery of services is that it can relieve weak public institutions of the burden of day-to-day operations so that they can concentrate on the tasks of sector policy making, planning, and regulation. At the same time, these arrangements create the need for an oversight agency. It is therefore useful to scrutinize arrangements for private participation to determine what capacity requirements are implied for public oversight agencies and whether some are institutionally less burdensome than others.

Privatized infrastructure require effective government regulation, which should be based on a stable and trusted systems of enforceable laws concerning property rights, contracts, disputes, and liability. Regulations should be designed and administered to protect both the public users of the service and the private partner. Key elements of a regulatory framework include rates, performance, reliability, degree of competition, and access to interconnection with other systems in the case of such services as water supply, and airline operation. The process of regulation should be as straightforward and predictable as possible, with automatic price adjustments based on predetermined formulas and minimal reporting requirements; price regulation should allow producers to benefit from efficiency improvements.<sup>11</sup>

## **CONCLUSION**

Although the private sector is generally assumed to be more efficient than the public sector, involvement of the private sector does not automatically lead to economic efficiency from the point of view of the society as a whole. The best approach to this issue is first to seek a balance between public and private roles by identifying the minimum responsibilities the government should assume (to ensure that these public goods are supplied and broadly consumed at near optimal levels) and the sector functions that could be carried out effectively by the private sector. Second, it is essential to explore ways in which the characteristics and mechanisms of free markets that are associated with efficiency can be introduced into sector operations, for example, determining how competition can be introduced into sector operations. "Which institutional and legal arrangements can be used to ensure that privatization actually improves efficiency- When privatization is not feasible or when a market is not contestable, what market surrogate mechanisms can be used to create incentives for efficiency, rational investment planning, and adequate maintenance-" <sup>12</sup>

The implications of institutional arrangements for private and public sector capacity should be examined. In specific countries, the comparative strengths of the private and public sectors and their incentives to perform effectively, as well as the official attitude toward the private sector, must be considered. Since the strength of the public sector and its ability to adapt to changing circumstances vary considerably from one developing

country to another, the choice of arrangements will depend greatly on local conditions. The division of labor and specialization between the private and public sectors will vary from country to country depending not only on economic situation and level of development, but also on cultural and socioeconomic factors. In most instances, the choice is not an either-or proposition, but a question of balancing the roles of the various actors.

"Other questions to be researched concern regulatory and incentive frameworks. To what extent do local labor laws, tax regimes, import restrictions, and banking and foreign exchange restrictions inhibit private sector participation-""[13](#) It is worth emphasizing that regulating and monitoring a natural monopoly are complex and difficult responsibilities. The oversight agency must establish financial and technical standards, design a selection process, choose the operator, monitor, and evaluate the operator's performance, and periodically renegotiate contracts and revise standards. Good regulation requires not only technical skills, but also high ethical standards, consistent political support, and a minimum of political interference.

"Finally policies and mechanisms for cost recovery and, in particular, for implementing distribution objectives in the context of commercial operations should be investigated. Which payment terms and mechanisms best promote efficiency- For example, payments that are based on performance (cubic meters of water provided) are more effective than non-variable fees." [14](#)

In the following two chapters, I will apply this framework to understand the characteristics of water supply and wastewater treatment and irrigation sectors and discuss the various institutional arrangements that can be used for efficient and effective provision of these services.

## NOTES

[1](#) The basic framework for this chapter has been adapted from Kessides, Christine. 1993. **Institutional Options for the Provision of Infrastructure**. World Bank Discussion Paper No. 212. World Bank, Washington D.C.

[2](#) World Bank. 1994. **World Development Report 1994: Infrastructure for Development**. New York: Oxford University Press. 22.

[3](#) Kessides. 7.

[4](#) Kessides. 5.

[5](#) Savas, E. S. 2000. **Privatization and Public-Private Partnerships**. Chatham House Publishers, New York. 248.

[6](#) World Development Report 1994. 9

7 Kerf, Michael.

8 World Development Report 1994. 52.

9 Mody, Ashoka, ed. 1996. **Infrastructure Delivery: Private Initiative and the Public Good**. World Bank, Washington D.C.

10 Dnes, Anthony W. June 1996. Franchising and Privatization. **Public Policy for the Private Sector**. World Bank, Washington D.C. 17

11 Klein, Michael. 1996. Economic Regulation of Water Companies. **World Bank Policy Research Working Paper No. 1649**. World Bank, Washington D.C.

12 Carnemark, Curt. Foreword in Triche, Thelma A. 1990. Private Participation in the Delivery of Guinea's Water Supply Services. **Policy, Research, and External Affairs Working Paper No. 477**. World Bank, Infrastructure and Urban Development Department, Washington D.C.

13 Carnemark.

14 Carnemark.

## CHAPTER 2 **WATER AND WASTE WATER TREATMENT**

In developing countries private sector participation in water and wastewater treatment is a relatively recent phenomenon. A decade ago, almost all developing countries relied on government provision of water supply and sewerage services, and private participation in the sector was rare. Although the potential for gains from private sector involvement, through greater efficiency and improved access to finance for new investments, was as great in water and sewerage as in other infrastructure sectors, governments' willingness to secure private participation was relatively limited. In many countries water continued to be treated as a social rather than an economic commodity. There was considerable political resistance to raising tariffs to cost-recovery levels, reducing the potential for long-term investment in water and wastewater treatment assets<sup>1</sup>.

Government provision of water supply and wastewater treatment has traditionally been justified on the ground that these sectors are natural monopolies. However, experience suggests that government ownership does not make it easier to limit monopoly power. All monopoly suppliers, private or public, are tempted to charge excessive prices or ask for excessive subsidies or compromise with the quality of the service. Besides, there are many other problems that are frequently associated with the public sector provision of water supply and waste water treatment, such as, unaccounted-for water, inadequate maintenance, low sales, low productivity of staff, low collection ratio, and often an unsustainable financial position.

Approaches to deal with these problems include the introduction of private sector ownership, management, and operation. However, there are several impediments to private sector involvement in water supply and wastewater treatment, especially in most developing countries. First, water has historically been extremely under-priced in most developing countries. Though subsidized water tariffs generally do little to help the very poor (who often lack formal water connections), governments continue with them in the belief that it helps the poor, and proposed tariff increases tend to be opposed from the middle class and wealthy. Second, water systems are often poorly run, sustaining losses through physical leaks and poor collection systems. And with many of the assets underground, the actual system of systems is often unknown. Third, regulatory frameworks are often lacking, incomplete or internally inconsistent. Fourth, water and wastewater sector assets are amortized over long periods and have limited or no resale value. Finally, due to the high social value of water, the sector is prone to political intervention.

This is not a setting propitious to the substantial, long-term, sunk investments needed to build or rehabilitate infrastructure or a setting in which the private sector will happily take on commercial risk. Nevertheless, given an appropriate framework, private sector may be willing to deliver these services, because "water supply and waste water treatment have a key characteristic that makes it a potentially viable commercial enterprise for the private sector--it is feasible to charge users of the service and exclude non-payers.<sup>2</sup>"

Yet, involvement of private sector does not automatically lead to economic efficiency from the point of view of society as a whole. Therefore, it is essential first to examine the arguments for introducing market mechanisms and private sector involvement in water supply and wastewater treatment and to understand its practical implications for sector policies and institutional arrangements keeping in mind the special characteristics of the sector. Furthermore, to evaluate the effectiveness of various institutional arrangements in different countries, it is important to observe the unique social, political and economic circumstances of a given country.

This chapter first discusses the special characteristics of the water supply and wastewater treatment sectors followed by a discussion of the conditions necessary for successful private sector involvement. Various institutional options, which involve different degrees of involvement by the public and private sectors, are discussed with reference to specific examples in developing and developed countries. The intention is to understand the various issues involved in private sector production of these services and understand the design principles of the different arrangements.

## **CHARACTERISTICS OF WATER SUPPLY AND WASTE WATER TREATMENT**

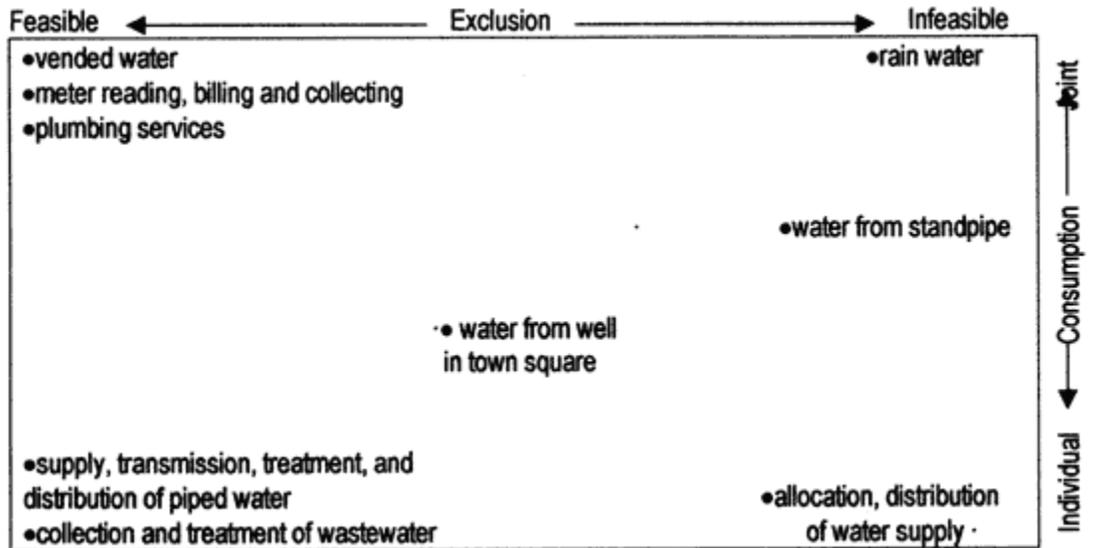
"The activities of urban water and sanitation utilities range from impounding and treating raw water, to distributing water and collecting wastewater, to treating wastewater. In many ways, decisions about how to involve the private sector in these operations

resemble decisions about privatization in any other utility sector. But water and waste water treatment have special features that governments must take into account in choosing and designing a contract and in designing a supporting policy framework"<sup>3</sup>:

- Water in an underground aquifer is a common-pool good because it can be tapped by anyone who owns the land, but once it is brought into a water distribution system, it becomes a toll good. While water consumption is rival between users, monitoring the use of groundwater from underground aquifers or from other natural resources is difficult and costly, and therefore groundwater use is rarely excludable. Wastewater treatment service is a toll good although not a pure toll good because it is subject to excessive demand and congestion, which results in inferior product.<sup>4</sup>
- Water and wastewater treatment systems are characterized by a high degree of natural monopoly. The infrastructure required has very high investment costs and is subject to important economies of scale. Investments in the delivery system, such as underground pipes, are mostly irrecoverable or sunk because they cannot be converted to other uses or moved elsewhere. Moreover, because the delivery system is networked, coordination of service flows along the system is critical to its efficiency.

Due to these properties, competition in water supply and waste water treatment is feasible only in limited areas such as building capacity and providing plumbing services, and it is often impractical to have competing systems for distribution and collection, which are core activities in water and wastewater treatment. Therefore, governments that wish to involve the private sector are not able to rely on competition to assure good outcomes for consumers and instead have to devise regulatory systems for this purpose.

## **FIG. 2-1. CHARACTERISTICS OF PRINCIPAL GOODS AND SERVICES OF THE WATER SECTOR** <sup>5</sup>



Many infrastructure services can be produced by very different technologies. Sanitation based on improved latrines or septic tanks provides the same underlying service, as does sewerage-disposal of wastes, but without networked investments. Table 2-1 classifies the various activities involved in water and wastewater treatment as competitive or monopolistic in nature.

**TABLE 2-1**

<b>TABLE 2-1 COMPETITION AND MONOPOLY IN WATER AND WASTE WATER TREATMENT</b>	
Activity	Characteristics of Competition
Allocation of water resources and regulation of use	Natural monopoly in each hydro-geographical unit (such as a river basin)
Capacity construction	Competitive (but may depend on access to water resources)
Bulk supply generation	Small number of possible suppliers (often only one)
Water treatment*	Local monopoly
Local distribution*	Local monopoly
Local Wastewater network*	Local monopoly
Wastewater treatment*	Local monopoly
Equipment and appliance sales, plumbing services	Competitive
* Core activities of traditional water and wastewater utilities	

Source: Cowen, Penelope J. Brook. September 1997. The Private Sector in Water and Sanitation - How to Get Started. Public Policy for the Private Sector, Quarterly No. 11. World Bank, Washington D,C. 20

- Water is essential to life and is appropriately considered a worthy good for society. Therefore, access to it must be ensured for all. Guaranteeing access for the poor usually requires designing subsidies or schemes for reducing the cost of delivering services to the very poor. Water supply and wastewater treatment also involve significant externalities in the form of health and productivity benefits for the society as a whole. Since some individuals may not be aware of the benefits or may not be willing or able to pay, an optimal level of water supply services might not be produced or consumed without some public intervention to subsidize or provide for cross-subsidization through differential block rates. Due to these properties, government interventions to promote these benefits are likely to remain after privatization.
- Many of the assets of water and sanitation are buried, so obtaining accurate information about them is costly, which increases the cost of preparing for private sector participation and the chance of unanticipated events after the contract is signed.

None of these issues, however, is a barrier to private sector participation-all arise under both public and private provision. Although some government intervention is desirable to allocate monopoly rights, regulate prices, monitor performance and sometimes to make costly investments, it does not follow that public operation is essential.

## **WATER AND WASTEWATER TREATMENT SYSTEM COMPONENTS** **6**

There are various ways to organize a water supply and sewerage system. A single company may be responsible for investment, finance and operations of a whole water and sewerage system as in many cities of the world. Alternatively, different part of the system (Figure 22) may be the responsibility of different companies. For example water and wastewater treatment plants as well as pipelines and storage facilities may all be run by separate companies. "Such is the case in China in several cities, such as Tanzhou, Guangzhou and Nanchang, where the water treatment plants are built and operated by joint ventures between the municipality and private water companies".<sup>7</sup>

The cost structure of water systems and concerns about quality are two key reasons that inhibit competition in water supply and wastewater treatment. First, in most systems, the cost of water pipelines, which are generally not subject to competition due to natural monopoly characteristics, is a large part of total system costs. Therefore, competition can be beneficial only in areas where water is scarce and therefore expensive and where a sufficient number of water sources compete with each other. "The number of relevant water sources is also a function of economies of scale in treatment plants. Where the

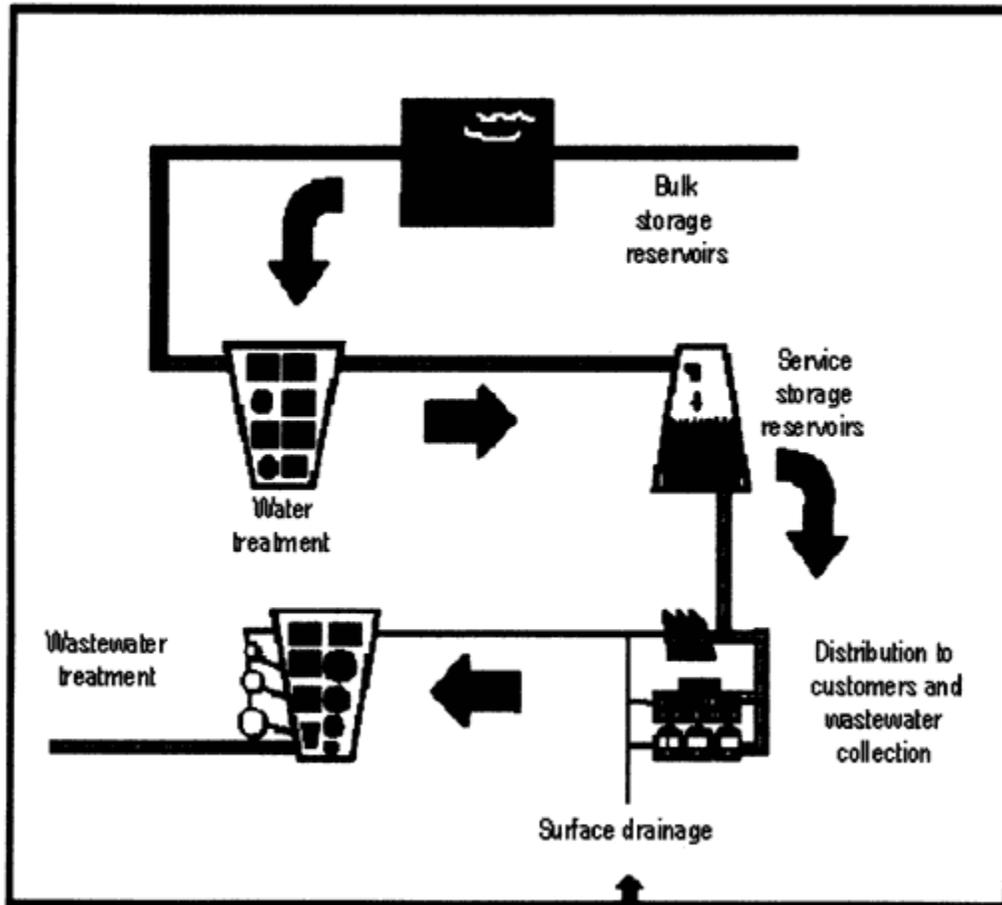
minimum optimal size of a treatment plant is such that no more than three or four plants could compete, effective competition may not be achievable".<sup>8</sup>

Second, due to extreme importance of quality in water and sewerage systems to protect the public health, it may be preferable to limit competition among water suppliers and accept higher costs in return for higher quality. If competition is encouraged, competing water suppliers may be tempted to sacrifice quality to survive in a competitive environment. Therefore, there is a need for rigorous water testing by a regulatory authority and the imposition of effective penalties in order to maintain quality.

Competitive options in water systems are currently limited to competition at the boundaries of service areas and to some forms of bypass. For example, in areas where the territories of two water companies meet, it may be sensible to allow consumers to contract with either one of the water companies. In other cases it may be efficient, particularly for large customers to build their own water supply system, which may better match quality requirements. Such types of limited competition or bypass of existing systems are possible when governments award service areas to water companies without the exclusive rights to service customers in the particular area. Some duplication of water pipes may also be justified by better price-quality combinations for the customer. Duplication may in particular be cheaper when customers would otherwise be forced to resort to expensive street vendors or private supply options such as boreholes. In a few cases governments have judged it to be economical to lay parallel water systems for water of different quality. Such is the case of Hong Kong, where seawater pipes supply flushing water, while treated drinking water is supplied by another network.<sup>9</sup>

## **FIG. 2-2 MAIN COMPONENTS OF WATER AND WASTEWATER TREATMENT** <sup>10</sup>

FIG. 2-2 MAIN COMPONENTS OF WATER AND WASTEWATER TREATMENT<sup>10</sup>



Source: Klein, Michael. September 1996. *Economic Regulation of Water Companies*. Policy Research Working Paper No. 1649. World Bank, Washington D.C.

Wastewater Treatment systems "are in a sense complementary monopolies to water supply systems. and pose similar problems for the introduction of competition. In addition, it is more difficult to enforce payment discipline in sewerage systems, because disconnection is not generally an option. For these reasons payment for sewerage may often be collected together with the water tariff In the following, the problems of sewerage regulation are generally assumed to be structurally similar to those of water system regulation."<sup>11</sup>

Some level of competition may be obtained by letting water and sewerage companies bid for the right to service a particular area. Different operators could also be allowed to bid for the right to perform some specific functions contracted out by the water and sewerage companies (e.g. reading meters, collecting bills, maintaining or repairing the network etc.). In some cases, water and sewerage companies could themselves have to compete against such operators to undertake some specific activities. This is, for example, the case in Morocco, where public water and sewerage companies compete with private entrepreneurs for the right to equip housing sites. Once the water and sewerage system is

in place, however, only the public water and sewerage companies have the right to operate it.

By allowing different parts of a water system to be run by different companies, more and better information about costs and performance of the various parts of the system are likely to be generated and it may be easier to compare company performance across jurisdictions. This would render it easier to detect poorly performing, high-cost companies and to set prices correctly. Moreover, by allowing companies to run only small part of an overall system, non performing companies may be easier to change than when they control an of a water system.

On the other hand there may be real benefits from integrating different parts of a water system. Integration may save managerial and administrative overhead costs and render labor redeployment easier. System operations itself may also be slightly easier and less measurement and contracting at interfaces between the parts of the system will be necessary. In developing a water and sewerage system these costs have to be weighed against the benefits mentioned before. Some countries have tended to choose integrated systems, for example England and Wales, whereas others have a tradition of more unbundled systems, such as France.

In all cases, it is advantageous to allow several companies to run different water systems in a country. In case of non-performance the authorities would then have the option of replacing non-performing companies with others that are already familiar with the country environment. Over time it may also be possible to generate yardstick information across countries.

## **CONDITIONS FOR SUCCESSFUL PARTICIPATION OF THE PRIVATE SECTOR COMPETITION**

Where water vendors provide services, consumers have choice. They can bargain over price and check quality. The advent of piped water drastically changes the situation. In piped systems, water can be supplied much more cheaply than by street vendors. Prices of piped water are often only 10 to 20 per cent of those charged by vendors, or even less. Even if one corrects for subsidization of piped water systems, the cost of piped water remains significantly cheaper by at least 50 per cent and is more likely to be a fourth or less of the cost of vendors.

But at the same time choice is reduced, because it is normally inefficient to lay competing pipeline systems, which would provide consumers with choice. Initially, in the 19th century, competing water pipeline systems were laid in various towns in a number of countries, for example Canada and the United Kingdom. But whether as a result of free competition or municipal regulation soon there were only single water monopolies left for each area supplied with piped water.

Though day-to-day competition in the marketplace is not practical, it is possible to introduce incentives for efficiency through competitive bidding for concessions or

contracts to operate services. In theory, as long as competition is fair, it does not matter whether the competing firms are publicly owned or private. But in developing countries where public administrations are not particularly strong, it may be advisable for the public sector to concentrate on those aspects of water supply that are not appropriate for the private sector, and to contract with private firms for the day- to-day commercial operation of systems and, if possible, for the planning, financing, and implementation of investments. In situations where no viable competitors to an incumbent operator exist, the government may take steps to foster the development of competitors.[12](#)

Whatever the system of ownership, in a monopoly sector like piped water supply, prices are not set by bargaining between consumers and competing vendors. Without some controls that preserve the interest of consumers, the latter would be at the mercy of the monopoly and would have to pay excessively high prices, may be even as high as those of competing street vendors and all the advantages of the low cost of piped water would accrue to those controlling the piped water system.

## **REGULATION**

Piped water systems tend to be natural monopolies. Consumers, therefore, need some type of institution to oversee the water supply agency so as to limit abuse of monopoly power. In smaller water systems, consumers may form cooperatives to run the supply system themselves and attempt in this way to balance the legitimate interests of water consumers and suppliers. As systems grow larger, individual consumers have more limited ways to exercise direct influence. They have to rely on other forms of representation, for example through municipal offices or independent regulatory agencies.

Regulators rule on issues of price and quality of services and sometimes also on investment performance. Pricing rules try to balance incentives to use water efficiently with social concerns, such as quality of the water supply, universal service goals, and subsidy schemes for the poor. The key to effective regulation is to generate information that allows the regulator to make good rules and allows the interest groups to watch out for improprieties by the regulator. The best way to generate information is to introduce multiple players in the water system in ways that enhance direct or indirect competition. In particular, it seems advisable to minimize exclusivity rights and to let companies compete for concessions of limited duration. Incentives to compete and to behave efficiently will be strongest when the owners have their own money at risk. For this reason, government-owned water companies could on average be expected to perform worse than investor-owned companies. Competent government-owned companies should be given a chance to compete on an equal footing with private companies rather than be sheltered from competition and given benefits from taxpayer subsidies.[13](#)

Ideally, the regulator would limit oversight to issues of price and quality, while delegating investment and operating decisions to the water company, because the water company will generally know these matters much better than the regulator. The regulator would review prices and performance that may be agreed in contracts or set prices and

performance requirements as part of regulatory rule making. No matter how detailed original contracts and rules may be, unexpected changes in operating or financial conditions will make it necessary for the regulator to adjust prices and performance standards from time to time or to rule on the desirability of negotiated adjustments.

## **THE MAIN PRIVATE SECTOR OPTIONS**

Different countries have adopted different options for private sector participation in water supply and wastewater treatment. While Chile uses service contracts for various activities, Trinidad and Tobago is using a management contract and plans to replace it with a concession. Guinea has a lease arrangement and Buenos Aires has a concession for water and wastewater treatment. England and Wales have divested their water and sanitation utilities and Bolivia utilizes a relatively rare co-operative model for its water supply. These various arrangements are briefly discussed later in this section.

Many countries have adopted a stepwise approach in which they start with a simple service or management contract and later to other arrangements that involve a higher degree of private sector responsibility, such as a lease or a concession. The virtue of the stepwise approach is that it allows gains from private sector involvement while providing the government time to address tariff, regulatory, or information problems in the sector. But there is no guarantee that they will get beyond the first step. In stepwise processes that replace low-responsibility, low-risk contracts with high responsibility, high-risk, and potentially high-return contracts, the question of re-bidding necessarily arises. The company that wins the management contract will naturally have an advantage in bidding for subsequent contracts, and seeing this, other potential bidders may stay away. But barring that company from bidding for the next phase may reduce interest in bidding for the management contract. In either case, competition is likely to be limited or absent during the shift to a more complex contract. Thus, while stepwise approaches have many attractions, and may be the only viable option for poorly endowed countries, their design and implementation are not straightforward.

The main options can be clearly distinguished by how they allocate responsibility for such functions as asset ownership and capital investment between the public and private sectors (See Table 2-2). The more risk and responsibility are passed to the private sector, the more powerful are its incentives to improve services. In practice, private sector arrangements are often hybrids of these models. For example, leases may pass some responsibility for small-scale investment to the private sector, and management contracts may, like leases, have revenue-sharing provisions that pass on some commercial risk.

"One striking feature of the water and sewerage sector is the dominance of concessions compared with other forms of private participation. Concessions are attractive to governments because they place full operational and investment responsibilities, and associated commercial and investment risk, with the private sector, thus maximizing potential benefits from efficiency improvements and gaining access to private sector financing. But they also require significant government commitment and the creation of a credible regulatory environment for private investment."<sup>14</sup>

Almost all concession projects take the form of BOT contracts, with ownership reverting to the government after the initial contract period. In public-private joint ventures, ownership of the assets often remains with the public partner during the contract term. Some BOT contracts also give the private sector responsibility for managing the distribution while most others are for the construction and operation of water treatment plants in countries with an increasing demand for piped water.

**TABLE 2-2**

**TABLE 2-2 THE MAIN OPTIONS FOR PRIVATE SECTOR PARTICIPATION IN WATER SUPPLY AND WASTE WATER TREATMENT**

<b>Option</b>	<b>Applications</b>	<b>Incentives &amp; Duration</b>	<b>Examples</b>
<b>Service Contract</b>	Meter reading, billing and collection, and maintenance of private connections	Permits competition among multiple providers, each with short and specific contracts	Santiago, Chile, Madras, India
<b>Management Contracts</b>	Operation and maintenance of the water supply system or major subsystem	Contract renewed every one to three years, and remuneration based on physical parameters, such as volume of water produced and improvement in collection rates	Gaza, Trinidad and Tobago, Mongas, Venezuela
<b>Cooperative</b>	Operation and maintenance of the water supply system or major	Self service gives strong incentives to curb costs and maintain quality	SAGUAPAC/Bolivia

	subsystem		
<b>Lease</b>	Extended Operational contract	Contract bidding with contract duration of about ten years; provider assumes operational risk	Guinea, Gdansk, Poland
<b>Concession</b>	All features of the lease contract, plus financing of some fixed assets	Contract bidding with contract period up to thirty years; provider assumes operational and investment risk	Buenos Aires, Argentina, Cote d'Ivoire, Manila, Philippines
<b>Divesture</b>	Total responsibility for operation, maintenance and investments	Price-cap gives incentives to improve efficiency	England and Wales
Source: Adapted from World Bank. 1994. World Development Report 1994: Infrastructure for development. New York: Oxford University Press. 61			

## MANAGEMENT CONTRACT IN TRINIDAD AND TOBAGO

The government of Trinidad and Tobago has adopted a two-phase approach to privatizing its water services. In the first phase, a pre-concession, or enhanced management contract, was awarded through a competitive bidding process. After three to five years, in the second phase, this management contract will be converted to a long-term concession for which the incumbent will have first rights of negotiation. The two-phase strategy is a good choice for a small country with poor sector information and limited regulatory capacity because it gives the government time to gather information for better risk allocation in the future, to develop a long term tariff regime, and to establish a relationship of trust with a private operator, while it also improves service using private management.<sup>15</sup>

Prior to the contract, The Water and Sewerage Authority (WASA) of Trinidad and Tobago, a publicly owned and managed company, provided service to the island's 1.27 million inhabitants. However, WASA suffered with many problems, such as, availability of water for less than twelve hours a day and high rate of unaccounted for water. The sewerage system was also in bad condition and served only 30 percent of the population. Labor costs were very high accounting for 60 percent of total operating expenses as compared to 40 percent for an efficient water company. Despite great need for investment, water tariffs were kept very low and WASA consistently failed to generate enough revenues to cover operating expenses. By the end of 1992, it had accumulated an enormous burden of government transfers totaling US \$ 800 million.

Therefore, under immense public pressure for better service, in early 1994 the government started to recruit a private operator to take over WASA's operations. But a typical long-term thirty-year concession was not chosen because it would require the amending the company's authorization act. "Moreover, with poor regulatory capacity and limited information on the condition of the system or on water consumption patterns, the government needed time to establish an effective rate-setting mechanism or a basis for setting an initial tariff during the competitive bidding process so that bidders could develop reasonable estimates of the long-term risk and probable rate of return."<sup>16</sup>

Therefore, the government of Trinidad and Tobago adopted a two-phase strategy. In the first phase, under an interim management contract, WASA contracted with a private operator to provide a management team to meet operational, maintenance, and investment targets and follow an agreed business plan over the period of agreement. WASA collected service fees as before, but the new operator had to fund any operating deficits through a loan to WASA, giving the operator an incentive to minimize deficits. A World Bank loan to the government provided funds over the contract's five-year term to enable the operator to maintain the system, expand coverage of water and sewerage services, improve billing and collection and install meters. If the targets are not met, the contract may be terminated early. The operator was also required to provide the government with the information it needs to design a long-term regulatory regime. The operator would received a fixed management fee, a variable fee contingent on its meeting annual coverage and service targets, and first rights to the full concession.

Moving to the long-term concession in the second phase would add to the private operator's responsibilities for operation and maintenance the responsibility for financing capital expenditures. Failure by the operator and the government to reach an agreement for the concession would initiate competitive bidding and disqualify the operator from future bidding. In either case, the operator would be able to recover the money lent to WASA during the management contract. Under both the interim and the long-term arrangements, ownership of assets would remain with the government.<sup>17</sup>

Competition was achieved by requesting bids to earn the right to the management contract. Trinidad and Tobago started reform with limited regulatory capacity but it incorporated performance standards into the contracts to make up for it.

## **SAGUAPAC/BOLIVIA'S WATER CO-OPERATIVE 18**

Large cities in many low-income countries face a water supply crisis. The most common solution found today is to invite in private contractors but a University of Birmingham study suggests that the co-operative could be another feasible option. The study examined the only major urban water supply and wastewater treatment co-operative in the world, known as SAGUAPAC, the Cooperativa de Servicios Publicos 'Santa Cruz' Ltda, which has provided water since 1979 to the people of Santa Cruz, the largest city in Bolivia, with a population of one million. All of its domestic customers are automatically members of the co-operative. The city is divided into nine water districts, where customers elect members to the administrative board of SAGUAPAC. This board appoints the general manager and approves tariffs. Customers also elect a separate supervisory board that monitors the performance of the administrative board.

The Birmingham study found that SAGUAPAC is one of the best-run water companies in Latin America, measured by criteria of efficiency, equity and effectiveness. It has a low level of unaccounted-for water, a low number of employees per 1000 water connections, efficient accounting because 100 percent of all connections are metered, a 96% bill collection efficiency rate, 80% water coverage despite rapid population growth, and a 24 hour supply of clean water.

The study identifies two key reasons for SAGUAPAC's superior performance. First, its cooperative structure guards management from undue political interference, especially with regard to hiring, firing, and the awarding of contracts. Second, the co-operative structure also means that SAGUAPAC is not bogged down with legal delays in tendering procedures and the administration of external loan finance like water companies belonging to the public sector. This means that it can implement investment projects much faster and more efficiently than other companies.

SAGUAPAC model suggests that the private sector lease and concession contracts are not the only way to improve the performance of water companies in low-income countries because the co-operative model is sustainable and capable of high performance. It is being imitated elsewhere in Bolivia, with new water co-operatives established in the towns of Tarija (1988) and Trinidad (1991).

## **GUINEA'S LEASE FOR WATER SUPPLY 19**

When Guinea's water supply sector was restructured in 1989, the Republic of Guinea had one of the least developed urban water supply sectors in West Africa despite the availability of adequate water resources. The public agency in charge of the sector, the Enterprise Nationale de Distribution de l'Eau Guinéenne (DEG) was inefficient, overstaffed and virtually bankrupt. Less than 40 percent of urban dwellers had access to piped water either through connections or standpipes while the remaining population had to rely on private wells for their water. Where connections existed, service was often interrupted, and water treatment was inadequate. Many residents used polluted well water as their primary source of drinking water and even more relied upon it as a secondary

source when the piped system was not operating. Consequently, water-borne diseases, including cholera and diarrhea, had become a major problem. Further, after disappointing results from previous investment projects, donors, including the World Bank, were becoming frustrated. The poor, and deteriorating, performance of the sector convinced many observers that significant reform was necessary.

To improve this situation, the government of Guinea in 1989 entered into a lease arrangement for private-sector operation of water services in the capital city, Conakry, and sixteen other towns. The private partner was selected through international bidding and a joint venture led by SAM was awarded the contract. New contracts were formally signed in 1989 and were supported by the World Bank coordinated Second Water Supply Project.

"As part of the reform, two enterprises were created: Société Nationale des Eaux de Guinée (SONEG) and Société d'Exploitation des Eaux de Guinée (SEEG). The reform involved a set of three contracts: one between the Government and SONEG ("Contrat plan"); one between SONEG and SEEG (the lease contract), and one between SEEG and its international shareholders (a "Technical assistance" contract). In addition, there are contracts between SEEG and its customers, i.e., users of the water system."<sup>20</sup>

The lease contract defines the responsibilities of SONEG and SEEG. SONEG owns sector assets and is responsible for planning, projecting and managing infrastructure, sector accounting, managing funds from the rental fee it receives from SEEG and donors to pay for new investment and service sector debt. It is also responsible for supervising most large-scale investment (e.g., reservoirs and transmission pipelines) and for the construction and maintenance of the primary distribution network (i.e., pipes more than 160 mm in diameter).

SONEG also has ultimate responsibility for capital financing, which provides it with strong incentives to seek adequate tariffs and to make prudent investments based on realistic demand forecasts. SONEG is also responsible for monitoring the performance of SEEG in discharging its obligations under the lease contract (for example, water supply standards, implementation of the program, and proper maintenance). It also adjusts and if necessary renegotiates SEEG's remuneration, the lease-contract rate.

SEEG, which is 49% state-owned and 51% privately owned, is responsible for operating and maintaining urban water supply facilities, distribution and commercialization of water, including building and maintaining the secondary and tertiary distribution networks (i.e., pipes under 160mm in diameter); metering, billing and collecting; and paying the rental fee to SONEG, all at its own commercial risk. Its remuneration is based on user charges actually collected and fees for new connections. SEEG could also benefit from improvements it achieved in the collection ratio, from reduced operating costs, and from reduction in unaccounted-for water.

The private partners of SEEG, in addition to the lease contract, signed a "technical assistance contract" with SEEG to provide managerial support, technical assistance and

financial expertise, and to help train Guinean personnel. As their contribution to SEEG, SAUR and CGE provided 51% of the initial US \$3 million of capital. For its contribution, the Government donated equipment and infrastructure from DEG and, through SONEG, took responsibility for accumulated sector debt.

To make sure the necessary tariff increases would be affordable; the lease contract included an innovative cost-sharing arrangement under which the consumer tariff was to be adjusted gradually from the first to the tenth year of the contract. During this period, the World Bank agreed to assume a declining share of the foreign expenditures of operation, and the central government agreed to cover the full cost of water. Tariff increases have to date exceeded the planned schedule, rising from US \$ 0.12 per cubic meter in 1989 to about US \$ 0.90 in 1995.

The division of investment responsibilities between the two agencies, however, has led to significant problems, with the two agencies blaming each other for delays and disagreements. SONEG tends to be more concerned with social and political goals, while SEEG has commercial goals, they often disagree on priorities concerning network expansion. SONEG's processes are often slow and costly, and provide opportunities for public interference, corruption, and delay. In contrast, SEEG, as a private company, has much greater flexibility.

Notwithstanding these problems, the bottom line is that all parties have benefited from reform. On aggregate, increased coverage and improved quality more than compensated consumers for higher prices. In the contract's first five years, connections increased from 12,000 to 30,500. Metering has increased from about 5 percent to 95 percent of all connections. Investments in new supply capacity, combined with rehabilitation and maintenance, have brought about a substantial increase in the population with access to safe water, from 15 percent in 1980 to 52 percent in 1994. And with progressive tariff increases, the average tariff (US \$0.90 per cubic meter) now more than covers costs. SEEG's water revenues rose almost tenfold between 1989 and 1994, and the operating ratio (the ratio of operating costs to operating revenues) improved from 122 percent to 77 percent.<sup>21</sup>

Further, government subsidies have been reduced and the foreign investors have made modest, but positive, profits. This shows that even in a weak institutional environment, where contracts are hard to enforce and political interference is common, private sector participation can improve sector performance.

## **THE BUENOS AIRES WATER AND WASTE WATER CONCESSION <sup>22</sup>**

The signing of a concession contract for the Buenos Aires water and sanitation system in December 1992 has attracted worldwide attention and been the subject of considerable controversy in Argentina. In addition to being one of the world's largest concessions, the case is interesting for a number of other reasons. First, the rapid implementation of the Buenos Aires concession is in contrast to the slow moves towards private participation in

other water systems, such as Santiago or Lima. Second, the reform has been widely acclaimed for generating major improvements, including wider coverage, better service, more efficient operation of the company, and a reduction in waste. What makes these improvements especially striking is that the winning bid brought an immediate 26.9 percent reduction in water tariffs. Finally, the Buenos Aires case is of interest because the contract was renegotiated in 1997, provoking criticisms of the original bid and the regulation.<sup>23</sup>

Prior to concession, the public enterprise Obras Sanitarias de la Nacion (OSN) produced 3.7 million cubic meters of water a day and served about 6 million inhabitants, about 70 percent of the area's population. Coverage for sewerage was even lower, about 58 percent. While OSN provided almost complete water and sewerage coverage in the City of Buenos Aires, coverage was limited in the suburban areas. Prior to privatization, the enterprise provided water to 99 percent of the three million inhabitants of the City of Buenos Aires, but to only 55 percent of the suburban area's population of six million. Wastewater services were provided to 99 percent of the population in the City of Buenos Aires but to only 36 percent of the suburban population.

By the early 1990s the maintenance and expansion of OSN's infrastructure were limited by financial constraints. Investments had Men from 1.5 percent of gross domestic investment in 1970 to 0.58 percent in 1990. Resources were not available for badly needed maintenance and rehabilitation. OSN's services were also affected by inefficient management. About 20 percent of the consumers had meters, but most meters were broken and few of those that worked were actually read. As a result, approximately 90 percent of the water supply was unmetered. Average per capita consumption was very high, an estimated 300 to 500 liters per day. This figure reflected unaccounted system losses, estimated to be at least 40 percent of the total production of 100 million cubic meters of water per month in 1992. In addition, OSN was over staffed, with a total of 7,500 employees. There were eight to nine employees per 1,000 connections-about five times more than in European enterprises.

In spite of these inefficiencies, the rate charged in the Buenos Aires metropolitan area (US\$ .40/cubic meter) was sufficient to cover all operating and maintenance costs. Therefore, with increased efficiency, particularly in billing, collection and water consumption control, the operation could be profitable, especially if the infrastructure were to be rehabilitated and modernized.

In 1993, Argentina privatized the provision of water and wastewater treatment services in the Buenos Aires metropolitan area. The public enterprise, OSN was given to the private sector under partial sale and long-term concession. To avoid delay, the government opted to award the right to provide service under a concession rather than sell the utility, thus keeping the fixed assets under public ownership. Selling the assets would have required overcoming legislative hurdles, and the government feared that assessing the value of the underground pipes would be costly and time-consuming. The government also decided not to break up the utility. A single private firm would operate the services for thirty years, a reasonable period in which to finance and complete the required investments.

The main objective of the reform was to reduce the cost to the government of operating the services while minimizing the price for service delivery. Bidders would compete to provide services at the lowest price. The winning bidder, as the concessionaire, would assume responsibility for operating and maintaining the fixed assets and would be obliged to expand coverage, guarantee water quality, and develop wastewater treatment. Pricing would be governed by general tariff principles set out in the concession contract, maintaining the cross subsidies that existed under public provision. The first price review would occur after 5 years. The concessionaire would also be responsible for negotiating the private labor contracts with the labor unions since

In the Buenos Aires concession, competition was introduced through the bidding process. This process, which plays a critical role in drawing out enough information to ensure that a concession is awarded successfully, generally worked well. The rules required pre-qualification of potential bidders in order to limit the bidding to firms with string technical and financial capabilities and to ensure that any foreign bidders would be the very top operators. The concession contract was awarded in December 1992 to Aguas Argentinas, a consortium headed by Lyonnaise des Eaux-Dumez that offered a tariff discount of 26.9 percent. This result suggests that the competition for the market has been effective in reducing costs to consumers.

Because competition was limited to the bidding process only, the government had a crucial role to play as a regulator. Therefore, a new independent regulatory agency, Ente Tripartito de Obras y Servicios Sanitarios (ETOSS) was created, which monitors the concessionaire, enforces the concession contract and regulatory decisions, and levies fines when necessary.

The Buenos Aires water system concession had large benefits for consumer welfare, along with smaller gains for buyers and employees. Performance improved dramatically. The average annual investment of Aguas Argentinas in the first six years of the concession was 2.4 times that of OSN in the last decade of its operation, its operating efficiency improved markedly, and product and service quality were much higher. There were also important social and external benefits from the increase in coverage. Some 1.46 million people who now have access to piped water and 583 thousand with access to sewerage will no longer be consuming contaminated well water or polluting groundwater or rivers. Coverage for wastewater treatment services is up about 8 percent. And prices were initially reduced by 27 percent. While they rose later, they are still 17 percent lower than those charged by the public utility, OSN.

However, soon after the concession had been awarded, water quality problems revealed that the infrastructure was in worse shape than the government and the concessionaire had estimated. Therefore, in June 1994, the concessionaire agreed to expedite the delivery of some service requirements but the resulting cost increases triggered a 7 percent threshold in the contract allowing an increase in tariffs, and Aguas Argentinas was granted a 13.5 percent tariff hike. There was much public confusion about this increase, and many users felt that it was unfair. This experience reinforces the need for rules allowing adjustment in the terms of concession contracts when new information

becomes available or circumstances change. It also shows the need for regulators to ensure that the public understands their decisions and perceives them as independent.

## **WATER PRIVATIZATION IN ENGLAND AND WALES**

In 1989, the government in England and Wales sold ten publicly owned water companies encompassing water and sewerage assets and operating licenses, and set up a new, independent sector regulator. "The government argued for privatizing the publicly owned services on two counts: privatization would result in more efficient companies, and private owners would fund the investments needed to meet tighter water quality standards and make up for past under investment. The government split the water authorities, transferring the main environmental regulatory responsibilities to the National Rivers Authority and converting the remaining water and wastewater services into private companies to be sold on the stock exchange. The government also set up a new regulatory agency, OfWat, which sets the maximum prices that water companies can charge." [24](#)

These reforms have delivered an impressive amount of new investment, full compliance with the world's most stringent drinking water standards a higher quality of river water, and a more transparent water pricing system. However, experience during the first regulatory cycle also reveals some lessons about the information requirements of effective regulation and the risks to the political independence of the regulator. [25](#)

Prices are regulated through a price cap formula that links water rates to the retail price index plus a factor (K), determined individually for each company, that takes into account the cost of the investment program. A central authority monitors and enforces environmental standards, a function previously carried out only loosely by the water authorities themselves. The cost to the British government of this privatization was significant: the government wrote off debts totaling L 4.9 billion, transferred the existing cash balance of the water authorities to the new companies, and injected an additional 1.6 billion pounds into selected companies. The regulatory method chosen has high information costs and provides no clear incentive for the companies or the regulators to economize on the costs of meeting required standards. On the benefits side are improved enforcement of environmental and drinking water standards and the promise of more efficient and reliable service.

While there is no direct competition among the UK water companies, they compete for capital in the stock market with other investment opportunities and through the use of benchmark indicators by the regulatory agency. The UK price-cap approach is intended to avert over investment, but the K factors were set without any apparent cost-benefit analysis of the needed investment or scope for cost minimization. Furthermore, the approach appears to be moving in the direction of de facto rate of return regulation, as high dividends and large increases in managers' salaries have prompted a review of price caps sooner than the planned ten years.

The complexity of marketing water and sewerage assets and lack of interest on the part of the private sector to assume responsibility for rehabilitation and investment, along with the heavy regulatory requirements, may make the UK model unattractive to many developing countries.

## **CONCLUSION**

The water sector has a long history of tariffs below costs and political resistance to raising them. Considerable government commitment is required to raise tariffs to cover costs, and to build regulatory arrangements that give private companies confidence that they can make a fair rate of return on their investments. Even relatively low-risk contracts, such as management contracts and leases, still require governments to establish their credibility as good partners for the private sector. While many governments are currently contemplating reforms that will make private participation in water and sewerage possible, only thirty-five countries in the developing world have so far succeeded in implementing private transactions in the sector. The small number of projects and the dominance of a few major international players are characteristic of an industry in transition.<sup>26</sup>

The primary objective of projects to secure private sector participation in the water and wastewater treatment sector is to get better services to consumers at lower cost. In most developing countries, the poorest customers face an appalling situation. Many lack access to potable water and any kind of sanitation. In many cities, the wealthy receive piped water at below cost, while the poor must rely on unsafe water at very high cost. In Luanda, where recipients of piped water pay less than a cent per cubic meter, people without connections may pay as much as US\$16.00 per cubic meter for untreated water delivered by tanker. Involving a private sector partner in the delivery of water and wastewater treatment services is often the only sustainable way of resolving these problems.

Urban piped water and wastewater treatment should be provided by enterprises run on commercial principles. Professional management accountable to users and having clear incentives for providing high-quality, reliable services and efficient asset management is also desirable. The responsibility of government in such situations is, at minimum, to ensure commercial operation, which can be achieved through delegation to a private company via a management, lease, or concession contract. Public oversight is necessary to ensure access for low-income users and to protect public health and environmental quality. Pricing water to reflect the full financial, environmental, and economic costs of supply is essential for generating funds to expand service and for promoting efficient use.

Low-income countries should consider a two-pronged approach to developing water sector. First, contracting systems, such as concessions, can apply commercial management to sanitation facilities in urban areas. Second, in poorer urban and rural communities which are unlikely to be connected to the formal supply systems in the foreseeable future, intermediate technology can be adapted to match users' service requirements and their willingness to pay. These lower-cost tertiary systems can be

chosen, financed and operated by the community with technical assistance. The trunk infrastructure, to which the tertiary systems can be chosen, financed and operated by the community with technical assistance.<sup>27</sup>

## NOTES

<sup>1</sup> Gisle, Silva, Nicole Tynan and Yesim Yilmaz September 1998. Private Participation in the Water and Sewerage Sector-Recent Trends. Public Policy for the Private Sector Quarterly No. 14. World Bank, Washington D.C. 41.

<sup>2</sup> Triche, Thelma A. 1990. Private Participation in the Delivery of Guinea's Water Supply Services. Policy, Research, and External Affairs Working Paper No. 477. World Bank, Infrastructure and Urban Development Department, Washington D.C. 4.

<sup>3</sup> Cowen, Penelope J. Brook. September 1997. The Private Sector in Water and Sanitation How to Get Started. Public Policy for the Private Sector, Quarterly No. 11. World Bank, Washington D.C. 19-20.

<sup>4</sup> Savas, E.S. 2000. Privatization and Public-Private Partnerships. Chatham House Publishers, New York. 48.

<sup>5</sup> This diagram to explain the exclusion and consumption properties of water sector goods and services has been adapted from Savas, E.S. 2000. Privatization and Public-Private Partnerships, Chatham House Publishers, New York. 46-47.

<sup>6</sup> This section of the paper has been paraphrased from Klein, Michael. September 1996. Economic Regulation of Water Companies. Policy Research Working Paper No. 1649. World Bank, Washington D.C.

<sup>7</sup> Klein, Michael. September 1996. Economic Regulation of Water Companies. Policy Research Working Paper No. 1649. World Bank, Washington D.C. 4.

<sup>8</sup> Klein. 6.

<sup>9</sup> Klein. 6

<sup>10</sup> Klein. 5

<sup>11</sup> Klein. 6.

<sup>12</sup> Triche. 5.

<sup>13</sup> Klein.

<sup>14</sup> Sliva, 45

15 Nankani, Helen. December 1996. Testing the Waters---A Phased Approach to a Water Concession in Trinidad and Tobago. Public Policy for the Private Sector, Quarterly No. 9. World Bank, Washington D.C. 27.

16 Nankani. 27.

17 Nankani. 28.

18 Nickson, Andrew. SAGUAPAC/Bolivia: A Water Co-operative for a Large City. Does it work- IRC's SOURCE Bulletin and the DECNET Bulletin. Retrieved September 22, 2000, from the World Wide Web:

[http://www.africanwater.org/ppp\\_Aebate.htm#Articles](http://www.africanwater.org/ppp_Aebate.htm#Articles)

19 For a detailed discussion of Guinea's water lease, See: Menard, Claude and George Clarke. June 2000. A Transitory Regime: Water Supply in Conkary, Guinea. Policy Research Working Paper No. 2362. World Bank, Washington D.C.

20 Menard. 19.

21 Cowen, Penelope I Brook. June 1996. The Guinea Water Lease-Five Years On. Public Policy for the Private Sector Special Edition. World Bank, Washington D.C. 89-92.

22 For a detailed discussion of Guinea's water lease, See: Alcazar Lorena, Manuel A. Abdala and Mary M. Shirley. April 2000. The Buenos Aires Water Concession. Policy Research Working Paper No. 2311. World Bank, Washington D.C.

23 Alcazar

24 Berg, Caroline van den. June 1997. Water Privatization and Regulation in England and Wales. Public Policy for the Private Sector, Quarterly No. 10. World Bank, Washington D.C. 9.

25 Berg. 9.

26 Silva. 48.

27 World Bank. 1994. World Development Report 1994: Infrastructure Development. New York: Oxford University Press. 117.

## **CHAPTER 3** **IRRIGATION**

In many countries irrigation development policy has undergone a dramatic shift during the past few decades. Heavy investments to expand irrigated area are giving way to an emphasis on demand management, and to dealing with increasing scarcity of water

resources and competition between water users, both in agriculture and other sectors. This is due to a number of factors.

First, at global level water resource development either has reached or is fast approaching the limit of ultimate utilizable potential in most countries. Meanwhile, the demand for water is on an ever-increasing spree due to the formidable effects of population expansion and economic development. The main result of a growing demand-supply gap is the intensification of inter-sectoral and inter-regional water conflicts. The unfavorable effects of water scarcity are magnified further by rapid deterioration in water quality that discounts the utility of an already inadequate water supply.<sup>1</sup>

Second, rapid deterioration of irrigation infrastructure and poor overall management performance, compounded by increased awareness of the potential environmental impacts of large-scale irrigation development, have all led to a slowing down in the rate of irrigation investment. In addition, the dramatic expansion of irrigated area in the world has not been matched by a similar expansion in financing the management of irrigation systems after construction. This decline in support for irrigation management has seriously hampered the performance of government-developed irrigation systems. Consequently, "water is wasted in the upper parts of systems and unavailable in the lower-end sections, while water deliveries are often untimely and unreliable. Canals and gates, whether built properly or not, have been allowed to fall in disrepair. In general, only about 25 to 30% of water diverted into large canal systems in developing countries reaches the crops needing it."<sup>2</sup>

Third, in many developing countries irrigation charges are so low and collection attempts to collect them so feeble that cost recovery has fallen far short of even modest targets such as recovery of operational and maintenance costs. Charges do not reflect the cost of production, consumption increases beyond the optimum level, and the subsidies disproportionately serve the better off. Low water charges and poor recovery rates risk the efficient maintenance of existing water infrastructure as well as the additional investments on future water-development projects. Moreover, this pattern of financing creates a vicious cycle: financial difficulties cause irrigation departments to defer maintenance to the detriment of the water system, while farmers complain about the poor services and have little incentives to pay for it.<sup>3</sup> Despite all this, the politically rooted system of public provision and subsidized water charges prevents the water economy from the influence of actual market forces.

Finally, government efforts to improve the management of irrigation have focused mostly on building hydraulic infrastructure and on the creation of physical capital in the form of dams, aqueducts, diversion weirs, and canals, and less on institutional arrangements. However, persistent problems with the design, construction, operation, management, and use of irrigation projects have led donors and national governments to reevaluate the emphasis on engineering in irrigation planning and to stress the importance of strengthening institutions and improving pricing policies.

A major response to these pressures has been for governments to devolve management responsibility to other institutions, notably user associations or private companies. Irrigation management transfer (IMT) or turnover generally refers to programs that shift responsibility and authority from the state to non-governmental bodies. In these cases, the government generally withdraws from a role, and either cuts or re-deploys irrigation agency staff. Participatory irrigation management (PIM) refers to programs that seek to increase farmer's direct involvement in system management--either as a complement or substitute for the state role. Either approach generally leads to some form of joint management of irrigation systems, with the state responsible for more tasks at higher levels of the system and farmers' organizations responsible for more at lower levels.<sup>4</sup>

However, "along with the pressures to decentralize and transfer the management of irrigation systems from government agencies to alternative institutions comes a need to understand the factors that contribute to the success of other institutional arrangements. Such an understanding is necessary if devolution or market forces are to succeed in improving the performance and sustainability of irrigation systems."<sup>5</sup> This chapter examines the characteristics of the sector, reasons traditionally cited for state management, various ways to privatize the sector and the potential contributions of local organizations or water markets in irrigation. It also addresses the limitations with government agencies, organized user groups, the sources of market failure, and the contexts in which outside intervention is required.

## **CHARACTERISTICS OF IRRIGATION SECTOR**

This section discusses the nature of the good and services in irrigation based on their exclusion and consumption properties; the production characteristics in terms of monopoly attributes and coordination requirements; and the various externalities and other social objectives involved.

### **THE NATURE OF GOODS AND SERVICES IN IRRIGATION**

Whenever a water resource system is jointly owned, it can be treated as a common pool resource (CPR)<sup>6</sup> out of which an individual consumer would obtain resource units in such a way that each bundle of resource units consumed is subtracted from the pool of resources, and is not available to other consumers. However, there is a distinction between the flow of resource units and the resource system producing the flow. While individual use is a characteristic of the resource unit appropriated from a CPR, the jointness of use is a characteristic of the resource system. In case of irrigation, it means that while water is an individual good, the physical infrastructure for irrigation, such as canals and dams, is collective in nature. Depending on their exclusion and consumption properties, water resources systems can be held by the following four categories of property rights <sup>7</sup>:

**Private Property.** Examples of private property include private tube well, warabandi/turn in rotation of a watercourse, or a terminal system such as a sprinkler on a

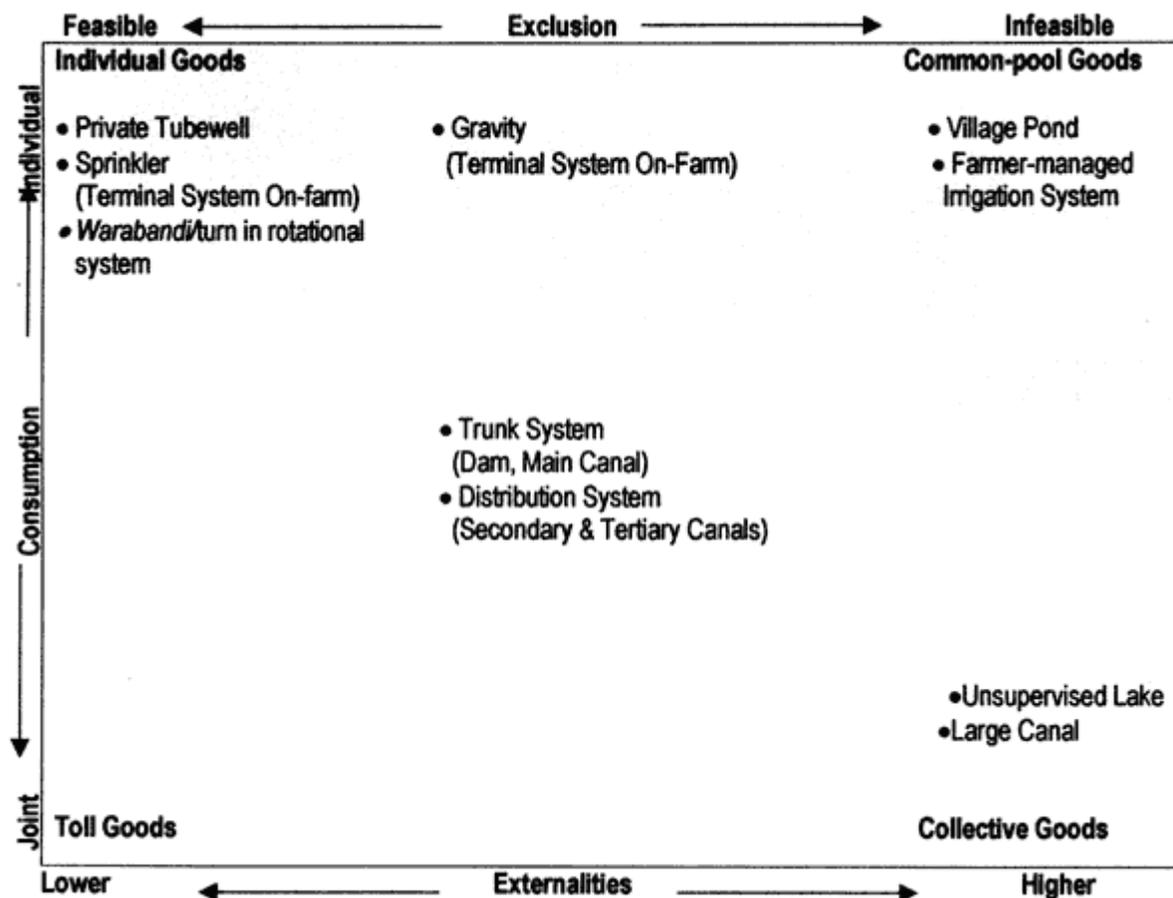
farm. It is feasible to exclude consumers from using these. Hence, resource allocation can be efficiently achieved.

**State Property.** Dams, main, secondary and tertiary canals are examples of state property. For these goods, relatively high cost of exclusion can lead to free riding. Therefore, these goods are susceptible to overuse and non-cooperation of consumers is common.

**Common Property.** For common property goods such as a village pond, or farmer-managed irrigation systems, it is possible to exclude consumers. Hence, cooperation by consumers can be achieved and resource allocation can be made efficient.

**Open Access.** Access to collective goods, such as an unsupervised lake or a large canal, is open to all and non-exclusion is the norm. Cooperation by consumers is difficult to achieve; therefore, overuse is most likely to occur.

**FIG. 3-1 CHARACTERISTICS OF PRINCIPAL GOODS AND SERVICES OF THE IRRIGATION SECTOR 8**



## **NATURE OR CONDITIONS OF PRODUCTION**

Monopoly or Competition in Irrigation. "According to traditional regulatory economics, the development and distribution of water for agricultural purposes is riddled with potential for market failure, which supposedly can be overcome only by public ownership<sup>9</sup>". The provision of network or pipeline-type facilities, especially the primary or trunk level, such as the main and secondary canals in large scale irrigation networks exhibits, to varying degrees, the characteristics of public goods, natural monopoly and sunk costs. It is considered a natural monopoly because of its large scale, heavy and irrecoverable investment costs, and large economies of scale in storage and delivery systems.

Due to all these factors in production, public planning and policy making, as well as public financing and ownership is generally required. An alternative may also be private sector financing and ownership under public regulation. Irrigation projects require relatively large initial capital outlays years prior to operation which makes it difficult to acquire financing under private ownership. Moreover, private ownership is believed to be crippled by the variable nature of the water supply due to its dependence on weather and geology.

The operation of these networks, on the other hand, often does not entail large irrecoverable costs of equipment, and is thus contestable. Operation and maintenance could be allocated on the basis of competitive bidding for the right to the monopoly.

Coordination. Coordination refers to need for control over the rights to perform the function because of technical conditions for efficiency, safety concerns, etc. Irrigation involves coordinating many input activities. For example, to distribute a large flow of water without excessive waste requires that several individuals open different gates located at some distance from one another in a rapid, sequential order. Other examples of coordination activities include setting the date for the first release of water from a reservoir, at which time farmers will need to be ready to make effective use of the water released; establishing the first and last days of a budgetary cycle and the time public funds will be available for disbursement; supervising the work of laborers digging a canal etc. The transaction costs involved in coordination can be extraordinarily high unless those who craft institutional rules find creative mechanisms to keep these costs low.<sup>10</sup>

## **EXTERNALITIES AND OTHER SOCIAL OBJECTIVES**

Irrigation water and externalities<sup>11</sup>. At the heart of the problem of irrigation water allocation is the fact that the same water is used and reused along a river basin. When water is diverted from a stream or pumped from groundwater for use in agriculture or other activities, some of it is consumed and some, returns via drains or percolation to the stream or aquifer, thus becoming available for a further cycle of diversion at another time, another place, and at another quality. The non-consumed fraction of water applied at the field returns to the system, but it returns in an altered state. First, to the extent that

the originally diverted water contained some salt, the return flow will have a higher concentration because plants consume only water. Second, because of the application of fertilizers and pesticides the return flows may be further degraded by pollutants. Third, if the soil in the irrigated area contained natural salts, these may also be leached by the return flows, reducing its quality still further. Fourth, the return flows may go to a deep aquifer or into a stream below the lowest diversion structure from where not all can be recovered.

Finally, the return flows may arrive at a time when water is in temporary excess (diversions during the dry season returning during the rainy season), or vice versa.

This description indicates that in order to privatize the allocation of water, the first change that needs to be made is to base accounting not for diverted water, but for consumed water, with additional adjustments for time, location, and quality. It also demonstrates the need to pay attention to external effects in a water basin--that is where water is going, where it is being consumed, where it is being reused, and what is happening to salt and pollution loading, and the timing and location of return flows as water is being recycled and reused. These effects must be regulated to bring private behavior into accord with social interests and to achieve an economic optimum. Unless this is done, pricing and trading water will have uncertain impacts on economic, social, and environmental efficiency.

**Treating Water as an Economic Good and Social Objectives<sup>12</sup>.** There is considerable disagreement over the issue of treating water as an economic good. However, even if people agree that water is an economic good, the real question is whether it is a purely private good that can reasonably be left to free market forces, or a collective good that requires some amount of extra-market management to effectively and efficiently serve social objectives. The proponents of water as a private good insist that water is just like any other good, and its production allocation should be determined by the consumer's ability and willingness to buy it. This criterion totally ignores the distribution of income in society. If the poor cannot pay as much for a unit of water as the rich they should get less water, even if the marginal value to them in terms of other values (or utility) is greater.

This is what the proponents of water as a public good object to. They assert that safe water is a basic need that should be available at reasonable levels to everyone. Access to clean water for drinking, food production, washing and personal hygiene has health benefits that generally exceed the cost of providing the water. They also assert that water used for irrigation can be a powerful means of reducing food costs to poor people and, under the proper conditions, should be subsidized. Therefore, at least up to some minimal level of availability, water is a merit good whose availability to certain groups and for certain purposes at well below market prices will serve the greater benefit of society as a whole. On the other hand, most advocates of water, as a public good would agree that after a basic level of service is attained, additional supplies could properly be allocated by market forces.

Water for irrigation is different than drinking water due to several reasons. First, it is the largest consumer of water virtually everywhere that irrigation is practiced. Second, policies governing water use in irrigated agriculture are fraught with disagreements over both values (should it be treated as a purely private good, a public good, or a basic human need) and facts (what is the most cost-effective allocation policy and method if water is treated as a purely private good, or a public good, and in what instances should it be treated in one way rather than in the other).

Therefore, the role of water as a basic need, merit good, and a social, economic, financial, and environmental resource makes the selection of an appropriate set of prices exceptionally difficult. Moreover, application of price-based instruments is particularly difficult in the case of water because the flow of water through a basin is complex, and provides wide scope for externalities, market failure, and high transaction costs. In these cases, various kinds and degrees of government intervention or other kinds of collective intervention, or both, are required to make the market perform effectively to serve the value of consumer's sovereignty.

## **PUBLIC SECTOR MANAGEMENT OF IRRIGATION**

"Governments have long justified a strong role for the state by the need to regulate common pool resources and manage irrigation technology. Many countries adhere to some form of Public Trust Doctrine that maintains that the state holds navigable waters and certain other water resources as an aspect of sovereignty. Because these are held as common heritage for the benefit of the people, the state cannot alienate such ownership of the basic resource and concomitant responsibility. The argument is reinforced by the natural monopoly characteristics and the positive and negative externalities associated with irrigation water that are too widespread for users to internalize.<sup>13</sup>" State intervention is often needed to prevent certain populations from being deprived of any source of water. Moreover, governments have assumed that the scale and technological complexity of many irrigation systems require state intervention to manage them. Thus, in most countries, government run agencies have traditionally designed, constructed, and operated irrigation systems.

The poor performance of many state-managed irrigation systems has not validated these assumptions in practice. States have relied on a centralized approach to resource management while ignoring private incentives to both farmers and public employees. Poorly adapted services have resulted in deteriorating structures and systems that have not been sustainable over time. Some of the well-known and interrelated problems associated with public sector provision of irrigation water are:

- rent seeking, either economically, in the form of direct bribes and corruption, or socio-politically in the form of empire building, high costs, and excessive supplies. An example is trying to influence decisions made by donor agencies, national governments, or local irrigation associations about the location of and subsidies to irrigation facilities. The person who seeks rents receives a

- disproportionate profit on private activities because the value of his or her assets is artificially increased.<sup>14</sup>
- Irrigation projects are subject to corruption, resulting in massive cost overruns and windfall gains to favored clients. An example of corruption is withholding the delivery of water to those entitled to it in order to receive illegal side-payments of money, commodities, or special favors.
  - The divorce of incentives from performance—indeed, sometimes almost an inverse relationship. Under public management the dominant incentive to comply is coercion; that is, setting regulations and using sanctions for those who break them. But this type of incentive is only effective if the state detects infractions and imposes penalties. In many cases the state lacks the local information and ability to penalize, e.g. for breaking water delivery structures or for excessive water withdrawals. Such incidents occur frequently on large-scale irrigation projects. Common practices include constructing illegal outlets, breaking padlocks, drawing off water at night, and bribing, threatening or otherwise in some way inducing officials to issue more water.<sup>15</sup>

The structures of fees for water use under public allocation often do not create incentives for the users themselves to save water and use it more efficiently. The vast majority of irrigation systems charge a flat rate per hectare. Volumetric pricing in public systems creates more incentives to conserve, provided prices are set at appropriate levels. However, public water delivery systems are often under strong political pressures to keep water charges low. Evidence indicates that these subsidies do not even serve the purpose of distributional equality because most often they go to disproportionately to the better-off: urban water users connected to the public system, not the poor in slums without household connections; or to irrigated farmers rather than those relying on uncertain rainfall.

The organization of irrigation institutions in much of the developing world unfortunately creates many opportunities for rent seeking and corruption. The costs of providing irrigation water are much higher in many settings because of the prevalence of these activities, and the distribution of irrigation benefits is frequently distorted.

While public sector management may have a comparative advantage over other types of institutions for sanctioning, constructing, and even operating the head works and main trunk distribution systems of large-scale irrigation systems, it is usually unsuitable at the local level, especially in small-scale systems or tertiary distribution networks of large systems. Moreover, inadequate funding and poor motivation of staff have left many critical tasks undone at higher levels of the irrigation systems, and it is this, which has given greatest impetus to the devolution of irrigation management. From the state side, there is an interest in reducing the costs of operation and maintenance (O&M) for tertiary and even secondary distribution systems, while from the farmers' side, there is an interest in gaining greater control over irrigation systems in the hope of improving their water supplies.

## **PRIVATIZING IRRIGATION SECTOR**

The problems with public sector management and allocation of water have created the movement toward privatizing irrigation systems. "Privatization can be defined here as the act of reducing the role of government or increasing the role of the private sector, in the delivery of irrigation services to farmers or in the ownership of irrigation system assets.<sup>16</sup>" Privatization can take several form, from volumetric or quasi-volumetric pricing at the farm level, to development of water markets and tradable water rights, to irrigation management transfer (IMT) to non-governmental entities such as farmer associations or commercial irrigation companies. In case of IMT, governments turn over management responsibility and authority to the private sector or user organizations although they generally retain some role in the irrigation sector such as regulation of the overall water source, support services or ownership of the actual facilities. Governments may transfer management responsibility for subsections of large systems or entire small-scale systems. On the other extreme, the government agency totally withdraws from an activity or sector, at aft levels. An example is the withdrawal of the Government of Senegal from irrigation management.

"In each case, the aim of privatization is simple-to institutionalize a mechanism for the management and allocation of water that approximates a conventional market, including a direct relationship between service provided and charges for water that approaches marginal costs, and to a mechanism for (re) allocating water from lower- to higher-value uses.<sup>17</sup>" In the next section, I will discuss various ways to privatize irrigation sector.

### **VOLUMETRIC PRICING**

The potential benefits of volumetric pricing or quasi-volumetric pricing are great because it links water use benefits with costs and the value of services provided. By setting volumetric prices equal to opportunity costs, water is efficiently allocated. Because water rents are captured through such pricing, losses associated with rent seeking are also avoided. The costs of volumetric pricing include the capital, administrative, and institutional costs associated with volumetric metering, billing, and collections of water charges at the farm level.<sup>18</sup>

### **WATER MARKETS AND TRADABLE WATER RIGHTS**

**Water Markets.** "Water markets most commonly operate locally to allow agricultural water suppliers and consumers to include the opportunity cost of water in their management decisions. Usually, this involves trading water among similar uses (for example, the sale or exchange of irrigation turns in a rotational system), or sale of water by the owner of a tube well to nearby farmers.<sup>19</sup>" "Water markets can provide flexibility in water allocation, by permitting the sale and purchase of water across sectors, across districts, and across time. Because the outcome of the exchange process reflects the water scarcity condition in the area and the changing user needs for water, advocates argue that water would flow to uses where its marginal value is the highest.<sup>20</sup>"

However, water rights have been difficult to define and enforce, particularly for the individual user. The nature of irrigation water resources creates numerous sources of market failures as explained in previous sections. The pervasiveness of externalities such as pollution, overdraft and lower water tables, water-logging, and other adverse, often irreversible environmental impacts, is one of the strongest arguments against free market allocation.

Even in the presence of externalities, however, markets could still be made workable if these effects are identified, agreements as to their effects are reached, and compensation paid to the aggrieved parties. In New Mexico in the United States, prospective transactions are openly advertised as required by law. There are legal provisions to compensate those who are adversely affected for damages that would arise from the transfer or alteration in the water rights on appeal. However, legal processes can be long and difficult, and claiming compensation for third-party impacts through the legal process may be nearly impossible.

Finally, there are strong equity concerns about the outcome of water markets. Because water is vital to life, as well as to livelihoods, there are strong social norms that argue against water being treated as a simple marketable commodity. Pursuing efficiency through market allocation may not be politically or socially acceptable if equity considerations are not met.

**Tradable Water Rights.** Tradable water rights allow the formal transfer of water entitlements among users, and as such are more likely to involve inter-sectoral transfers than the local water markets described above. While water markets can function in the absence of formal water rights, tradable water rights require a much more specific definition of the entitlement. As in the case of water markets, while tradable water rights are likely to result in reallocation of water from low- to high-value uses, there is no guarantee, in the absence of other charging mechanisms, that the costs of providing the service will be recovered.

Tradable water rights require both the formal definition of entitlements, and the specification of the conditions under which the entitlement may be traded. Water markets, on the other hand, have developed widely, for example in areas where private tube wells provide competitive services to numerous potential buyers, in the absence of the formal definition of water rights, tradable or otherwise.

There are actively functioning markets for tradable water rights in New Mexico and California in the United States, and in Chile. In developing countries, informal water trading and water markets are expanding in India, Pakistan, Indonesia, and Jordan, even though water rights are not clearly established by law. The development of water markets in these countries has generally been most extensive for groundwater.

In countries where water markets and trading of water have worked beyond the purely local level, there are in place: laws assigning rights, laws describing how rights may be traded; legal system that enforce the rights and punish infringements on those rights;

farmers who are accustomed to working with laws and rules that are enforced; and a physical irrigation infrastructure and irrigation management system capable of allocating water in accordance with market-friendly principles and the changing needs and priorities that flow from these principles.

A study<sup>21</sup> of a project in Colorado in the western USA shows that such arrangements do indeed allow the rational allocation of water among competing uses through market mechanisms. First, Colorado has a strict system of water rights. These rights are based on the doctrine of "prior appropriation," the first in use, the first in right. The system is legally enforced and transparent, and provides all users with information for planning their operations.

Second, while there is an active market for water in Colorado, transactions are firmly embedded in a legal and administrative structure that carefully regulates external effects. The office of the State Engineer consists of professional engineers, hydrologists, and others who investigate all technical aspects of proposed new developments and reallocations of water.

Third, each of the seven water basins in Colorado has its own specialist Water Court, which only deals with water issues, and adjudicates all water disputes. Thus a person who feels that he or she is to be adversely affected by a water transaction can lodge a suit in these courts and the court can draw on the expert advice of the office of the State Engineer to advise on the facts of the case.

The point that needs to be considered is that effective water markets and water pricing are utterly dependent on secure and effective property rights in water. This explains the complexity of the institutional frameworks required for sound water resource management; especially when water allocation and management are passed from a centralized bureaucracy to local entities, with consequent privatization of water resource management. None of this is characteristic in developing countries--indeed most lack the first requirement; water rights--nor is it costless or easy to establish such frameworks.

## **IRRIGATION MANAGEMENT TRANSFER**

Management approaches in irrigation generally fall into three categories: (1) public sector management, (2) private sector management, and (3) cooperative or users' organizations. I have already discussed the first option of public sector management. In this section, I will discuss the devolution of management to the latter two entities, commonly referred to as Irrigation Management Transfer or IMT.

Irrigation management transfer can be defined as a reduction of the government's role in irrigation management and the corresponding expansion of the role of water users and other local institutions in irrigation management. Transfer of management of irrigation can mean transfer of responsibility for any or all of the roles of financing irrigation, diverting and/or distributing water, maintaining infrastructure, rehabilitating system, managing water related disputes, allocating water rights or planning crop calendars. It can

include transfer of management authority for entire irrigation systems or only for tertiary or distributary canals. Management can be transferred from public agencies to farmer organizations, third-party firms, Non Governmental Organizations or commercial irrigation companies. However, management transfer does not necessarily mean total withdrawal of the government, nor in most cases does it include transfer of ownership or privatization of irrigation systems assets.[22](#)

Early efforts to transfer irrigation management from the government to farmer organizations occurred in the USA, France, Colombia, and Taiwan from the 1950s through the 1970s. IMT became a national strategy in most developing countries only in the 1980s and 1990s. Chile, Peru, Brazil, the Dominican Republic, Haiti, Senegal, Nigeria, Madagascar, Turkey, Pakistan, India, Lao PDR, China, Indonesia, and the Philippines are among the countries implementing national transfer programs. This process has been referred to as turnover in Indonesia and the Philippines, management transfer in Mexico and Turkey, privatization in Bangladesh, disengagement in Senegal, post-responsibility system in China, participatory management in India and Sri Lanka, commercialization in Nigeria, and self-management in Niger.[23](#)

Most often, governments pursue management transfer programs to reduce their expenditures on irrigation, improve productivity and stabilize deteriorating irrigation systems. Management transfer saves money for the government as it divests itself of the responsibility to finance routine costs of operations and maintenance of irrigation systems. The savings can be used either to reduce government expenditures in the irrigation sector or to reallocate funds to more inherently government functions, such as regulating water use along river basins and addressing environmental and health concerns.

Douglas L. Vermillion's in his report, Impacts of Irrigation Management Transfer: A Review of the Evidence, evaluated data from 29 studies of IMT and synthesized evidence about the impacts of management transfer programs on the financial viability of irrigation systems, the quality of irrigation operations and maintenance, the physical sustainability of irrigation infrastructure, agricultural and economic productivity, and the environment. This report shows a mixture of positive and negative results, while on balance most sources report positive results, especially in operations and finance.

In less-developed countries, most post-transfer organizations tend to be water users' associations that take over O&M responsibility directly, at relatively small scales (i.e., less than 1,000 hectares of service area). The components most commonly lacking in Asian countries tend to be clear water rights, clearly designated lines of authority between farmers and agencies, and effective accountability and incentive systems. At larger scales of transfer, such as in the USA, Mexico, Japan, and Taiwan, post-transfer governance entities tend to be farmer-elected boards of directors while management entities tend to be organization of professional staff. These countries have stronger legal systems and local institutions that are more capable of handling management at larger scales of complexity than legal systems and organizations in less- affluent countries.

Irrigation organizations in industrial countries are independent legal entities, such as semi-municipalities, mutual companies, and water districts.

I will briefly discuss the management and ownership of irrigation systems by the private sector after discussing the more popular option of management by the user organizations commonly called Participatory Irrigation Management. Many people often use the words IMT and PIM interchangeably but Irrigation Management Transfer (IMT) is not the same thing as Participatory Irrigation Management (PIM). The term, IMT, refers to the act of transferring management from the public sector agency to some other entity, usually a water user association. PIM usually refers to the situation after this act of transfer has taken place.<sup>24</sup>

**Participatory Irrigation Management (PIM).** Participation refers to a continuum of involvement of the water users in management decisions. One meaning of PIM may be that the irrigation users have total control and responsibility of all aspects including the initial planning and design of new irrigation projects or improvements, as well as the construction, supervision, and financing, decision rules, operation, maintenance, monitoring, and evaluation of the system. Another meaning of PIM may be that a farmer council only plays an advisory role, with real power remaining in the hands of the irrigation agency.

The range of government-user relationships can be characterized as a continuum from the government doing everything on behalf of the users, to the case of the government doing nothing for the users. In between these two ends of the continuum, government agency performs some management functions and farmers perform other functions. The continuum can be divided into four types from more to less government involvement<sup>25</sup>:

**Type 1: Government does everything.** In Malaysia, the Department of Irrigation and Drainage provides for the operation and maintenance of the main and secondary canals, while government sponsored farmers organizations are responsible for providing water to individual farms. Farmers have no responsibility and make no management decisions about the water upstream from their outlets.

**Type 2: Government dominates; users help.** The conventional management division in large irrigation systems is that the government takes responsibility for operation and maintenance of the head works such as a dam or river diversion, and the main, secondary, and larger tertiary canals, while farmers are responsible for managing water distribution and maintenance along the lowest level canals. Typically this entails farmer groups of between ten and fifty farm families who are expected to work out sharing arrangements on their own.

**Type 3: Users dominate; government facilitates.** In some countries, associations of water users enter into contractual agreements with government water agencies for the provision of specific water services. In the case of Mexico, the National Water Commission manages the head works and main canals, while legally recognized water user associations employ their own technical staff for the management of the secondary

and tertiary levels of the canal networks. Farmers pay their associations for the water, and a small portion of that fee is passed on to the National Water Commission for their services.

**Type 4: Users do everything.** In the Hill regions of Nepal, most of the irrigated area is in the hands of local communities who have constructed their own canal systems, generally tapping small stream flows. Similar examples of local, farmer-managed systems can be found in nearly every country where irrigation is important, and the rules and customs of such systems provides a valuable pool of local knowledge that can be tapped in developing new irrigated areas.

Countries can be ranked according to their level of participation of the users in the irrigation sector. At the one end, there is the United States, France, and Japan where irrigation users have largely replaced the state in managing the irrigation sector although the government retains regulatory functions. At the other end of the continuum, where the state continues to dominate most aspects of irrigation and down to the tertiary or even quaternary levels, there are countries like Morocco, India, Pakistan, etc.

The strategies, that countries have taken in implementing PIM policies may be characterized according to three basic approaches: (1) the rapid "big-bang" approach of Mexico where water users are strongly pressured to establish an organization to replace the government, (2) the "bottom-up" slow approach of the Philippines with a strong focus on organizing and consensus building, and (3) a hybrid approach which adopts a moderate pace, such as that adopted by Turkey.

Douglas L. Vermillion in another study, *Management Devolution and the Sustainability of Irrigation: Results of Comprehensive versus Partial Strategies*,<sup>26</sup> asserts that in order for management devolution to produce effective and sustainable results it should be formulated as a comprehensive, integrated reform Partial or incremental approaches do not put in place sufficient motivation or capacity for farmer organizations to intensify management and investment nor ensure the long-term sustainability of scheme infrastructure.

Devolution in the Colombia Basin, USA included a water right, strong legal status for the districts, formal service agreements between the government, districts and users, full transfer of authority for district finances, O&M and rehabilitation, removal of government staff from the districts and strong capacity to impose incentives and sanctions to ensure accountability. The transfer resulted in significant reductions in staff and management costs, gradual enhancements in water delivery efficiency, technical innovation and long-term improvements in the economic productivity of irrigated agriculture.

By contrast, management turnover of distributary canals in Sri Lanka includes no water rights, only weak legal status for the WUA, no binding agreements between the agency, WUA and farmers, continuity of government staff in the scheme and a continuing supervisory and financial role for the government in O&M and rehabilitation. The modest

reforms have produced no significant improvements in total cost efficiency, quality of O&M or agricultural or economic productivity of irrigated agriculture. Inspection of infrastructure indicates that farmers have been seriously under-investing in maintenance after transfer. The case of management devolution in Colombia is somewhere in between the two cases, both in terms of extent of devolution and outcomes for performance.

The logic of PIM is that it ensures a coincidence of interests between managers and users because the users are themselves the managers, or the employers of the managers. Farmers can control water distribution in these arrangements and reduce the risk of supply shortages at critical growing periods. They have a direct interest in enhancing and sustaining the quality and cost efficiency of irrigation management. When given the authority and incentives to act collectively, farmers will act to contain the cost of water management while improving operational performance because it is in their direct interest to do so. Such service increases the farmers' willingness to pay for water. In the Philippines, farmers participate in communal programs by operating the irrigation distribution facilities. As part of the irrigation associations they are also responsible for maintaining the water systems and collecting the irrigation service fee. Cost recovery as a percentage of operations and maintenance expenditures averaged 80 percent in the 1979-89 period.[27](#)

This model is probably not well suited for management at higher levels of larger systems or in more complex management environments. Accountability between farmers and leaders, especially in finances, is often weak, and water users' associations generally do not have professional staff. As a result, many conclude that transfer can only occur at small scales of management. The operation of trunk and feeder facilities can increasingly be handled by financially autonomous entities, while the ownership and operation of tertiary systems may be best devolved to user associations or cooperatives. This solution improves both maintenance and the collection of water charges- two perennial problems in many irrigation systems.[28](#)

Action research is needed on alternative non-governmental management models that are expected to be more capable of managing medium-scale or large irrigation systems, such as irrigation districts or mutual companies. Here, we discuss the results of an action research in Pakistan on the feasibility of user management at the secondary level.

**Shared Management of Irrigation Systems in Pakistan** [29](#). An action research program conducted at four pilot sites in Pakistan found that organizing water users at the secondary level of Pakistan's contiguous canal irrigation system was socially feasible. This was contrary to the popular beliefs that existed both within and outside Pakistan. It resulted in successfully achieving the formation of two hundred water user associations (WUAs) at the tertiary (watercourse) level, and four water user federations (WUFs) at the secondary canal (distributary) level at the four pilot sites. The suggested institutional framework for sharing responsibility for water resources management is a combination of property rights regimes. Notably, the newly introduced element to this framework is the conversion of the existing state-property regime at the secondary canal level to a common-property regime. This change will involve the common-property regime at the

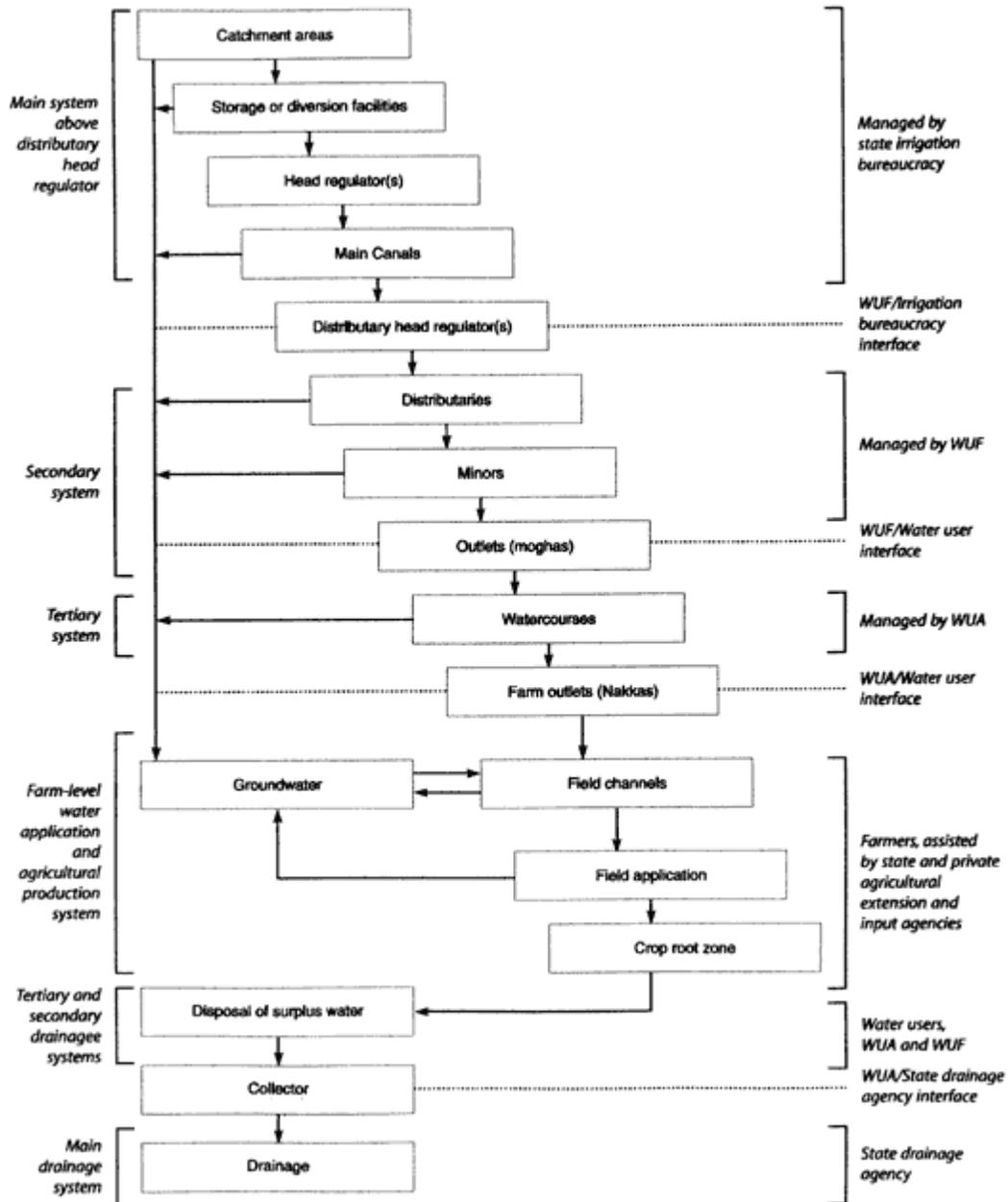
secondary canal level to have interactions with the state for water delivery in the main canal and with a private property regime at the tertiary level for appropriation of water resources units.

On this basis, the property rights of a canal irrigation system in which a time-based water turn rotation (warabandi) among the individual water users is in operation at the tertiary level, can be assigned to the state and the users in the following manner:

- the secondary level distributary canal and the primary level main canal, including both the water flowing in them and their physical facilities, are state property.
- the tertiary level watercourse is a combination of common and private property rights. The physical system is common property as it belongs to the whole group of water users in the watercourse command area, whereas, the water flowing at a given time in the water-course is private property as it belongs to one water user who is having the warabandi turn at the time.

### **FIG.3-2 SHARED WATER RESOURCES MANAGEMENT IN LARGE CANALS**

**FIG. 3-2 SHARED WATER RESOURCES MANAGEMENT IN LARGE CANALS**



Source: Bandaragoda, D.J. 1999. Institutional Change and Shared Management of Water Resources in Large Canal Systems: Results of an Action Research Program in Pakistan. Research Report 36. International Water Management Institute, Colombo, Sri Lanka. 30.

In this combination of property rights regimes, a significant effort is necessary to effectively reorient roles of the state, community, and the individual. Figure 3-2 depicts the interface between water users, their organizations, and the state. At the top level of the canal system, the state will be responsible not only for

the management of reservoirs and main canals, but also for determining higher-level allocation rules with greater clarity. Once the organized water users take over the secondary level canal subsystems, the water resource system in the distributary can be treated as a common pool resource, which is owned and managed as common property. At the distributary level, the communities will adhere to the allocated water and take the responsibility for the equitable distribution of water according to their own agreed internal rules, and also for mobilizing resources for managing the distributary as well as sharing the upstream canal management cost with the state. Much greater freedom can be exercised by the individual water user at the watercourse level, once their water allocations are known.

The private property regime associated with water resources in the watercourse and its application in crop fields also requires that the handling of surplus water is a private responsibility until it reaches a drainage facility commonly owned by a WUA. The WUF can undertake drainage responsibility within the distributary command area, until the collected surplus water reaches a larger drainage facility operated by a state agency.

**Prerequisites for Successful Irrigation Management Transfer to Water Users.** A review of world wide experience with water users' organizations found the following to be critical factors that influence the likelihood of success of irrigation management transfers:

- **Socially cohesive groups, with existing institutions to build on:** Where there are not strong patterns of cooperation, or a very heterogeneous group of users, employing trained social organizers may be a necessary investment. (These can be thought of as a subsidy to help meet initial transactions costs.)
- **Adequate training:** Devolution programs need to ensure that farmers or their employees have the technical skills for O&M and organizational skills such as accounting and running meetings.
- **Policies that emphasize cost recovery from irrigation systems:** Authorizing farmers' associations to keep a portion of the irrigation fees to meet their own expenses can strengthen the organizations, and collecting fees can provide the organizations with leverage in dealing with government agencies to improve irrigation services for farmers overall. Low official irrigation charges make it more difficult to offer a rebate on irrigation fees as an incentive for farmers' organizations to take on certain tasks (such as collecting the fees or maintaining part of the system). A facilitating legal framework that balances requirements or responsibilities with rights of the user organizations: specific provisions would include recognition of the organization as representative of irrigators in dealing with external agencies; rights to mobilize resources from its membership (and, potentially, other sources); ability to open and operate bank accounts and obtain credit; and provision for contracts between the government and farmers' groups, that clarify the responsibilities of each party.
- **Ownership of irrigation facilities and/or water rights by the user organizations:** Ownership can strengthen local management groups, provided the latter are willing and able to make the necessary resource commitments to maintain the systems.
- **A sustainable water right vested in a legally recognized WUA.** The water right should be environmentally sustainable and vested in a legally recognized water users association. This enhances farmer confidence in the service and willingness to invest in the long-term viability of the system.
- **An agreed irrigation service.** Clear and binding irrigation service agreements between the government and the water users association (WUA) and between the WUA and the individual users create essential cross-accountability between parties and clarify expectations essential to effective management. Such agreements should also be implementable within the constraints of local management capacity and irrigation technology.
- **Balance between responsibility and authority devolved.** Devolution programs tend to involve power struggles. This sometimes results in a transfer of responsibilities without commensurate authority. An example is in the case of Colombia, where, for the early schemes which were transferred, responsibility to implement O&M was given to the districts but the districts had no control over developing the O&M plan and budget. We argue that without a balance between

- responsibility and authority for key management tasks (the third element) the local organization will lack the ability and incentive to discharge its new responsibilities.
- **Devolution of integrated management responsibility.** An important element is integrated management responsibility, meaning that the local organization must have primary control over the three closely-interconnected roles of financial management, O&M and conflict resolution. Because of their inter-relatedness, where farmer organizations do not have primary control over all three, management will be overwhelmed by political disputes, speculation, corruption and standoffs.
  - **Adequate incentives and sanctions to ensure accountability.** Organizational incentives and sanctions should be commensurate with whatever level of management control and accountability is required by the agreed irrigation service. This may sound obvious but it is commonly absent in centrally financed irrigation agencies and development authorities. It is one of the main problems that devolution is supposed to solve.

## PRIVATE SECTOR MANAGEMENT

Among the various types of management transfer options, the most rare type is private management. This is mainly because irrigation water is a social good involving large numbers of small farmers, and it is very difficult for a commercial company to manage it with profit. This type of management is not a commonly used option currently. Here we discuss the private management of irrigations systems through contracting or franchising and ownership of by mutual agencies.

**Private Sector in Service Delivery.** The government encourages private-sector organizations to provide irrigation services, in particular from groundwater sources. In Bangladesh, Pakistan, and Nigeria governments are actively encouraging private-sector development of locally managed tube-well irrigation. Competition can be created through:

- **Contracting.** The government specifies the scope of work, terms and conditions and pays nongovernmental contractors or water users' associations to do the work. An example is management of distributary canal organizations in Sri Lanka.
- **Franchises.** The government awards rights to non-governmental organizations to supply an irrigation service for a specified period of time. However, unlike service contracts, water users pay for the service directly. An example is in Hunan, China, where local irrigation management organizations hold auctions and grant franchises to local groups to manage O&M for a specified period of time.

**Privatization of Assets.** This is the conversion of ownership of irrigation property from the government to non-government organizations or individuals. Such property may include irrigation infrastructure and/or water rights. Privatization may be implemented through sale of assets, sale of stock, or legal transfer of ownership. Examples are the sale of public tube-wells in Bangladesh and Pakistan and the sale of all public irrigation systems to the water users' organizations in New Zealand.

**Mutual Agencies in California** The history of irrigation in the western United States shows coexistence between public and private ownership of facilities used in capturing and transporting water between the locations of natural water supply to fertile agricultural lands. An astonishing array of private and public institutions exists in California for the purpose of developing and allocating water resources. The important private institutions are long-standing commercial water companies and mutual water agencies. Their principal purposes are to establish rights to water use and to sell and deliver water to users. The mutual agencies sell water to members at supply costs and are thus nonprofit. The water companies sell water to customers within their service areas at whatever prices the market will bear, and the profits are distributed to stockholders as with any private company. The mutual companies are more frequently utilized in irrigation, whereas the commercial companies are more heavily involved in serving urban customers.

The public water districts that supply most of the water to agriculture in California are the reclamation districts, the irrigation districts, the water districts and the water storage districts. Their primary purposes are to reclaim and protect lands from overflow and to irrigate lands both inside and outside the district. Irrigation districts supply, distribute and salvage water for beneficial use. Water districts and water storage districts may produce, store, and distribute irrigation water to individual farmers. Each of these public districts in essence become a nonprofit wholesaler of water to farmers.

Analysis of resource decisions under the contract rules of the mutual irrigation company indicates that private enterprise is quite capable of overcoming the three problems identified by traditional regulatory economics: financing, monopoly and risk spreading. The decisions of individual, profit-maximizing farmers would allocate water efficiently among its competing uses, pursue the optimum scale of irrigation development, and efficiently allocate the economic risk.

**Prerequisites for Introduction of Market Forces.** Research to date and reports from practitioners in international meetings favor the notion that certain prerequisites are needed before countries can expect to achieve success with introduction of market forces into the allocation of water. The most common preconditions for the beneficial introduction of market forces into the allocation of water are:

- A clearly recognized and sustainable water right and water service
- Infrastructure that is compatible with the water service and local management capacities
- Well-specified management functions and assignment of authority
- Effective accountability and incentives for management
- Arrangements for viable and timely conflict resolution
- The entitlements of all users under all levels of resource availability are defined and include specified assignments to social and environmental uses
- Reallocations of water can be measured and delivered, and third-party impacts (in quality, quantity, time, and place) can be identified
- Users must be legally obligated to pay defined user fees through effective legal and policy procedures
- Large-scale transfers of water with and between sectors must be subject to approval and relevant charges by regulatory agencies.

## **CONCLUSION**

No single type of management entity is best for all types of irrigation systems. It is increasingly rare to find pure state management without user involvement, or user management without a strong state presence. Water markets are likely to require both state regulation and user organization. What is required is to find the appropriate combination of state, user, and market institutions for each context.

Douglas J. Merrey's report, *Institutional Design Principles for Accountability in Large Irrigation System*<sup>30</sup>, makes a crucial assumption: that the government agency will continue to retain primary responsibility for overall system management in the larger systems and will share some of these responsibilities with farmer organizations. It explores the hypothesis that irrigation systems managed by financially and organizationally autonomous system-specific organizations that are accountable to their customers perform better and are more sustainable than systems managed by agencies dependent on the government and agencies responsible for many systems. Although there are variations in what tasks and responsibilities are shared, turned over to farmers, or retained by the government, the most frequent pattern in Asia is one in which the government retains overall ownership and financial responsibility for the system and control over the water resource, reservoirs, and main canals. There is an essential role for the state in the development and management of large-scale systems and in oversight areas-over exploitation of ground-water; pollution of canals, drains, and aquifers; dam safety; competition among urban and agricultural demands; and drought planning.

Maintenance and (perhaps) operation of lower-level canals are turned over to WUAs. Representatives of farmers may or may not be consulted on policy issues affecting the larger system. Devolution of water management to user groups can reduce the fiscal costs of irrigation management, and can lead to more flexible allocation patterns than under state management. However, the high transactions costs for organizing users to develop systems and allocate water over large areas means that user management is more often found for small-scale systems and the tertiary level of major systems. An expanded role for user allocation is possible with federations of base-level groups, and with organizational structures such as irrigation districts. With fiscal pressures to reduce state subsidies for recurrent operation and maintenance costs, policies to officially transfer management responsibilities from agencies to farmers are likely to receive increasing attention.

Privatizing water, in the sense of giving farmers-and markets--a greater role in both the financing and management of irrigation, is a promising development. Its major benefits are likely to be more in the long run than in the short run, by inducing technological and institutional innovations in irrigation management.

Market allocation has strong advantages in providing incentives for users to seek the highest value applications for scarce water resources. For the operation of effective water markets, well defined, quantifiable, and transferable property rights must exist. Market development and the establishment of clear and firm water rights are compatible with continued state involvement and expanded user group participation in water management. In the establishment of tradable water rights and development of water markets, identifying, establishing, and adjudicating water rights; quantifying, monitoring and regulating harmful externalities, and providing the appropriate legal and institutional support remain the government's vital

The problems of irrigation management are complex, and are likely to require a combination of institutions. The state, user groups, and markets are all likely to be called on, though the role of each may shift. Government agencies are likely to shift from direct management of systems to regulation and facilitation of user groups and markets. Organized farmer involvement is increasingly called on for direct management of systems, or for coordinating market exchanges within and between groups of water users. Finally, the private economic incentives of water users need to be taken into account in demand management and irrigation development.

## NOTES

1 Dinar, Ariel and R. Maria Saleh. January 1999. Water Challenge and Institutional Response: A Cross Country Perspective. Policy Research Working Paper No. 2045. World Bank, Washington D.C.

2 Vermillion, Douglas L. and Sam H. Johnson 111. September 1994. Globalization of Irrigation Management Transfer: A Summary of Ideas and Experiences from the Wuhan Conference. Proceedings of the International Conference on Irrigation Management Transfer. Wuhan, China.

3 Mody, Ashoka, ed. 1996. Infrastructure Delivery: Private Initiative and the Public Good. World Bank, Washington D.C. 140-141.

4 Meinzen-Dick, Ruth. State Administration, Devolution, and Water Markets in Irrigation Management. DVWK Bulletin 20: Deregulation, Decentralization, and Privatization in Irrigation, German Association for Water Resources and Land Improvement, Bonn, Federal Republic of Germany. 5-24.

5 Meinzen-Dick, Ruth

6 CPRs are "natural and man-made resources sufficiently large that it is costly to exclude users from obtaining subtractable resource unit&"

7 Bandaragoda, D.J. 1999. Institutional Change and Shared Management of Water Resources in Large Canal Systems: Results of an Action Research Program in Pakistan. Research Report 36. International Water Management Institute, Colombo, Sri Lanka.

8 This diagram to explain the exclusion and consumption properties of irrigation goods and services has been adapted from. Saves, E.S. 2000. Privatization and Public-Private Partnerships. Chatham House Publishers New York. 46-47.

9 Perry, C.J., M. Rock and D. Seckler. 1997. Water as an Economic Goo & A Solution or a Problem- Research Report 14. International Irrigation Management Institute, Colombo, Sri Lanka.

10 Ostrom Elinor. 1992. Crafting Institutions for Self-Governing Irrigation Systems. Institute for Contemporary Studies, San Francisco.

11 For a detailed explanation of externalities in water, see Perry.

12 Perry

13 Meinzen-Dick, Ruth.

14 Ostrom 33.

15 Ostrom, 6.

16 Svendsen, Mark. 1994. Financial Autonomy, Institutional Reform and Irrigation Performance. Vikalpa 19.2: 35-42.

17 Perry

18 Perry

19 Perry

20 Meinzen-Dick, Ruth.

21 Anderson, Terry L. ed Water Rights: Scarce Resource Allocation, Bureaucracy, and the Environment. Pacific Institute, San Francisco.

22 Vermillion, Douglas L. and Sam H. Johnson 111.

23 Vermillion Douglas L. 1997. Impacts of Irrigation Management Transfer: A Review of the Evidence. Research Report 11. International Irrigation Management Institute, Colombo, Sri Lanka.

24 May 1997. Editorial: "PIM" or "IMT"- INPIM. Newsletter No. 5.

25 World Bank. Electronic Learning Guidebook to Participatory Irrigation Management. Retrieved August 25, 2000, from the World Wide Web: <http://www.worldbank.org/wbi/pimeig/index.htm>

26 Vermillion, Douglas L. 1997. Management Devolution and the Sustainability of Irrigation: Results of Comprehensive versus Partial Strategies. Presented at the FAO/World Bank Technical Consultation on Decentralization and Rural Development, Rome.

27 Mody 141-142.

28 World Bank. 1994. World Development Report 1994: Infrastructure for Development. New York: Oxford University Press. 117

29 For a detailed discussion of this action research, see Bandaragoda.

30 Merrey, Douglas J. 1996. Institutional Design Principles for Accountability in Large Irrigation Systems. Research Report 8. International Irrigation Management Institute, Colombo, Sri Lanka.

## **REFERENCES**

May 1999. Abstracts of Papers from Fourth International Seminar on PIM. INPIM Newsletter No. 9.

May 1997. Editorial: "PIM" or "IMT"- INPIM. Newsletter No. 5.

World Bank. Electronic Learning Guidebook to Participatory Irrigation Management. Retrieved October 25, 2000, from the World Wide Web: <http://www.worldbank.org/wbi/pimelg/index.htm>

Anderson, Terry L. ed. 1983. **Water Rights: Scarce Resource Allocation, Bureaucracy, and the Environment.** Pacific Institute, San Francisco.

Bandaragoda, D.J. 1999. **Institutional Change and Shared Management of Water Resources in Large Canal Systems: Results of an Action Research Program in Pakistan.** Research Report 36. International Water Management Institute, Colombo, Sri Lanka.

Berg, Caroline van den. June 1997. **Water Privatization and Regulation in England and Wales.** Public Policy for the Private Sector, Quarterly No. 10. World Bank, Washington D.C.

Cowen, Penelope J. Brook. September 1997. **The Private Sector in Water and Sanitation-How to Get Started.** Public Policy for the Private Sector, Quarterly No. 11. World Bank, Washington D.C.

Cowen, Penelope J. Brook. June 1996. **The Guinea Water Lease-Five Years On.** Public Policy for the Private Sector, Special Edition. World Bank, Washington D.C.

Crampes, Claude and Antonio Estache. September 1996. **Regulating Water Concessions in Argentina.** Public Policy for the Private Sector, Quarterly No. 8, World Bank, Washington D.C.

Dinar, Ariel and R. Maria Saleth. January 1999. **Water Challenge and Institutional Response: A Cross Country Perspective.** Policy Research Working Paper No. 2045. World Bank, Washington D.C.

Dnes, Anthony W. June 1996. **Franchising and Privatization.** Public Policy for the Private Sector. World Bank, Washington D.C.

Kerf, Michael and Warren Smith. 1996. **Privatizing Africa's Infrastructure: Promise and Challenge.** World Bank Technical Paper No. 337. World Bank, Washington D.C.

Kessides, Christine. 1993. **Institutional Options for the Provision of Infrastructure.** World Bank Discussion Paper No. 212. World Bank, Washington D.C.

Klein, Michael. September 1996. **Economic Regulation of Water Companies.** Policy Research Working Paper No. 1649. World Bank, Washington D.C.

- Lorena Alcazar Manuel A. Abdala and Mary M. Shirley. April 2000. **The Buenos Aires Water Concession**. Policy Research Working Paper No. 2311. World Bank, Washington D.C.
- Meinzen-Dick, Ruth. **State Administration, Devolution, and Water Markets in Irrigation Management**. DVWK Bulletin 20: Deregulation, Decentralization, and Privatization in Irrigation, German Association for Water Resources and Land Improvement, Bonn, Federal Republic of Germany.
- Menard, Claude and George Clarke. June 2000. **A Transitory Regime: Water Supply in Conkary, Guinea**. Policy Research Working Paper No. 2362. World Bank, Washington D.C.
- Merrey, Douglas J. 1996. **Institutional Design Principles for Accountability in Large Irrigation Systems**. Research Report 8. International Irrigation Management Institute, Colombo, Sri Lanka.
- Mody, Ashoka, ed. 1996. **Infrastructure Delivery: Private Initiative and the Public Good**. World Bank, Washington D.C.
- Nankani, Helen. December 1996. **Testing the Waters--A Phased Approach to a Water Concession in Trinidad and Tobago**. Public Policy for the Private Sector, Quarterly No. 9. World Bank, Washington D.C.
- Nickson, Andrew. **SAGUAPAC/Bolivia: A Water Co-operative for a Large City. Does it work- IRC's SOURCE Bulletin and the DECNET Bulletin**. Retrieved November 15, 2000, from the World Wide Web: <http://www.africanwater.org/ppjebate.htm#Articles>.
- Ostrom Elinor. 1992. **Crafting Institutions for Self-Governing Irrigation Systems**. Institute for Contemporary Studies, San Francisco.
- Perry, C.J., M. Rock and D. Seckler. 1997. **Water as an Economic Good: A Solution or a Problem-** Research Report 14. International Irrigation Management Institute, Colombo, Sri Lanka.
- Savas, E.S. 2000. **Privatization and Public-Private Partnerships**. Chatham House Publishers, New York.
- Silva, Gisele, Nicole Tynan and Yesim Yihnaz. September 1998. Private Participation in the Water and Sewerage Sector--Recent Trends. **Public Policy for the Private Sector, Quarterly No. 14**. World Bank, Washington D.C.
- Svensden, Mark. 1994. **Financial Autonomy, Institutional Reform and Irrigation Performance**. *Vikalpa* 19.2: 35-42.
- Triche, Thelma A. 1990. **Private Participation in the Delivery of Guinea's Water Supply Services**. Policy, Research, and External Affairs Working Paper No. 477. World Bank, Infrastructure and Urban Development Department, Washington D.C.
- Vermillion, Douglas L. 1997. **Impacts of Irrigation Management Transfer: A Review of the Evidence**. Research Report 11. International Irrigation Management Institute, Colombo, Sri Lanka.
- Vermillion, Douglas L. and Sam H. Johnson 111. September 1994. **Globalization of Irrigation Management Transfer: A Summary of Ideas and Experiences from the Wuhan Conference**. Proceedings of the International Conference on Irrigation Management Transfer. Wuhan, China.
- Vermillion, Douglas L. 1997. **Management Devolution and the Sustainability of Irrigation: Results of Comprehensive versus Partial Strategies**. Presented at the FAO/World Bank Technical Consultation on Decentralization and Rural Development, Rome.

World Bank. 1994. **World Development Report 1994: Infrastructure for Development**. New York: Oxford University Press.

---