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A Primer on Water Economics and Financing for Developing Countries

June 2008

Paper prepared for the EXPO 2008 Zaragoza

by

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Chapter I: Increasing Efficiency and Availability of Water Investments

Water is essential for survival. It has been estimated that human beings need at least 4 to 5 gallons of water a day to survive. While there is enough water for everyone, access to that water is a considerable problem. Recent studies forecast that, under current water management conditions, 35 percent of the world's population will run short of water in the next 25 years. Even in areas where water is not scarce, many people do not have access to it. More than one billion people lack access to safe drinking water (two-thirds of them live on less than $2 a day) and more than 2.6 billion lack access to improved sanitation.

Recent UN figures show that there are more than 100 million persons that still lack access to safe drinking water in Europe, contributing to the deaths from diarrhea of nearly 40 children across the region every day. At the world level, current evidence shows that 1.7 million deaths a year could be avoided by providing access to safe drinking water and sanitation. These gaps have been recognized in the Millennium Development Goals (MDGs), where Target 10 of Goal number 7 calls for halving, by 2015, the proportion of people without sustainable access to safe drinking water. It is also dealt with indirectly in Target 5 of Goal 4, which calls for reducing by two-thirds, between 1990 and 2015, the mortality rate of children under 5 years of age.

The Food and Agriculture Organization (FAO) estimates that by 2030, food production needs to grow at 1.4 percent a year to satisfy demand. About half of this increase would have to be generated from irrigated fields. The challenge to meeting this need is water availability because more than half the world's population lives in parts of the planet where water is scarce. On a global scale, agriculture accounts for over 70 percent of world-wide water consumption, while industry accounts for 20 percent, with only 10 percent devoted to domestic consumption. In low-income countries, the figures are 88 percent for agriculture and 6 percent each for industry and domestic consumption. Thus, means need to be found to increase food production without increasing the share of water consumed by agriculture.

Needs for investment and water scarcity coexist with water waste, inefficient management, weak institutions, indiscriminate subsidies on water prices for both agricultural use and human consumption, and continuous increases in water investment costs. Indicators of water use efficiency in irrigation show that only 40 to 50 percent of the water delivered at various levels is actually used. In urban water systems, unaccounted-for water can reach 40 percent. This is even higher in developing countries. Expanding water supply through groundwater and reservoir storage implies huge environmental and economic costs. For example, in some parts of the world, the cost of tapping new groundwater supplies has tripled because aquifers have been drawn down. The drawdown is also causing pollution problems, further driving up the cost of treating water. Some users are turning to desalinization to meet rising demand, but even with recent technological advances, desalinization still is expensive.

It has been estimated that simply to achieve the water and sanitation MDGs, it will be necessary to undertake investments of $30 billion a year, more than double the current level. And these numbers do not include water for industry and agriculture, which are the major water users by far. It has also been recently estimated that, on average, developing countries should be investing at least 2 percent of GDP in the sector (with large variations by country income), but are investing significantly less. Most research indicates that while all sectors of national economies receive water subsidies,

industrial and agricultural water users receive the largest ones. Most users in developed countries as well as wealthy consumers in developing countries do not pay the true cost of water. However, the poorest sometimes have to pay up to 500 times the price paid by their better-off fellow citizens because their only options are to buy bottled water or purchase from local carriers.

New mechanisms for allocating resources must be put in place in order to bring demand and supply into balance. The "Dublin Principles," which were agreed to at the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro, Brazil, in 1992 establish, among other recommendations that ***"[w]ater has an economic value in all its competing uses, and should be recognized as an economic good."*** Although underlying concepts and theoretical foundations of economic incentives for this are quite simple, their application in practice is complicated by a variety of problems because incentive-based measures for improving efficiency in water use and attracting investment into the sector to expand supply were rarely used.

The problem of access to drinking water and sanitation is a complex one. Water is a capital intensive sector and significant investments are required to collect and distribute the resource. Nevertheless, many people consider water access a right and, as such, there is resistance to paying a price that is concomitant to its full delivered value. The matter is further complicated by the fact that water is indispensable for human health and for food production. As a result, access to water is a highly charged political issue that clouds decision-making regarding investments and control of the resource. Furthermore, many of the responsibilities for production and delivery are in the hands of sub-sovereign entities, adding another layer of political risks that stem out of shorter planning horizons and potential differences in political outlook with national governments, both of which increase the politization of decision-making.

Compounding these pricing and political problems is the fact that the investment climate in most developing countries is not conducive to investment in such a risky sector. Key elements like macroeconomic stability, rule of law, fiscal management, regulatory institutions and the functioning of the judicial system are in need of improvement in many developing countries. An enabling policy environment is critical for access to finance for the sector.

At the time of the publication of this paper, there is considerable turmoil in the financial markets, making access to finance more difficult for a sector considered by most as very risky because of the socioeconomic and political characteristics mentioned above. This situation is exacerbated by the decrease in public and private investment in infrastructure in general and the water and sanitation sector in particular. Private sector participation in water investments dropped from an average of $5.8 billion a year in the last five years of the twentieth century to less than $2.2 a year in the first six years of the current one. However, encouragingly, this lower level of participation includes more projects than before (albeit of a smaller size) and a significant increase in participation by local operators. The number of countries with private participation in such a complex sector has increased by 10 percent in the last five years and 16 countries have introduced private participation for the first time since the nadir reached in 2000. But even the peak figures achieved in the mid-1990s were a drop in the bucket compared to existing water finance requirements. Official Development Aid (ODA) for the sector has also increased considerably in the last few years as has that of the multilateral donors. But again, the combined $4 billion (in 2005) of these two sources are still insufficient.

Most of the financial resources are expected to come from the public sector, both national and

subnational governments, although the needs are so high that the financial, technical and managerial contributions of the private sector cannot be neglected. Ways must be found to increase the availability of new public and private resources and, especially, to make better use of existing ones. While it must be recognized that private investment and structured finance are now (temporarily) out of fashion, this does not mean that the sector can afford to ignore their potential contributions, particularly when seen in the broader context of their possible technical and managerial contributions.

The goal of this paper is to present a schematic discussion of the issues involved in increasing the economic and financial efficiency and availability of resources for improving access to water. Given the short space available, the issues cannot be discussed in any length and the reader is referred to the extensive bibliography at the end of the paper.

Chapter II: Mechanisms for Assigning Raw Water

Water has been traditionally viewed as an inexhaustible resource that should be available to everyone at little or no charge. The high cost of expanding the supply of water is not reflected in its price because pricing and allocation have been historically determined without reference to basic economic principles of supply and demand. Indeed, if the price of water were to reflect the actual cost of supply, demand would decrease. Efficient mechanisms for allocating resources must be put in place in order to bring demand and supply into balance. This chapter uses simple economic principles to guide the application of incentive-based measures for improving efficiency in the use of raw water.

Trading and Efficiency

In order to achieve the efficient allocation of water from a given river basin among the different uses and users, the marginal social benefit from each use should be equal. If this is not the case, there is at least one user whose allocation can be increased and who can be made better off without making the other users worse off. Given that the costs and benefits of different water users (such as irrigators of a particular crop or different households along a street) vary, equalizing users' marginal benefits requires either voluntary trade or the establishment of a mechanism for ensuring equal marginal benefits across users. Trading options would improve efficiency when externalities are not present. This pursuit of individual well-being by firms and households will draw on all the available information to equate marginal private benefits (which will also equal marginal social benefits) with the market price across the different uses and users of water.

Although trade would improve efficiency, government intervention is still necessary for several reasons. First, if externalities, such as pollution costs, are not included explicitly in the prices paid by water users, trade may still increase efficiency but the allocation of users and uses will not reach its most efficient point. In this case, measures such as taxes, pollution permits and regulation can be used to correct for the failure of the market. Second, government intervention may be also necessary to provide the public goods associated with water. For example, water that is allocated to environmental uses supports biodiversity for the benefit of current and future generations. Since public goods are characterised by non-rival consumption, the sum of individual marginal benefits yields the marginal social benefit. As a result, voluntary trade will generate allocations that are below the most efficient allocation. A final reason for government intervention is that property rights to

water must be defined and protected in order to make trade possible. In fact, the cornerstone of water trade is water rights.

Water Rights

A water right is a legal authorization to use a predefined quantity of water, which is a public resource. Authorization allows use for a designated purpose or for any other purpose that qualifies as a beneficial use. Beneficial use involves the allocation of a reasonable amount of water to a non-wasteful use, such as irrigation, domestic water supply or power generation. Transferable water rights are those that can be freely transferred between the owner of the right and other potential users for the same or for other uses. Trade in water and the development of a water rights market require transferable water rights. However, water rights markets need a well-defined system of property rights in order to facilitate the buying and selling of the resource.

There are four major issues associated with the proper definition of property rights that are independent of its transferability. The first of these issues has to do with the cost associated with a right, which varies across users and uses. The use of water involves at least three stages: delivery of the water to the user, the actual use of the water and wastewater disposal. These stages involve very different activities for different users and uses and, therefore, involve different costs. Transferable water rights must take into account the different costs associated with different users and uses of water. One way to approach this multiple characteristics issue is to unbundle them by establishing separate property rights for the primary water product (at the dam or aquifer), a delivery right, and a use licence to internalize the pollution costs associated with wastewater. This means that water use would require holding a water entitlement, as well as a delivery right and a use licence, which may involve different prices or costs.

The second major issue regarding the proper definition of property rights to water refers to the establishment of rules for resolving conflicts that may arise if the real flow of water is less than the assigned water rights. There are two basic models to establish these rules. One is the so-called *Prior Appropriation System* under which rights are expressed quantitatively (for instance, in cubic meters per hour). If the real flow of water is less than the assigned water, any conflicts that may arise are resolved through seniority. As will be discussed later, when these water rights are transferable and there are markets for them, the price of water rights will vary with the risks of shortages. Thus, it is possible to establish a price for water shortage risks. The other system for establishing conflict resolution rules is the *Correlatives Shares System*. Under this system, rights are expressed as a portion of available water. This avoids conflicts because water is appropriated after the real flow is known and, as a result, water rights with similar risks have uniform prices.

The third problem surrounding the definition of water rights has to do with the period of time for which the water entitlement is given. Most uses of water require complementary investments with effective lives of many years (often decades). As a result, water entitlements with long lives are preferable because they provide the assurance necessary to make these investment decisions. As long as any future changes in water rights are explicit, property rights remain clear and markets can work.

The final problem is whether the water entitlements should be assigned for gross or for net water diversions (that is, once account is taken for the return of quality water). In principle, net use is the appropriate measure, but it raises measurement costs for the quantity and quality of the return flow of water. Thus, for practical reasons, gross flows are a second best solution.

Payment and Fees for Water Rights

Water rights usually include a charge for variable costs that are generally defined as the operating costs. Sometimes, the rights also include the annuity value of investments and major refurbishment extensions. However, in many cases, local and central governments face fixed costs associated with water delivery. From an economic perspective, it can be argued that past capital costs are sunk and, as such, should not be taken into account when calculating efficiency prices. However, if the water entitlement is to include a scarcity of both investment and water, long-run prices should be able to meet investment costs

An area of contention is how to charge for the cost of delivering water when a large portion of the operating costs (such as maintenance expenses) are largely fixed. If potential users (who may not be actually using water) do not pay these operating costs, remaining users will be faced with paying a relatively higher share of the operating costs. One good option for dealing with this problem is requiring that owners of water delivery property rights bear their share of the operating cost regardless of whether they use the water or not .

Another issue regarding fees and payment associated with water rights is how to charge for pollution costs, such as sewage and industrial waste, or irrigation run-off into rivers. As mentioned earlier, one way to internalize pollution costs is to issue licences for the use of water. Licensing could take the form of regulation, for example, by requiring that sewage be treated and by blocking the transfer of irrigation water from low-impact to high-impact regions. Licensing could also take the form of taxes on the externality. In some cases, it is relatively easy to measure pollution (for example most household and industrial wastewater). By contrast, much of the water pollution related to irrigation is difficult to measure. Indirect methods are the only measurement option in such cases.

Market Institutions

Effective water markets will require a registry of information on the ownership and transfer of water entitlements, delivery rights and use licences, which is transparent, available to all at a relatively low cost and has the full backing of the law. Options include a publicly-operated system similar to that which applies to land titles, or a system similar to the ownership of rights in public companies. Such systems could be administered by a public institution or by a regulated private organization. Electronic markets could bring buyers and sellers together to negotiate mutually beneficial transfers and prices. Again, information on transfer prices and quantities should be made readily available to the public.

When full transferability of water rights is possible, water rights transactions may have different characteristics as is the case with other assets. For example, a sale contract is a permanent exchange of a water right, but in the case of a lease contract, the owner keeps the property but allows others to use the right for a specified period of time. Another example is that of an option contract between a buyer and a seller, which specifies the circumstances under which the buyer can use the water rights. If the buyer uses the water right, he would then pay an additional price (striking or exercise price). Notice that transferability of water rights does not mean that all types of contracts can be entered into. Some systems only allow the full sale of rights, while other systems allow all types of contracts. However, despite the fact that all types of contracts may be legally permitted,

some may not be entered into because of the lack of appropriate institutions for recording and enforcing transactions other than a full sale.

The effective degree of transferability is important for the efficiency of market allocations under different regimes of water rights. If transferability is limited to only the full sale of water rights and users are not homogeneous, then efficiency is higher if water rights are based on an appropriation system, which, in addition, would promote larger investments. If transferability is limited to only the full sale of water rights and users are homogeneous, then efficiency is higher if water rights are based on correlative shares. Finally, if transferability is not limited and full sale, leasing and options are allowed, then both water rights systems are similar from an efficiency standpoint.

Final Remarks

Efficiency is achieved by allocating water between the different uses and users so that the marginal social benefit from each water use is equal. Otherwise, at least one user can be made better-off by increasing his allocation without making the others worse off. Given that different water users (such as irrigators of a particular crop, different households) could have different costs and benefits, equalizing users' marginal benefits requires either voluntary trade or a mechanism for ensuring equal marginal benefits across all users. However, due to externalities such as pollution, human health and environmental diversity, the existence of a market for trading water is not a sufficient condition for optimal allocation. Therefore, some sort of government intervention is also necessary. Although there are no simple rules to find the right balance between water trade and public sector intervention, both are needed.

Chapter III: Pricing Drinking Water and Sanitation

Overview of Pricing Issues

In most cases, drinking water is provided by a utility that is managed by a public or private entity, which operates within a subnational or national authority (such as a ministry). Water and sanitation services are generally provided together, although this is not always the case. When water and sanitation services are unbundled, sanitation is usually provided by a relatively autonomous municipal agency and financed through municipal taxes.[1] The reason for this is that sanitation services are required to ensure the proper disposal of wastewater, leaving no room for individual choice in the matter. If it is not feasible to enact municipal and national taxes to pay for sanitation, then water and sanitation should be bundled, and provided and billed together to ensure that sanitation charges are actually paid by consumers. This is necessary in order to avoid creating the wrong incentives that might lead to moral hazard if water and sanitation services were provided by different utility companies and payment for both services were collected by the water company. Taking the foregoing into account, the pricing discussion that follows refers to bundled and unbundled service provision.

As is the case in all monopoly segments of infrastructure services, pricing water and sanitation services is the central issue of sector regulation. The reason for this is that while in competitive

[1] Drinking water is generally provided in Europe by a typical utility while sanitation and water treatment is provided by the municipality. In many Latin American municipalities water and sanitation services are provided by one organization.

environments firms may not set prices higher than marginal costs without experiencing a large reduction of their market share, monopoly firms are able to do this without facing the same consequences. Moreover, given that the short-run demand elasticity of water is low, an unregulated monopoly will yield prices that are well above marginal costs. There are two different dimensions that must be taken into account when pricing water and sanitation utilities; namely, average prices and the price structure.

Operator revenues are a function of average prices, effective consumption of water and sanitation, and the degree to which bills are collected. In some services, operators' revenues are supplemented with public sector transfers, or a portion of this consumption is supported by the public sector and financed through taxes without passing these costs on to consumers in the form of higher prices.

Another issue is the distribution of the average price among various services and consumers. For example, service provision may be divided into two distinct services: access to the network and the actual provision of water for consumption. Thus, water users usually pay a charge for access to the delivery network, but not for the water itself. Access charges may include a fixed periodic (e.g. monthly) access fee as well as an initial charge. Connection fees may or may not be the same for all consumers. This is a function of the maximum water flow, user revenues and the location of the housing unit.

There are two main schemes for computing the charges associated with water usage. One is based on c*onstant rates per unit of water consumption;* that is, each consumer pays the same price for each unit of water. If charges are set equal to marginal cost and there are no externalities or increasing returns, this system allows for optimal allocations (to the extent that it allows for the equalization of marginal utility among all consumers, which, in turn, is a necessary condition of optimal allocation). The other scheme is based on increasing *rates per unit of water consumption.* Under this second system, average charges increase as water consumption increases. This system makes it possible to correct for externalities and could be a second best solution when increasing returns are present. In some cases, particularly in those services where it is not feasible to meter consumption, *flat rates* are charged that are more or less independent of the amount of water consumed. Rates *may* be linked to the projected level of use, according to, say, the number of persons in the household or the size of the pipe connection. Although no economic rationale can be found for this practice, it could be the only feasible way of collecting revenues in a system characterized by lack of meters or poor management. Charging different rates to different groups of consumers gives rise to the cross-subsidies issue that is discussed in chapter 4.

Marginal Cost Pricing

Most economists would accept that maximizing net social benefits implies that prices should be equal to marginal costs. However, marginal cost pricing is only a necessary condition for welfare maximization, not a sufficient one. It would be a sufficient condition only if average costs were not decreasing and there were no externalities. Moreover, marginal cost pricing would be a necessary condition for minimizing welfare when increasing returns are present. Given that the main reason for having only one firm provide water and sanitation services is that the underlying technology yields increasing returns in the relevant size range, the marginal cost pricing rule does not have much theoretical support. In other words, such a rule would only ensure optimality with decreasing returns and most specialists agree that this is not the case of water and sanitation services. Another problem is that in an increasing returns environment, the rule of marginal costs pricing would generate

financial losses for the utility because average costs would be higher than marginal cost. This would require some sort of government payment to cover the difference between average and marginal costs.

When water and sanitation services show non-increasing returns (as could be the case with services that are used at full capacity) and the cost of new connections is above the average cost paid by existing users, marginal cost pricing could be theoretically an option. However, there are practical difficulties that would advise against such an approach. Two additional points are in order in this regard. The first is that when marginal costs are increasing very fast, applying such a rule raises prices for consumers and increases the utility's profits, which could, in turn, trigger social condemnation of the utility and make payment unaffordable for a large part of the population. The second point refers to the difficulty in defining and calculating marginal costs, including using historical accounting data, imputing external costs and distributing joint costs. The American Water Works Association (1991) contends that "the application of the theory of marginal cost pricing to water rates lacks considerable practicality."

In most cases, accepting that water and sanitation present increasing returns also means accepting the lack of mechanisms to generate efficient allocations that are, at the same time, decentralized with respect to information and compatible with the incentives facing consumers and managers. The advise for politicians and regulators that stems from this powerful result emphasizes the importance of finding a market-like mechanism and showing some trade-offs between adequate incentives and informational requirements. The economic literature discusses the criteria to make appropriate decisions on how to cover the costs of water and sanitation services and how much revenue to collect from users. These criteria provide specific recommendations on how to achieve the primary goal of maximizing welfare while taking into account the limitations of the marginal cost pricing rule. An important criterion is the financial sustainability of the service, which requires sufficient revenues to meet the present and future financial obligations of the utility (that is, operating costs as well as the capital costs of facilities and infrastructure). Another criterion is that users should bear the cost of the service; that is, consumers should pay an amount equivalent to the burden of their consumption on society. This implies that charges should be high enough to recover the full costs, including not only operation, maintenance and capital replacement, but also taking into account positive and negative externalities. The third criterion is that water should be affordable for all. This means that prices should be set in such a way that low-income groups are able to pay for their efficient and rational consumption. Unfortunately, these criteria are often conflicting. For example, assuring that low-income groups are charged an affordable rate is likely to clash with the criteria of recovering full costs and ensuring financial sustainability. Other criteria for structuring user charges are simplicity, transparency and predictability. Simplicity means that tariffs should be understandable and straightforward for all social groups. This also allows consumers to understand how consumption patterns affect the amount they pay. Transparency enables consumers to understand how their own tariffs and those of other users are arrived at. Finally, predictability permits customers to reasonably anticipate and plan for their water-related expenses.

In some water and sanitation services **there are increasingly decreasing returns to scale** because of the need to use non-conventional water supplies (desalination, wastewater reuse, reduction of leakages in networks). This raises public concerns about the possibility that the

water companies may profit unfairly if services are priced at their marginal cost. To balance sustainability of service and consumer affordability, in cases where operator revenues stem from regulated prices, one option is to set average prices at average costs and have cost pricing guide the higher blocks in the block tariff structures.

Price Cap versus Cost-plus Schemes

There are several options available for establishing average charges for a utility. One option is high-powered incentive schemes such as price caps, which encourage cost-minimizing behavior, require less data from individual firms, and yield large rents to the most efficient types of firms. Another option is low-powered incentive schemes such as cost-of-service regulation, which control the profits of firms, require much internal information from firms, and create weak incentives for minimizing costs. A mixed mechanism in which charges are calculated using firms' real costs for some inputs and standard cost values for others is usually the most appropriate option.

However, in order to analyze the relative advantages of powered incentive schemes versus those with poor incentives, extreme cases such as pure price caps and pure cost-plus are considered. Comparing the costs and benefits of various schemes depends on the technological features of the water and sanitation sector, as well as the socio-political environment in which the services are provided. Although general recommendations that are valid for each environment cannot be made, certain rules for analyzing the cost-benefit implications of environmental features can be given. A first recommendation is that lower-powered incentive schemes mainly based on cost reimbursement are appropriate in developing countries as well as in other cases where the willingness and capacity to pay for the services are low. To understand this point notice that in high-powered incentive schemes, when an additional rent is relinquished to a particular firm to support an efficiency improvement, the same incentive must be provided to all of the more efficient firms generating high prices and large rents.

A second recommendation is that if there are large average cost differences across water utilities within a country, cost-plus schemes should be favored. If differences across units are large, setting average prices equivalent to those of the most inefficient utility results in large losses of consumers' surplus, while small differences generate smaller losses. Alternatively, as the differences across the average costs of utilities increase so does the ability to increase the efficiency of the less efficient utility. Thus, it becomes more important to set high-powered prices schemes. One balancing option is setting the rate of each utility as a convex combination of a cost-plus rate and a cap rate and making the effective rate approach the price cap as efficiency among the utilities also approaches.

A third recommendation is derived from the monitoring capacity. Monitoring of effort generally enables the regulator to reduce information rents and calls for higher-powered incentive schemes. A less efficient monitoring technology usually calls for less powerful incentive schemes. Indeed, low incentives and monitoring are substitute instruments used to extract the firm's rent. Decreasing the use of one instrument causes the other instrument to appear more attractive. In practice, however, costs are not perfectly observable. One must consider potential cost padding; that is, the many ways in which a firm can divert money such as, for example, establishing extra charges that benefit a firm's management and workers. The economic literature shows that imperfect auditing of cost padding calls for a shift toward higher-powered incentive schemes.

Chapter IV: Cross-Subsidies and Efficiency in Water and Sanitation Utilities

Cross-Subsidies and Consumer Separation: An Example

Assume that a profit-regulated firm provides water to two neighborhoods, *a* and *b*. Water supply requires two types of investments. The first type of investment, distribution pipelines, is specific for each neighborhood. Investments of the second type, storage tanks and pumps, can be used by both neighborhoods. The regulated firm´s total costs are the capital cost of investments and the cost of electricity for pumping water from the river to neighborhoods. The regulator sets the same price for both neighborhoods, which equals total average cost.

The manager of the regulated firm notices that the company may increase its profit by providing water to a new neighborhood, *c*, at a lower price than that charged neighborhoods *a* and *b*. The manager sets prices in neighborhood *c* so that revenues are slightly above that neighborhood's costs, as well as the pipeline distribution cost and the electricity cost. However, he does not charge for the cost of the storage tank and pumps. After starting the new policy, the firm's profits increase and so does total consumption. The regulator imposes a penalty on the manager because by setting prices in the new neighborhood lower, he is in noncompliance with existing regulations. The manager claims that the new price policy increases social welfare, arguing that because consumers pay voluntarily, their welfare must be larger than their payments. He also says that if revenues from new consumers are larger than incremental costs, the welfare gains are larger than the increase in social costs; that is, a net increase in social welfare occurs. In spite of the manager's claims, the regulator forces the manager to distribute the cost of the tank and pumps uniformly among the three neighborhoods. The new price policy means an insignificant reduction in the prices paid by consumers in neighborhoods *a* and *b,* and a large increase in the prices paid in neighborhood *c*. The results of this regulatory policy are a dramatic fall in consumption in neighborhood *c*, while consumption in neighborhoods *a* and *b* remains at approximately the previous levels.

The manager's arguments did not convince the regulator, but real life facts make him reconsider the manager's proposal. Thus, the regulator contracts a consultant to evaluate the manager's price policy. The consultant agrees that the manager's proposal increases social welfare, and points out that welfare can be further increased in the community if a full price discrimination scheme is established across the three neighborhoods. He recommends increasing prices in neighborhood *a*, decreasing them in neighborhood *b*, and maintaining the manager's proposed price in neighborhood *c*. He supports his recommendations with the following argument: Prices should be increased in neighborhood *a* because the area only has tourist hotels and the volume of water consumed by tourists is not sensitive to price increases. Thus, prices can be increased in neighborhood *a* to include the entire cost of the storage tank and pumps in addition to distribution costs, without resulting in a decline in water consumption. Prices can then be brought down in neighborhood *b* where consumers are sensitive to prices and the regulated firm would not incur any losses. The increase in consumption in neighborhood *b* is higher than the decrease in the neighborhood *a* and total consumption and social welfare increase.

The regulator carries out the consultant's recommendations. During the first months, the new measures are very popular. After six months, however, company revenues drop due to a decrease in consumption in neighborhood *a*, despite the fact that the number of tourists has increased sharply. Further investigations point to the fact that each hotel has its own well water system. Tourists may

have low price elasticity but hotels do not. The results are higher social costs for the communities and large losses for the regulated firm. The regulator tries to forbid the use of well water, but is unsuccessful.

Some Definitions

- *Marginal cost criterion*. Under this criterion, a price scheme is said to have cross-subsidies if some consumer prices are lower than the marginal cost. Otherwise, if all consumer prices are equal or above marginal costs, then the price scheme is subsidy free.
- *Average cost criterion*. Under this criterion, a price scheme is said to have cross-subsidies if some consumer prices are below average costs and others are above. Notice that when some costs are shared among different products, the average cost schedule cannot be precisely defined.
- *Incremental cost criterion*. Under this criterion, a price scheme is said to have cross-subsidies if revenues from a consumer or a group of consumers are less than the incremental cost of providing services to that consumer or group of consumers.
- *Stand-alone criterion*. Under this criterion, a price scheme is said to have cross-subsidies if the revenues from a consumer or group of consumers are larger than the cost of providing service alone to this consumer or group of consumers.

Market Efficiency

A well-known theoretical result states that any uniform price schedule different from marginal cost can be welfare dominated by a non-uniform price schedule if consumers have different price elasticities. These findings are relevant for setting discriminatory prices in water and sanitation services because marginal cost pricing does not cover total cost in the presence of increasing returns, a common feature of these services as well as other infrastructure. Therefore, if revenues from water and sanitation services cover total costs, then prices must diverge from marginal cost. In other words, from a welfare standpoint, price discrimination schedules may be better than a uniform price when the uniform prices do not equal marginal cost and price elasticity differs among consumers.

However, price discrimination may or may not imply cross-subsidies. If regulators set prices so that they just cover costs without yielding extraordinary profits, then any price discrimination scheme has implicit cross-subsidies according to the average cost criterion. The reason is that consumers who pay higher prices are paying more than average costs, while consumers who pay lower prices are paying less than average costs. In these cases, the allocations resulting from pricing with cross-subsidies according to the average cost criterion may dominate, from an efficiency standpoint, allocations resulting from uniform prices. It may occur that a price scheme that increases welfare with respect to uniform prices has cross subsidies according to the average cost criterion and does not have them according to the stand-alone or the incremental criterion. However, it may also be the case that a price scheme appropriate for welfare purposes has cross-subsidies according to the average cost, the stand-alone and the incremental cost definitions. Nevertheless, as discussed in the next section, prices must be free of cross-subsidy according to the marginal cost criterion for welfare goals.

Price Should Cover Marginal Costs

The previous sections have shown that price discrimination and cross-subsidies, in the increasing returns and a no-losses restriction, may increase social welfare. Yet, they are far from showing that all discriminatory schemes are appropriate for improving welfare. This section discusses three important considerations in analyzing the welfare implication of schemes with price discrimination and cross-subsidies.

First, cross-subsidy schemes with prices lower than marginal costs are not appropriate from the efficiency standpoint. The reason is simple, if the price paid by a consumer is lower than marginal costs; the social cost of this consumer service is larger than the benefit. Therefore, welfare is increased by just reducing production in the amount corresponding to the underpriced consumer. Second, schemes with cross-subsidies and price discrimination increase welfare only if they increase the level of consumption because price discrimination and cross-subsidies cause marginal rates of substitution to be different among consumers. If a cross-subsidy scheme is successful in increasing the consumption level, the welfare improvement from greater consumption may be larger than the welfare loss from the difference in marginal rates of substitution. Third, under increasing returns and the restriction of no losses in the regulated firm, a necessary condition for welfare maximization is that the deviation of prices from marginal cost in each market should be inversely related to the price elasticity of demand in each market.

Cross-Subsidies May Hinder Water Services

According to the average cost criterion, cross-subsidy schemes are a necessary condition for welfare maximization when increasing returns are present and losses are forbidden. Therefore, reasons other than welfare should be the cause for rejecting price schedules with cross-subsidies. One reason for rejecting cross-subsidies is that they may lead overpriced consumers to abandon the regulated firm or force the exclusion of underpriced consumers. The notion of voluntary sustainability is appropriate to analyze the extent to which cross-subsidies may destroy water and sanitation services.

A price discrimination scheme for a community is voluntarily sustainable if the following two conditions hold. First, each group of consumers pays less for the provision of the service than they would pay alone (*stand-alone criterion)*. This condition sets an upper bound for revenues from a consumer. Second, revenues from each group cover the incremental to total cost that occurs when the service is provided to that group as opposed to not being provided at all (*incremental cost criterion)*. This condition sets a lower bound for revenues from a group of consumers. When the first condition holds, no group will be willing to separate because doing so will increase their payments. However, if the second condition holds, no group is willing to exclude other groups.

Some observations on these conditions should be made. First, a price scheme is sustainable if, and only if, it is cross-subsidy-free according to both the stand-alone and the incremental criteria. Second, the incremental cost condition requires that prices should be above marginal costs. Therefore, price over marginal cost should hold for both welfare and sustainability reasons. Third, price schedules meeting the conditions for voluntary sustainability may have implicit cross-subsidies according to the average cost criterion. Four, the sustainability of a price scheme closely depends upon the alternatives for service provision of each consumer or group of consumers. That is, checking sustainability requires that information about alternative technologies be available to every group of consumers.

Three Main Conclusions

First, if a uniform price schedule is established and prices diverge from marginal cost, then social welfare can be increased by establishing appropriate price discrimination schemes that may have cross-subsidies. This does not mean that all schemes with cross-subsidies increase welfare, but some do. Second, from a voluntary sustainability standpoint, some cross-subsidy schemes are not suitable, whereas others are appropriate. Third, sometimes, optimal and voluntarily sustainable price schedules are not compatible. In these cases, a trade-off between optimality and sustainability is often necessary. In summary, cross-subsidies are good for increasing welfare, but inappropriate use may bring separation of overpriced consumers and large costs for all.

Chapter V: Challenges Facing the Use of Water for Agriculture

The Challenge of Agriculture

The Food and Agriculture Organization (FAO) estimates that by 2030, food production needs to grow by 1.4 percent a year, and that about half of this growth would have to be generated from irrigated agriculture. The challenge to meet this need is water availability because more than half of the world's population lives in water scarcity. Thus, the agricultural sector needs to increase food production without increasing agriculture's share of water consumption, which already is over 70 percent.[2] This challenge requires incentives for avoiding the squandering of water and ensuring that water flows toward the highest economic priorities. This chapter reviews issues associated with establishing such incentives

Prices and Water Efficiency

Water demand for irrigation is a derived demand; that is, it is derived from the demand for agricultural products. As a consequence, the sensitivity of water consumption to water prices (i.e. its price elasticity) is an increasing function of the share of water in total production costs, a decreasing function of the price elasticity of the final product and an increasing function of the elasticity of substitution between water and other inputs. These factors come together to determine the extent to which higher prices create an incentive for using water efficiently.

In most cases, an increase in the price of water would reduce its consumption without necessarily reducing agricultural output. The reason for this is twofold. First, higher prices reduce water squandering; that is, they create an incentive for using the least amount of water compatible with the existing technology and the given consumption of other inputs. Second, higher prices promote the use of technologies that consume less water. Some authors argue that because modern agricultural technologies require fixed proportions of inputs and water (i.e. a fixed proportion of water, land and fertilizer for a given amount of output), increasing water prices would not reduce the consumption of water, but would reduce agricultural income and destroy incentives to introduce new technologies. While such arguments are true in cases where technologies require a fixed proportion of inputs and there are optimal combinations of inputs and output, they do not hold when water is being squandered, as is usually the case when water has no cost and saving water is costly. Moreover,

[2] Globally, cereal yields will have to increase from the current average of about 3 tons per hectare to 4 tons per hectare by 2030. Agricultural water management will thus have to provide more efficient and equitable solutions for intensification at the basin level to increase water and land productivity.

fixed proportion technologies for a given output do not preclude choosing agricultural products requiring relatively less water.

In general, an increase in the price of water would have a smaller impact on water consumption in developed than in developing countries. This is true for two reasons. One reason is that the share of water in total costs is larger in developing countries (where land and labor are relatively cheaper) than in more industrialized countries. The second reason is that the price elasticity of the demand for food and other agricultural products declines as income increases, and spending on food as a share of total spending is proportionately larger for low-income groups.

Enhancing Agricultural Markets

Constraints to agricultural trade reduce the value added of agricultural products in most countries, but particularly in developing countries. Compared to other water and land uses, agriculture, in most locations, generates the lowest value added per unit of water or per unit of land. Therefore, as demand increases and competition mounts, farmers will progressively give up land and water to domestic, municipal and industrial uses.

Open trade in agricultural products would help establish incentives for investments in agriculture in developing as well as in developed countries. To the extent that new investment will embody new and more water efficient technologies, the liberalization of agricultural trade would promote more efficient and less water-intensive crop practices. However, policies that distort agricultural trade remain much more pervasive and substantial around the world than policies that distort trade in other goods. High agricultural tariffs are prevalent in East Asian countries, while the United States and the European Union rely on subsides.

Land Intensification and New Technologies

Given that agricultural inputs are limited, trade-driven growth needs to be accompanied by an intensification[3] in the use of land and the adoption of new technologies. Although research on the adoption of improved irrigation technologies is relatively new, there is evidence regarding the difficulties in introducing new technologies and their impact on water consumption.

First, the incentive to introduce new technologies appears lower in industrialized countries than in developing countries. Empirical studies show that investing in irrigation is not the unique response to more expensive water. Other options such as rainfed irrigation or selling a portion of land for other uses may be more profitable than investing in new technologies. The issue is finding incentives for increasing food, while promoting efficient water management. Second, subsides on capital cost technologies are effective for introducing new technologies, but not for saving water when water rights are not transferable and water prices are low. Moreover, simulations indicate that such subsidies may increase water consumption. According to the economic literature, the higher the level of capital subsidy, the more probable is the adoption of new irrigation technologies, but there is also evidence showing that water consumption may rise as a result. Third, the maximum efficiency of water utilization under common irrigation practices usually is not an economically efficient practice.

[3] Agricultural intensification has been defined as the use of "increased average inputs of labor or capital on smallholding, either cultivated land alone or on cultivated and grazing land, for the purpose of increasing the value of output per ha."

This implies that farmers would not choose irrigation technologies that embody maximum efficiency of water utilization. Therefore, water resource managers who are considering increasing irrigation efficiency as a major policy approach to saving water may be overestimating the potential increase in the supply of water as a result of the savings. In some cases, the overestimates can be large.

Investments in Irrigation

Public investment in agriculture has dropped, and investment in irrigation, drainage and other agricultural water management projects has also been declining worldwide. Two economic issues must be addressed in order to increase investments in efficient irrigation. Those issues are the identification and evaluation of costs and benefits from irrigation infrastructure, and the institutional framework for allocating costs among actors. These issues are not independent because the true benefits and costs to farmers will only be revealed if the benefits of doing so are higher than those of revealing false benefits and costs. However, it is not easy to attain an optimal level of investments even with public intervention, as the evidence below shows.

First, individual decisions by farmers do not result in optimal irrigation investments. The reason for this is that each farmer invests in irrigation by taking only his own benefits into account. Yet, the irrigation investments would also benefit others. Each consumer has an incentive to benefit from the irrigation investments of others, and invest insufficiently himself. This is referred to as "the free-rider problem." One option to remove the inefficiency of investments in irrigation is public sector intervention

Second, the Lindahl equilibrium provides a guide for the authorities to select the optimal level of investment. The idea is that each farmer pays a different price for water. Given that price, each farmer will maximize his or her profits; that is, the revenues from the crops minus the cost of water. The government will select the level of irrigation investments that maximizes the benefit of undertaking the investment and satisfying existing demand. Note that once individual prices are in place, each consumer chooses his/her own level of irrigation and the impact on the consumption of others is eliminated. The problem is in how to determine individual prices. One option is to set prices according to each farmer's willingness to pay. Nevertheless, under symmetric information, farmers could report a lower willingness to pay in order to minimize their own payments. Another option is to establish individual prices for water based on estimated benefits. Although this option may lead to the selection of inefficient agricultural products and technologies, its major shortcoming is societal rejection of price discrimination when discrimination is promoted by public sector authorities.

Third, a general lesson from the literature on public goods mechanisms is that, under asymmetric information, the optimal mechanism generally calls for deviations from the first-best allocations. The reason for this is that under asymmetric information, a farmer may report a willingness to pay for a public good that is lower than his/her actual willingness to pay, thus minimizing his/her own payments and letting other farmers bear the bulk of the investment. In order to remove those negative incentives, the authorities should undertake a lower level of investment than would have been undertaken under complete information.

Concluding Remarks

An economic policy whose aim is ensuring that water is not a barrier for agricultural production so that the sector can meet the increasing demand for food, must simultaneously set appropriate incentives in four areas. First, farmers should have incentives for the efficient use of water. Increasing water charges is a necessary condition for this, but it is not a sufficient one. Moreover, increasing water charges without introducing additional measures may lead farmers to reduce water-intensive crops and agricultural production. Second, the government should create incentives for increasing the value of agricultural products in order to avoid the transfer of land and water to other uses. This could imply temporarily higher prices for some agricultural products. Policy efforts should not artificially restrict prices, but should focus on promoting an increase in supply. Third, technical changes are a must if supply is to be increased in the face of higher input and output prices. If internal agricultural cash flows are not initially sufficient to finance investment, economic policy should create incentives to ensure that the appropriate investment is undertaken. Fourth, more infrastructure investments are needed to increase the availability of water. In most cases, these investments are public goods; therefore, some sort of public sector intervention is required to bring investment as near as possible to their optimal level.

Chapter VI. Efficiency as a Source of Finance

Inefficiencies

Reducing inefficiencies and having the proper environment for investment are important sources of financing. Before exploring the possibilities of obtaining public and private finance to carry out needed investments, governments must consider the elimination of technical and managerial inefficiencies in the provision of water services, as well as the creation of the proper policy, regulatory and investment environment to attract investment. The elimination of some of these inefficiencies may reduce the need for investments or may generate internal savings that diminish the need for external financing. In many developing countries, water service provision is relatively inefficient and the potential for improvement is very high. This section discusses the major sources of inefficiencies only in the context of their potential for reducing capital needs (**microeconomic inefficiencies** were discussed in the previous sections), and also considers the need for improving the sector´s enabling environment. Inefficiencies stem from technical, managerial and sectoral sources.

Among the major **technical inefficiencies** are non-revenue water and energy consumption; that is, losses from old pipes, illegal connections and non-metered water, which can reach upwards of 50 percent (although an overall average could be closer to 20 percent). Some of the losses are unavoidable, but many can be controlled. Investments to reduce non-revenue water and encourage conservation, water reuse and recycling can help avoid or postpone much more expensive capital investments. One of the major expenses in the provision of water is electricity consumption, which is used mostly to pump water. For instance, in Mexico and Brazil electricity consumption accounts for between 30 and 40 percent of water utility revenues. It is estimated that energy savings through efficiency improvements could reduce energy consumption by 10 to 40 percent, thereby saving between 5 and 15 percent of revenues. Moreover, the problems created by losses and energy efficiency compound each other because water that is lost has been pumped, wasting not only water, but also energy. In Brazil, 3.5 billion KWh per year are needed to pump water that is eventually lost. The cost of this electricity is over $300 million a year. Plugging this leak would generate potential savings in investment costs between $1 and $1.5 billion enough for a 500-1000 megawatts generating

plant (which would also contribute to reducing emissions). The potential energy savings of reducing non-revenue water are important even for smaller countries.

Inefficiencies in irrigation are similar and also include productivity losses resulting from the failure to manage catchments, losses due to evaporation, and losses from inappropriate irrigation and agricultural practices (such as irrigation of low value crops or even the cultivation of high water intensive crops where the marginal value of water is very high—the traditional "more crop per drop").

Among the major **managerial inefficiencies** at the service provider level are corruption, billing and collection issues, improper incentives for consumption, bloated payrolls (some public utilities are used for political patronage) and deficient management systems. The World Bank has estimated that the excess costs for civil works due to collusion between contractors are more than 15 percent, and that those resulting from kickbacks for contract awards are in the range of 6 to 11 percent.

Moreover, the World Bank has found that 40 percent of customers in South Asia reported having paid a bribe. In terms of inefficient billings and collections, it has been found that not all the water used is billed, not all bills are collected, and not all of the revenues collected are used efficiently. In many cases the incentives for consumption are perverse: there is a lack of metering, illegal connections are not billed and tariff structures do not provide the right incentives. In addition, efforts to collect on invoices are lacking. As explained in previous sections, in many cases, tariffs are insufficient to cover costs and are not related to the consumers' ability to pay. Correcting some of these inefficiencies can reduce costs and/or increase revenues, thereby reducing the need for new financing.

Other managerial inefficiencies include institutional weaknesses as they relate to the capacity of the sector authorities to prepare projects that can be presented for public or private finance. Most of the investments, particularly in new services, are the results of "projects" that have to identify the needs, make the trade-offs, demonstrate that they are a good use of resources and include plans for effective and efficient implementation. Many developing countries need to improve their institutional capacity in the areas of project preparation, execution and management of the operation of the system, particularly at the subnational level, where most water service projects are developed. This is a fertile ground for bilateral and multilateral aid geared to helping these countries help themselves. Indeed, several donors have developed special programs to support project development and institutional strengthening.

A third major source of inefficiency could be called "**sectoral**" **inefficiencies** and relates to issues of sector governance, policies and management. The water services sector is very complicated. In addition to the competing uses of water for domestic consumption, industry, agriculture and energy, water is a politically and socially sensitive resource. There are myriad institutions and government levels involved and, in most developing countries, the sector has traditionally faced scarcity of resources. In some cases, there are even cross-border management issues. There can also be a lack of national and subnational coordination in managing responsibilities, as well as an inability to integrate water resources policies, institutional fragmentation, unhealthy competition for the resource and limited capacity in the management of policies and regulatory institutions between these two levels of government. Clear allocation of ownership, responsibilities and resources, and the preparation and updating of Integrated Water Resource Management (IWRM) plans to improve allocation and management efficiency are critical ingredients of any improvement program.

Regulation and Investment Climate

It is important to emphasize the significance of the proper regulatory framework for the sector. With or without private participation, the water sector is so complex and sensitive that it requires strong institutions that have access to the required human and financial resources to do their job. In particular, experience has demonstrated the need for independent regulation and supervision (that is independent from the service providers) to ensure the proper checks and balances.

As many water service investments fall within the responsibilities of subnational governments, their institutional and fiscal capacity will have a large impact on the water sector. Thanks to decentralization, in most developing countries responsibilities fall closer to where the action is, enhancing the potential for responsiveness to local needs. Unfortunately, however, in decentralized countries local governments tend to change more frequently than national ones, and there are likely to be rivalries between the political parties governing different jurisdictions. This tends to complicate these relationships and make the investments more unstable. Furthermore, the decentralization of responsibilities and fiscal transfers make it more likely that general taxation can be used to transfer resources from areas of the country which are richer to those that are poorer. In water services, these national cross-subsidies make some investments feasible. The management of these relationships can have a significant impact in investment, regardless of the breakdown between public and private responsibilities.

When evaluating options to stimulate investment in water services, policymakers often concentrate their efforts on specific investments. The previous discussion has attempted to show that microeconomic and sectoral conditions are determining factors. But these investments develop in the broader macroeconomic and institutional environment. The right investment climate is necessary to attract investments and finance, including the proper policies for the development of long-term financial and capital markets, starting with macroeconomic stability, which is a prerequisite for almost all investment activities. Other directly relevant actions that may facilitate access to financial resources are the development of institutional investors with a long-term view, respect for property rights, an effective and efficient judiciary system, and alternative mechanisms for the resolution of investment disputes.

As part of the reform process, it is important that institutions, policies and investment structures present all participants with the proper incentives. Public sector ownership and operation normally lacks the incentives to perform and, in many cases, it may have perverse incentives arising out of the budgetary process that allocates more money to sectors that spend the most, not necessarily to those who spend it in the best or most efficient manner. Performance contracts may help overcome the problems resulting from the lack of efficiency incentives. As long as the marginal benefits exceed the cost, the private sector will have an incentive to increase coverage. However, without the proper oversight, there is a risk that private suppliers may not provide sufficient coverage or that the quality of their services might be low. Because the provision of water services is a monopoly, tariffs, quality, availability, coverage and the like must be adequately regulated and managed.

Even if water services were operated efficiently, there will still be large needs for public and private investments in water infrastructure and services. Removing some of these inefficiencies can go a long way toward reducing costs, enhancing the availability of the resource and attracting investments.

A thorough review of the microeconomic, technical, managerial and sectoral inefficiencies is a good place to start in any program to enhance investments in water services. This a very suitable use of international donor resources that will have a multiplier effect on the potential to attract investments and other financial resources.

Chapter VII. Sources and Arrangements for Financing Water Infrastructure

In the previous sections we discussed the potential for increasing the availability of water services by improving economic efficiency (tariffs, relative tariffs, sector governance, etc..) and the efficiency of existing assets (operational efficiency, waste reduction, management, etc.) to use existing financial resources in ways that are more effective. In this and the following sections we discuss ways of attracting more financing by exploring potential sources of public and private financing ,and structuring investments in such a way that the availability of finance is improved (alternative financial structures and risk mitigation tools).

Financial Planning

The first step in the process of financing is planning the needs and finding the financing gaps. There are several models that have been recently developed to assist governments in these tasks. The most widely-used one is FEASIBLE, a software tool developed to assist in the preparation of environmental financing strategies for water, wastewater and municipal solid waste services that can be used to facilitate the iterative process of balancing the required finance with that which is available, and determining financing deficits or surpluses and the structure of any gaps in financing. These results help policymakers understand where the main bottlenecks are as well as where, when and what additional policy interventions are needed to facilitate the effective financing of infrastructure development programs. Graph I in the Annex includes an overview of the iterative process, which is self-explanatory.

Most of the time, governments will find that goals have to be scaled down to conform to available and potential resources. Alternatively, they have to resort to some of the measures discussed earlier to enhance fund availability through efficiency gains, or seek alternative financing structures to increase the willingness of donors or financiers to commit resources. To implement the required investments, governments will have to explore all the options for achieving their goals. While all resources will have to come from users and taxpayers, the time gaps in the availability of those resources need to be financed, either through governments, directly by the private sector or by donors. The first two will recover their investments through either taxes or fees.

Financing Sources: Public and Private

For a politically risky sector such as water services, most of the financing will have to be provided by the public sector at the national and/or subnational levels. The public sector can provide resources through capital contributions and outright loans to water utilities or through development intermediaries such as development banks or infrastructure funds, among others. These banks and funds may, in turn, seek financing either from government contributions or borrowing (loans and marketable debt instruments), as well as from equity contributions from the national and international financial markets, including multilateral development banks (most likely) and bilateral

aid (ways to use international aid more efficiently will be discussed below). These indirect instruments can leverage public resources, attracting private resources through the pooling of risks (assets are invested in a pool of projects) and/or by providing explicit or implicit government guarantees (depending on the instrument structure). These instruments do have quantitative limitations in the amounts of funds they can intermediate; thus, care must be exercised to ensure that decisions follow commercial rules because funds are being raised from the general public and the financial markets.

Nevertheless, the large size of the unmet needs implies that the sector cannot ignore the potential of direct private investment. That is, all possible avenues must be explored. The most import constraint to tapping private sector resources refers to the characteristics of the water sector, in particular its low return for the social and political risks that are inherent in the sector. To attract private resources exposed to sector risk it will be important to enhance returns (with efficiency measures or with government or donor subsidies, for instance) or to decrease risk (with risk mitigating tools and financial structures to be discussed later).

Some will argue that public sector finance should be the preferred choice because it tends to be cheaper than private financing. However, there are limitations to the availability of public financing, and there also are alternative uses for public resources (for other socially desirable goods) that may not have access to private finance. The need to maintain a stable macroeconomic environment means that the capacity to borrow (in local and international markets), the capacity to tax and the capacity to spend also have limits. Some of these limits arise out of International Monetary Fund guidelines on current spending (in spite of the fact that some of these may be properly classified as investments and not current spending). As a result, the choice of financing must be able to provide "value for money," carefully avoiding the use of private resources only to bypass budgetary rules. The choice of financing structures will have to consider the relative efficiency gains of private versus public finance and operation (construction, management, operation and finance), the transactions and management costs, institutions to manage and regulate the operation, technology transfer, the efficient allocation of risks and political and social feasibility. In the next section we consider ways to structure projects to capture the best of both worlds.

If properly structured (see next section), some projects may be able to tap domestic and international capital markets. Given that the sources of revenue for these projects are denominated in local currency, it is almost imperative that funds be raised in domestic markets. Unfortunately, in developing countries these markets tend to have limited resources and be underdeveloped. The most common instruments would be debt securities, with or without guarantees (see next sections). Some countries have been developing local institutional investors, in particular pension and insurance funds that can invest in these projects, again, if the instruments are properly structured to suit their risk/return appetites (pooled projects to diversify risk, guarantees to reduce risk, carefully selected projects to enhance return). In addition, there has lately been a revival in national and international privately funded infrastructure funds that can be tapped with the proper structures. This private finance has to be confined to creditworthy projects and utilities (that are creditworthy on their own right or because of credit enhancements).

One of the sources of financing mentioned indirectly is foreign bilateral or multilateral aid. As these resources come at either low cost or no cost at all, it is very important to leverage them as much as possible (within the restrictions that they may have). Preferential use of grant resources should attract other financial resources. For example, they can be used for improving sector and investment

efficiency, instead of direct investments. Similarly, they can be used to cover revenue gaps resulting from insufficient tariffs until reforms take hold, or for setting up guarantee funds. Clearly, these funds should not be used on projects that are already creditworthy, but rather, they should be used to improve the creditworthiness of projects. Resources that come with a cost (such as those of multilateral financial institutions or export credit agencies) should be used as seed finance to leverage other funds. Even better, their guarantees should be used to obtain other resources.

In all cases, whether the financing stems from public or private donors, it is critical that financial support be predicated on previous or concurrent sector reform and linked to performance. A prerequisite of access to finance is efficiency; thus, the access itself can be used as an incentive to promote efficiency.

All Options Are Open

The current environment of risk aversion and experience with some unsuccessful ventures that included private participation, may make us prone "to throw the baby out with the bathwater." We must be careful not to eschew private participation because of the current situation. At the very least, the private sector can bring its technical and managerial expertise to a project, even if it does not contribute any financing. In many cases, the private sector will be involved in the construction of the project and, in some cases, private operators can be involved in managing service provision. The latter can range from providing advise, to managing certain functions (such as maintenance, billing and collections, and control of non-revenue water). A more involved modality that has recently been proposed in that of franchising, whereby a private operator transfers know-how, a business management model and system, and a name in exchange for an upfront fee and a percentage of revenues. The local franchisee manages the utility, thereby acquiring experience that can be transferred to other projects, while the franchisor manages central functions. Unlike retail franchises, most of the franchisor's involvement in the case of water is in management systems and specialist assistance. This modality would be most useful in small and medium systems that do not have the economies of scale to develop all the management systems necessary for efficient operation. Nevertheless, this modality has yet to take off. In the next chapter we will explore other options that include higher levels of private participation.

The public sector has other opportunities for engaging in nontraditional partnerships with the private sector, taking advantage of the willingness of large water users (for instance the beverage and the mining industries) to engage in community development as part of their responsible community response for consuming a large share of the resource. This type of community involvement could take the form of providing access to their water supply systems or transferring know-how, for example. Some large water users, like Antofagasta Minerals in Chile, have gone as a far as becoming the owners of the water utility; thus, serving both their needs and those of the community. In early 2008, Pepsi announced a partnership with the Earth Institute and H2O Africa to improve access to water, sanitation and irrigation in Brazil, China, India and Africa, donating $8 million as well as management expertise. In mid-2007, the United Nations launched the CEO Water Mandate (in the context of the Global Compact), which seeks to engage large companies in improving and deepening their involvement in the responsible management of water resources. As of March 2008, 21 companies had adhered to the call for action and strategic principles (Nestlé, Coca-Cola, Diageo, Unilever, and Dow Chemical, among others).

Chapter VIII. Financial Structuring of Water Projects

Given the very wide variations in the characteristics of water services projects, the relatively high political and social risk involved and the scarcity of funds, all available sources of finance must be explored. The availability of these sources for a given investment is a function of the modality chosen for the delivery of the services, the economic, social and political conditions that prevail in the country, the governance of the sector and the availability of tools to mitigate the ever-present risk. This section explores the most suitable investment structures given prevailing conditions. We can learn from the many projects that have failed in the recent past because they did not properly incorporate prevailing conditions and the sector's environment into the design of the project.

Graph II in the Annex presents a schematic model for structuring of water projects. It proposes that the feasible **modalities** of service provision (fully public, fully private and all the possibilities in between) are a function of **local conditions** (legal and regulatory framework, the government's fiscal space and macroeconomic factors, among others) prevailing in the country and sector as well as the availability of risk mitigation **tools** (political risk insurance, subsidies, partial credit/partial risk guarantees and the like).

Depending on the modalities of service provision, the different parties involved will face different rewards and risks and will have different incentives to perform. This will affect the efficiency of service provision and access to finance. Graph II lists fourteen typical modalities. They go from provision by a government office, to a publicly-owned public utility, to cooperatives owned by the customers, to various private sector arrangements with varying responsibilities. For instance, in the case of a concession, the operator is responsible for investments, coverage, quality, collections, finance and so on, but does not own the assets. In a typical leasing case, the private sector pays a fee (or receives a fee or subsidy), does not own the assets and is not responsible for investments or finance, but is responsible for the provision of services. In management contracts, the private sector is responsible for some aspect of service delivery (collections, maintenance, or even full managerial responsibility for the service). The fact that tariffs do not cover costs does not mean that the private sector cannot have a role; it could receive subsidies from the government in the form of payments for water served (tariffs for certain users). The government would have to pay for this water anyway, but by involving the private sector it has an opportunity to take advantage of the sector's managerial and/or technical efficiencies. However, because there are many documented cases of publicly-owned public utilities that have shown very high levels of managerial and technical efficiency, the case is not clear cut. With the proper incentives and regulations, these wide variations in responsibilities can be used to obtain the best of both worlds; that is, the best that the public and the private sector have to offer under the prevailing conditions.

As an example, Graph II lists eight local conditions that can have an impact on the selection of modalities and hence of financing. These conditions vary from the legal and regulatory framework to macroeconomic stability and from the fiscal capacity of the government to willingness to pay and capacity to set tariffs. Not all modalities are feasible when the local conditions are less than ideal, as is normally the case in developing countries. If the legal and regulatory framework is weak, the option of a water concession is unlikely to be successful, as it requires strong and effective regulation and may require recourse to the legal system to solve the inevitable disputes. If there is macroeconomic uncertainty, with the potential for inflation and depreciation of the currency, it will be unwise to use a modality that relies on foreign investment. If the government is politically

unstable, a modality that relies on government guarantees may not succeed. If the fiscal situation of the state is weak, modalities that depend on subsidies are likely to fail. Local conditions are critical to determining how investments will be structured and financed. However, some weaknesses may be countered by the application of risk mitigation tools.

As many of the local conditions affecting water projects in developing countries are weak, the most tempting answer is to rely on purely public sector solutions. However, doing so may miss significant possibilities of attracting other funds and, in any case, may also fail because, at the very least, the provision of water services is dependent on the government's fiscal space. Some form of public provision is the most likely outcome under weak conditions, but properly structuring the modality can enhance the availability of other funds.

There are some modalities that can work properly in the face of some weak local conditions, with or without mitigation tools. If due diligence finds, for instance, that the legal framework is weak, the suitable modalities are those that do not require recourse to this framework (such as fully public, public utility, cooperatives and outsourcing of services). If, in addition to the weak legal framework, political risk is high, outsourcing may be out of the question. But if a mitigating tool such as prepayment for services provided is found, outsourcing may become feasible. If fiscal space is weak, then the only feasible modalities are those that rely on the private sector and do not need government payments. But if in addition to weak fiscal space, the legal framework is weak, these modalities cease to be feasible. Then it makes no sense to insist on a private concession, or a BOT, as it is bound to fail sooner or later because these modalities require strong and consistent legal and regulatory frameworks.

The model included in Graph II is just one tool for analyzing feasible modalities and looking for tools that mitigate the risk resulting from weak local conditions by improving the feasibility of some modalities. Suffice it to say that consideration of all possible modalities and enhancement tools may help avoid mistakes and open up some avenues to increase the flow of financial resources to the sector. This brief paper cannot consider all possible combinations and readers are referred to the original publication (Vives et. al, 2006).

Chapter IX. Enhancing the Availability of Finance Through Risk Mitigation

The final step to increasing investment in water services (after having improved the investment environment, improved the operation of the existing assets, assessed the needs and gaps in new investments and decided on the most suitable financial structures for the investment) is to use available financial tools to mitigate as many of the investment risks as possible in order to enhance the risk/return profile. Some of the tools will mitigate risks inherent in the structure and some will mitigate the risks involved in the chosen finance sources. Some of these risks affect even pure public sector projects, although those with private participation will face a broader sets of risks derived from the relationships between the public and private parties.

Space precludes consideration of all possible risks that investment in water services may entail, but for the purposes of this study, the risks can be classified into three broad categories: construction, commercial and financial, and political risks. Construction risks are incurred during the project's construction phase and refer to things such as completion risks (likelihood that the project will the completed on time and at the budgeted cost) and associated risks like accidents, fire and the like.

Commercial and financial risks are those involved in the operation of the investment and include exposures to inflation, currency depreciation, revenue losses, interest and tenor of financing (that is, risks that arise when debt has been incurred at variable interest rates or for short periods of time, requiring refinancing). Political risks refer to changes in the contractual conditions of the investment and in the legal and regulatory environment (including devaluations and currency convertibility issue), outright expropriation and acts of war or terrorism. Some of these risks affect all projects regardless of ownership, while others are a function of the ownership and financial structure. Some are mitigated with insurance (accidents, war and terrorism, currency convertibility), others require guarantees or other contractual arrangements with third parties, and still others cannot be mitigated at any reasonable cost. We will discuss briefly some of the commercial and political risks that affect financing and are affected by financing, and their mitigation. Most of the commercial risks are simply a part of doing business and are absorbed by the operation. Some risks, those of a more extraordinary nature, have to be mitigated.

The possibility of mitigating financial risks can have a significant impact on the feasibility of the investment and of attracting finance. The most common financial risks are derived from the relative underdevelopment of local financial markets and the risk aversion of international ones, which tend to supply limited amounts of resources with shorter tenors than required. Water services investments have long payback periods and tend to require long tenors; however, international markets tend to provide shorter tenors than would be desirable. One way to mitigate this refinancing risk is to obtain guarantees from multilateral institutions, generally in the form of a guarantee to service the debt in case the borrower cannot do so (this is normally a rolling guarantee, guaranteeing, say, the first year and extending for a second year if the borrower complies with the obligations, and so on). This guarantee allows the lender to extend the tenor of the loan because it increases the likelihood that the debt will be serviced. This also applies to public corporations; however, in this case, it is likely that the guarantee was extended by the government (although then the risk of default becomes a political risk and lenders may want an external guarantee), For a fee, these guarantees can help reduce the overall cost of the loans, thereby enhancing the feasibility of investments and of private sector participation.

Foreign exchange exposure presents a critical risk. Sometimes projects demand equipment that has to be imported and financed overseas, requiring that the debt be serviced in foreign currency. Exchange rate fluctuations will have an effect on the investment because the revenues of water projects are in local currency. This mismatch between the currency in which the debt is denominated and the currency in which the revenues are received gives rise to foreign exchange exposure and risk, because of floating exchange rates (depreciation) or changes in a fixed exchange rate (devaluation). As a result, liabilities and debt service become more expensive and the economic balance of the project deteriorates. There are very few easy options for mitigating this risk. The most obvious one is to avoid it by obtaining credit in the local markets. However, the financial markets of most developing countries are ill-suited to supplying credit in the amounts and tenors required for water service projects. Institutional investors (such as pension funds, insurance companies and mutual funds), who have long-term liabilities and are able to invest in these types of projects, have been developed in some countries. Yet, while they can buy long-term assets, institutional investors require liquidity and a good credit rating on those assets. One option is to pool several projects and issue debt instruments collectively through a regular financial intermediary (that is, securitizing, or issuing securities backed by loans to these projects, which is the most commonly used method) or through a dedicated institution (that may require the explicit or implicit guarantee of the government or an outside entity). An alternative option is to obtain full credit guarantees in the market (see below).

Another way of mitigating this risk is to denominate the revenues in foreign exchange, as was the case in Aguas Argentinas in Buenos Aires. Unfortunately, as most people know, this experience did not end well. Devaluation hit with a vengeance and the required increase in the tariff was politically and economically unsustainable. However, this option may work when expectations are that currency depreciations will be small and incremental. This would be very similar to indexing tariffs to inflation. If mitigated this way, the commercial risk becomes a political risk because the government or regulator will have to approve the increase in tariffs. Such a system, however, tends to break down as elections near. If expectations are that exchange rates are not headed in a single direction (namely: down), another option for mitigating these risks is to obtain contingent lines of credit to cover the temporary shortfalls in the hope of recovering the losses when the trend reverses. Finally, foreign exchange risk can also be mitigated by setting tariffs above the required level, thus generating extra revenues that can be saved for use when tariffs are not sufficient to provide the minimum revenues required. The latter option can seldom be put into place; however, all options should be explored.

Multilateral institutions like the World Bank and the regional development banks provide credit risk guarantees, which are normally called partial risk guarantees because they only cover the default arising out of certain predetermined events (not just any event). However, partial credit guarantees cover a portion of the credit default under a broader range of circumstances. Full credit guarantees cover the entire amount of the loan, are normally used to enhance the credit rating of local or international debt issues, and are guaranteed by what are called monoline (specialized) insurers. For a fee, these guarantees can reduce the cost of debt and increase the availability of finance, allowing the project to tap other financial markets and other market players like institutional investors.

Another large group of risks are what is known as political and regulatory risks. These refer to the exposure of the investments to political and regulatory decisions. Investment in public services, which is normally provided by a monopoly, cannot be left to the market to allocate. Government regulation is needed regardless of the ownership of the assets and responsibility of the operation. The nature of water resources makes its regulation even more compelling. Tariffs, quality, coverage, termination payments (to a private operator at the expected or unforeseen termination of the project) and off-take payments (say, for the purchase of bulk water) are some of the areas subject to regulation. This gives rise to what could be termed policy risk; that is, risk resulting from government policies. Governments may have different interpretations than the service provider regarding the need to increase tariffs, the quality of the services, required investments, and the speed with which service coverage is increased (or not increased) because of events unforeseen in the agreements. Or governments may simply refuse to honor agreements to increase tariffs, for example, or grant smaller ones than existing agreements envision. The mitigants for these risks are limited and include ensuring that regulators are competent and independent; that service providers have recourse to binding, independent arbitration or that they have access to an efficient, effective and fair judicial system (as a measure of last resort). These policy risks are harder to mitigate and guarantee and insurance agencies provide little coverage for them (although some are starting to include policy risks among their products). As discussed in the previous section, these risks place the most conditions on the types of modalities than can be used to provide the services.

Some agencies will guarantee specific events like the termination payment (for which they normally obtain counter-guarantees from the government). As the departure of many private operators from the water sector in Latin America clearly shows, policy failures have been the most common cause

of the renegotiation of contracts and of investment failures. These failures can lead to what is called creeping expropriation; that is, the loss in the value of an investment resulting from violations of the original agreements. In the case of private capital at risk, this may lead to the failure of the investment, while in the case of a publicly-owned public utility it may lead to the deterioration of service and the need for additional public funds.

The problems created by currency convertibility are also in the hands of the government. If the project has external financing (equity and/or debt) it will need to convert the local currency earned into foreign exchange to service its debts in a timely fashion (this does not refer to the value of the exchange rate, which was addressed above, but to the availability of foreign exchange). Some countries will provide assurances and/or guarantees of availability, but the risk remains. This type of convertibility insurance is provided by international agencies, like the Multilateral Investment Guarantee Agency (MIGA) and national export credit agencies (for investments by the country's nationals). They also provide insurance against what are called acts of war and outright expropriation (but not for creeping expropriation, as mentioned earlier). This is "traditional" political risk insurance. There have been some recent extensions of this political risk insurance to cover breach of contracts and arbitration award default (that is, when the government does not recognize the results of the binding arbitration).

More complicated guarantees or insurance to cover the event that a government may not honor its contractual obligations (policy risk) have been emerging as well. For the most part, these are being provided by multilateral financial institutions and cover failure to pay termination payments, off-take payments, subsidies, failure to increase tariffs, failure to supply inputs, and specified changes in laws, regulations, taxes, and the cancellation of licenses, among others. As these are very specific risks and the consequences can be very large, the approach has been almost on a case-by-case basis. Unlike traditional political risk insurance that can be analyzed based on past experience, these policy risks tend to be unique.

After an initial project structure has been selected, including the risk mitigants, further analysis must be conducted to make sure that one risk is not substituted by another, like, for example, converting a commercial risk (revenue) into a political risk by taking on a government guarantee. If this is the case, then the government's political and fiscal capacity to pay, its political will and freedom from political interference to honor those commitments will have to be considered.

And finally, it must be remembered that water services are a strategic and social service, considered by some to be a basic human right. As such, there will always be the risk that some governments will want to have control of these services, particularly at the sub-sovereign level, where they are relatively more visible, governments change more frequently and the level of institutional development is lower. These risks are very hard to avoid. If the analysis shows that they are present in a given situation, then structures with some public sector involvement should be considered, sometimes sacrificing potential sources of finance and technological and managerial know-how. The long-term sustainability of the services is also a key consideration.

Chapter X: The Way Forward

The two keys aspects that define the water sector now and in the future are increasing water scarcity and more expensive infrastructure. If the high cost of expanding water supply and its scarcity were

translated into higher water prices, demand for water would be reduced. Moreover, high prices would generate enough cash flows to finance the new investment. However, this does not happen because prices and allocation are generally determined without reference to basic economic and financial realities.

This report has highlighted the need for policies to promote efficient water management and new investments in water infrastructure. Policy options include more water trading, appropriate pricing, agricultural policies, creating a conducive investment environment, adequate institutional delivery schemes (and their supervision and regulation), and better use of financing sources and financial structures. The major economic and financial issues that will affect the ability to improve access to water in the future are noted below.

On Mechanisms for Allocating Raw Water

- Mechanisms for assigning water that include trading options would improve efficiency. The pursuit of well-being by individual firms and households will equate marginal private benefits with marginal social benefits and the market price across different uses and users of water.
- Although water trade would improve efficiency, government intervention is still necessary. If externalities, such as pollution costs, are not included explicitly in the costs faced by water users, water trade may still increase efficiency but the most efficient allocation of the resource will not be achieved. The establishment of measures such as taxes, pollution permits and specific regulations may correct market failures.
- Water markets will require a registry of information on the ownership and transfer of water entitlements, delivery rights and use licenses that is transparent and readily available to all at a low cost and with the full backing of the law. Options include a publicly operated system similar to the one used for land titles, or a system similar to the ownership of rights in public companies. Such institutions could be administered by a public agency or by a regulated private entity.

On the Price of Drinking Water

- As in all monopoly segments of infrastructure services, pricing is the central issue in sector regulation. The reason for this is that firms that have monopoly powers are able to set prices over marginal costs without a large reduction in their market share, something that firms operating in a competitive environment are unable to do. Moreover, given that the short-run demand elasticity for water is low, an unregulated monopoly will be able to set prices well above marginal costs.

- The fact that, in most cases, water and sanitation services present increasing returns means that there will be a lack of simple mechanisms to generate an efficient allocation of the resource. This powerful result signals politicians and regulators that it will be quite difficult to set prices in such an environment. Following the accepted rule based on marginal cost pricing also has its share of problems. The American Water Works Association contends that the application of the theory of marginal cost pricing to water rates lacks considerable practicality.

- In some water and sanitation services **there are increasingly decreasing returns to scale** because of the need to use non-conventional water supplies (desalination, wastewater reuse,

reduction of leakages in networks). This raises public concerns about the possibility that the water companies may profit unfairly if services are priced at their marginal cost. To balance sustainability of service and consumer affordability, in cases where operator revenues stem from regulated prices, one option is to set average prices at average costs and have costs pricing guide the higher blocks in the block tariff structures.

- Operator revenues, and thus the sustainability of the service, are determined by average prices together with effective consumption of water and sanitation services and the ability of the operator to collect on bills due. To balance sustainability of service and consumer affordability, operator revenues need to be accompanied by tax-financed transfers from the public sector. This will allow some consumers to pay below-cost rates while protecting the financial viability of the utility.

On Welfare and Sustainability of Cross-subsidies

- Cross-subsidies are an appropriate option to increase welfare in water and sanitation services when consumers have different price elasticities and all costs must be covered with the payments made by consumers. However, not all types of cross-subsidies are acceptable; in fact, some cross-subsidies generate huge inefficiencies, while others may hurt the sector by placing too much of a burden on overcharged consumers.
- Cross-subsidy schemes with prices below marginal costs are not appropriate from the efficiency standpoint. The reason is simple, if the price paid by a consumer is lower than marginal costs, the social cost of the service is larger than its benefit. Therefore, welfare is increased by simply reducing production in an amount equivalent to that consumed by the underpriced consumer.
- A cross-subside scheme for a community is voluntarily sustainable if each group of consumers pays less for the provision of the service than it would otherwise pay, and revenues from each group cover the increase in total cost that occurs when that group is included in the service. When the first condition holds, no group will be willing to leave the scheme because doing so will increase its payments. In addition, if the second condition holds, no group would be willing to exclude other groups.

On Agricultural Trade and Other Issues

- In most cases, an increase on the price of water would reduce its consumption without necessarily reducing agricultural output. There are two reasons for this. The first is that higher prices would reduce the squandering of water; that is, it would create an incentive for consumers to use the least amount of water compatible with existing technology and the consumption of other inputs. The second is that higher prices will provide incentives for water saving technologies.
- Constraints on agricultural trade reduce the value added of agricultural products in most countries, but particularly in developing countries. Compared to other water and land uses, in most locations agriculture generates the lowest value-added per unit of water or per unit of land. Therefore, farmers will progressively give up land and water to domestic, municipal and industrial uses as demand increases and competition mounts. More trade in agricultural products would help establish incentives for investments in agriculture. To the extent that new investments embodied new and more water efficient technologies, agricultural trade would promote more efficient and less water-intensive crop practices.

Investment in irrigation, drainage and other agricultural water management projects has been declining worldwide. Two issues must be addressed to increase investments in efficient irrigation: (a) the identification of the costs and benefits of irrigation projects and (b) the institutional framework for allocating costs among actors. These issues are not independent of each other because the true benefits and costs will not be revealed to farmers unless true benefits and costs are more advantageous than the false ones.

On the Need to Increase Efficiency as a Source of Finance

- One of most important ways of increasing the availability of water is to reduce inefficiencies. Resources invested in removing technical inefficiencies (such as water losses) and improving energy efficiency and water conservation are normally very profitable, reducing the need for new investments.
- Reducing managerial inefficiencies can also help generate resources (or reduce their need) by improving the management of the institutions involved in water production and delivery. Examples of improvements in managerial efficiency include improved metering, improved billing and collections, the elimination of corruption and the prudent management and maintenance of physical assets.
- On a broader level, removing sector inefficiencies can attract investments and/or make them more effective. Better resource use planning, improving coordination, reducing political influence, reducing inter-agency competition, enhancing the management of water institutions, and implementing conducive policies are some ways of enhancing sector efficiency.
- In addition to removing inefficiencies, the creation of a conducive investment climate can help attract both public and private resources to the sector. Effective sector regulation, well defined fiscal responsibilities and relations between national and local governments, respect for the rule of law, and efficient mechanism for dispute resolution, among others, are needed to facilitate the flow of investments to the sector.
- A careful analysis of real and apparent incentives for the public and private institutions involved in the sector can uncover potential sources of improvements.

On Financing Water Infrastructure

- In addition to enhancing the efficiency of the system, more financial resources may be needed to increase the coverage of water services. Careful planning of those needs and their adaptation, over time, to the fiscal and financial capacity of the actors is the first step that should be taken.
- Financial resources will come from users, taxpayers and public and private donors. The time gaps between the need for and the availability of the resources will have to be financed out of government and private sector savings and borrowings. Given the large needs and the social characteristics of the sector, all sources must be explored and managed efficiently and effectively. In particular, care must be exercised to use these resources to leverage others through the use of innovative financial arrangements.
- Donor resources, many times in the form of grants, must be utilized in ways that can yield maximum impact, in particular, by facilitating access to other resources (for instance, by using them to enhance the attractiveness and effectiveness of investments). Also, the willingness of private firms to contribute to the achievement of the MDGs can be used to address some of the most pressing needs.

On Designing Financial Structures

- Proper structuring and financing of delivery modalities can help increase financing and create investment structures that are more robust and efficient, requiring fewer modifications later on. The relative distribution of the responsibilities between the public and private sectors must be adapted to prevailing local conditions, in particular, to the investment climate (rule of law, macroeconomic stability, fiscal capacity and quality of institutions, among others). All options for delivery must be explored; some may not be feasible under prevailing conditions, but others may be able to attract financial and managerial resources.

On Risk Mitigation to Attract Finance

- Investments in the water sector are particularly risky and the need to resort to financing to bridge the investment gap introduces additional risks that have to be mitigated in order to attract resources to the sector. The development of local capital and financial markets is critical, in particular, the development of insurance companies, institutional investors and institutions that can provide long-term financing and issue risk guarantees. While these institutions are being developed, it may be necessary to gain access to the resources of institutions outside the country. This will require macroeconomic stability and the minimization of political risk.
- There are no simple solutions. Investments will have to be structured to minimize exposure to risks, and any remaining risks will have to be examined in detail and mitigants sought, including access to the resources and guarantees of multilateral institutions and donor resources to prevent and mitigate those risks.

Closing Remarks

Water is a valuable resource that must be valued and managed accordingly. While there are many instances of water scarcity and lack of access for large segments of the population, particularly in developing countries, a large portion of the problems are due to inadequate policies and shortcomings in the management and delivery of the resource. This paper discussed the economic principles, the institutional and investment policies, the efficiency measures and the financial sources and structures that need to be in place to enhance water investments and facilitate access to water. While the economic policies, institutions and financing tools are known, their implementation is fraught with great difficulties, arising out of political and social resistance and lack of human and financial resources. While some of these difficulties will be hard to overcome, the rewards of the implementation of the proper policies are large and must be pursued, as much as possible.

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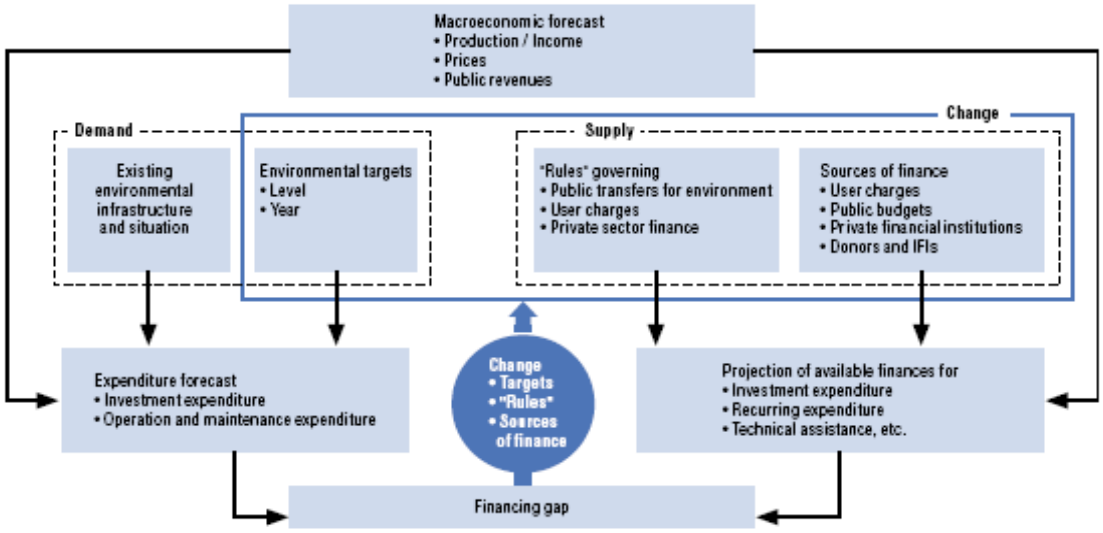
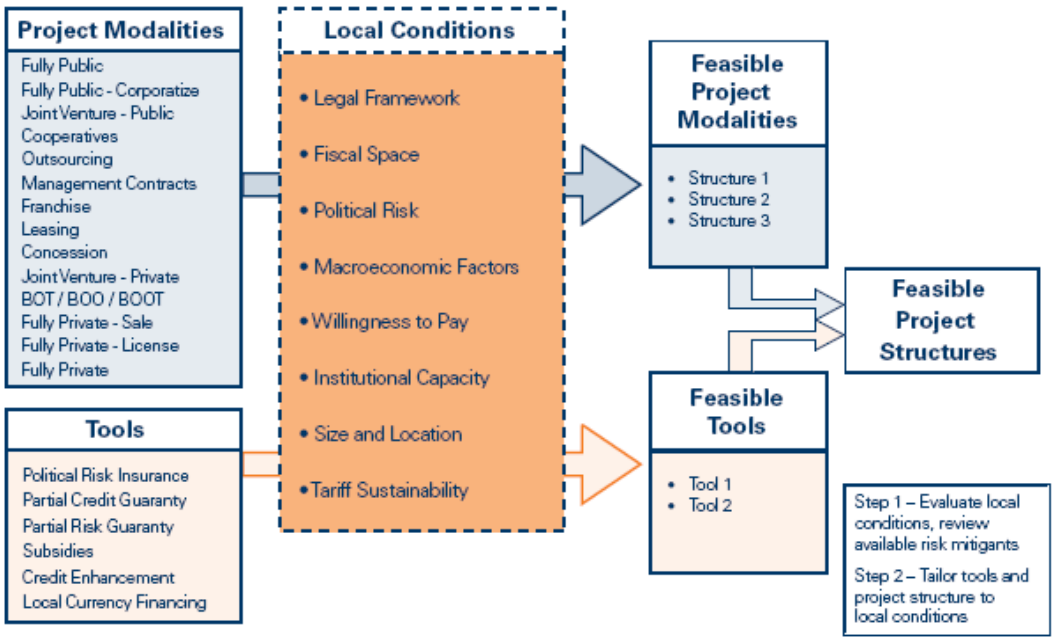
Tables and graphs



Graph I: FEASIBLE model Source: OECD, 2007b



Graph II: Financial structuring model Source:Vives, et.al, 2006