The Role of the Private Sector in Providing Water in Developing Countries

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The purpose of this article is to describe the role of the private sector in the supply of water in developing countries. In addition to citing some of the advantages to private supply, the paper discusses some of the objections to private provision, namely 'Natural Monopoly', 'Externalities', and the alleged inability to charge for water.
It is concluded that the main obstacles to the private supply of water services are political rather than technical or financial, and that the French *Affermage* system (or variations thereon) seems to be suitable for many developing countries. There also appears to be considerable scope, in both towns and villages, for consumer co-operatives, and for the enhancement of water vending.

1. INTRODUCTION

Of all the public services, the provision of piped water is the one with which the private sector is the least involved.

It may not be a coincidence that water is also the sector that, in many countries, seems to have the greatest problems. A regular supply of drinkable water is essential for survival, and yet 60% of all persons in developing countries live without a safe supply of drinking water; 75% live without any kind of sanitation facility; and, because water is remote as well as polluted, tens of millions of women and children may spend as much as three or more hours a day fetching polluted water.

The cost in human suffering is enormous. Diarrhoea, amoebiasis, polio, typhoid and the roundworm are but a few of the infections introduced or spread by insufficient and polluted water supplies and poor sanitation. Unsafe water brings high infant and child mortality, and for those who survive into adulthood, poor health, loss of productivity and a shortened life-span. On an average day in the developing world, more than 25 000 people die due to inadequate water supply and sanitation, while millions more suffer the consequent debilitating effects.

Despite significant efforts by the developing countries' government, their water supply situation deteriorated during the 1970s. As a consequence of poor maintenance of water facilities and rapid population growth, about 100 million more people drank unsafe water in 1980 than in 1975, and about 400 million more people relied on unsafe sanitation facilities in 1983/4 than in 1977. The incidence of water-related morbidity and mortality is expected to rise rapidly, unless the most strenuous efforts are made to combat this decline. It is therefore a matter of puzzlement, and concern, that so little is being done to bring to bear on this problem an economic system that has proved itself to be the most successful in meeting human needs for goods and services: the system of incentives and rewards known as private enterprise.

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2. PRIVATE SECTOR INVOLVEMENT

There are numerous examples of non-piped water being distributed by private vendors, but in view of the 'natural monopoly' associated with the distribution of piped water, there do not appear to be any examples where it is supplied competitively, i.e. where consumers have a choice of suppliers. There are, however, a number of cases in developing countries where private firms have been given concessions to supply water under conditions and tariffs regulated by municipalities. There are also examples of management contracts, i.e. situations where the investments are made by public agencies but private firms are employed to manage the systems. In villages, especially in the Middle East, the Philippines and Latin America, there are examples of water co-operatives. There is also substantial experience of private sector provision of wells for agricultural irrigation. Thus the involvement of the private sector in the provision of water may be considered under the following heads:

1) Vending of non-piped water
2) Provision of piped water by:
   a) Regulated monopolies
   b) Management contractors
   c) Rural co-operatives
3) Exploitation of ground water for irrigation

2.1 VENDING OF NON-PIPED WATER

Water vending—the sale of water by carriers—is ubiquitous in developing countries, and has been since cities existed. In many developing countries vendors obtain water either from public pipes, or directly from the source. They sell either directly door-to-door, or through middlemen. In their paper on 'Water vending in Developing Countries' (Zaroff *et al.*, 1984) Barbara Zaroff and Daniel Okun give information on water vendors, and on the consumption of vended water, all based on questionnaire results obtained from twelve communities.

The price paid for vended water is typically ten times as high as the price paid for piped water, as may be seen from the data in Table I was collected by the World Bank. The price of vended water in Karachi in 1979 is reported to have been 50 to 100 times the government subsidized rates for piped water (Thobani, 1984).

There are recorded cases in which the total amounts (in absolute terms) paid for water by those (generally the poor) who buy from vendors exceed the amounts paid by those who receive piped water. For example, sixty-eight families who were buying water in cylinders in Lima in the 1960s spent two to six times as much money for one third to one seventh as much water as was obtained by those with access to piped water. When the amounts paid for water are expressed as a percentage of family income, or as minutes worked to pay for them, the greater burden borne by those without access to piped water becomes even more striking. For example, a typical family using water from cylinders would have to work over seven hours to pay for water consumed in a month, while a family enjoying piped supply would have to work just over two hours

TABLE I
Prices of Vended Water vs *Piped Water*

City	*Vended water rates (US Dollars)*		*Metered domestic rate to customers served by the city water system (US Dollars)*	
	Per 1000 US Gals.	*Per m³*	*Per 1000* US Gals.	Per m³
Dacca	4.20–8.40	1.11–2.22	.35	.09
Kampala	5.84–14.60	1.55–3.86	.70	.18
Istanbul	3.52	.93	.35	.09

Source: World Bank: Water and Sewerage Sector Working Paper (1971).

(Adrianzen *et al.*, 1974).

Although vended water in urban areas costs consumers more per unit than piped water, there can be circumstances when it provides the more economical solution. In Abidjan and Cotonou, for example, and in Surabaya, low-income people often buy their drinking water from vendors (or from neighbours with access to piped water) while using for other purposes water from shallow wells that is unsafe for drinking. In this way connection charges are avoided, and no big water bills are accumulated.

The operations of water vendors may be illustrated by one of the ten companies serving the people of Santo Domingo, the capital of the Dominican Republic. Santo Domingo does have a supply of piped water (provided by a public sector agency) but this supply is unreliable because of frequent electric power cuts. This has resulted in the proliferation of private companies, all of which are inspected and regulated by the Ministry of Health. The ten companies all obtain their water from private sources; all purify and 'package' their products; and all distributed by truck. They all charge the maximum price set by the government, so the competition is on the basis of service.

Agua Pureza was set up as a private company in 1981 11km from Santo Domingo. Though owned by a religious organization (Iglesia Evangélica Metodista Libre), it pays taxes and is profit oriented. The operation consists of selling purified water in 5-gallon glass jugs to the people of Santo Domingo. The water comes from a source privately owned by Agua Pureza. Distribution is made by eight trucks specially designed to carry 104 'botellones' (jugs) each, from the source to the customers's door. The consumers have to make a one-time purchase of a 5-gallon glass jug for $7, and then they pay $.75 for the water per jug. The trucks distribute the filled jugs and collect the empty ones. Average family consumption is two to three jugs per week. Monthly sales amount to 10 000 jugs. They sell water not only to households but also to government institutions, e.g. Ministries of Education, Interior and the Police Department. The operation is profitable; operating costs are low except for the 'botellones' which are imported from Miami and Mexico. Sales are steady, except during the rainy season, when some customers switch to rain water.

The company employs a total staff of over 30, with 16 drivers (two per truck), 10 in bottling and purifying operations, the rest in the office. Truck drivers are motivated to sell water jugs, earning a basic salary plus a commission of 9 cents per botellon delivered.

The Ministry of Health supervises hygiene and water quality by weekly inspections. The company subcontracts specialist services to a private laboratory.

2.2 PROVISION OF PIPED WATER

Despite the long history of private vending in all countries, the provision of piped water by the private sector, either for irrigation or for household use, has been comparatively rare. The absence of property rights in water, its critical importance in times of war, the difficulty of collecting payments, and the magnitude of the resources required may explain why such is the case. There are exceptions however: in Hawaii, water has been traditionally privately owned, and it is privately provided to this day (Hutchins, 1946).

In France today much of the urban water is invariably supplied as a local monopoly, with the tarriff being determined by a public authority. The public authority (typically a municipality) often builds and operates the system with its own resources. This is known as the *régie* system. However, private companies are also involved in the supply of water. When a private sector operator is employed, the two most common arrangements are the concession system and the *affermage* system:

(a) In the concession system, the public authority contracts out to as single private operator both a construction and operation concession. The concessionnaire finances, constructs or subcontracts the construction of, and operates at its own risk, all the facilities for the supply of drinking water. On termination of the concession, it must return the system to the public authority in perfect condition, which means that during the life of the concession it must replace worn-out equipment as well as recover its invested capital.

To realize a return on its investment, the concessionnaire sells the water to the consumers in accordance with its concession contract. That price

takes account of economic trends during the life of the concession—inflation, economies of scale, taxation, legislation etc. Therefore the concession contract does not specify a single price, but rather a set of rules enabling the sale price to be calculated each year.

The concession contract also fixes the level of service to be provided by the concessionnaire: water quality and source; quantity of water to be supplied without charge to the public authorities (standposts, sewer flush, fire-hydrants and street cleaning); obligations and terms of connecting up consumers etc.

To enable the amoritzation of the concessionnaire's investment to be spread over a long period, concession contracts are generally for a long term, usually 30 years. This tends to reduce the price to the consumer.

(b) In the *affermage* system, the public authority handles the construction of the system by itself and contracts out its operation and maintenance, collection of charges, relations with the consumers, to a single private operator: the *fermier*. This is an operating concession only.

As under the concession system, the *fermier* discharges its assigned tasks to its own risk. This means that it must discharge them according to its contract and is compensated only by means of its sale of water. The contract sets the sale price.

To enable the public authority to amortize it initial investments, the water price customarily includes a surcharge collected by the *fermier* for the authority's account and paid over to it. The authority retains title to the system.

The French *affermage* system of private management of publicly financed facilities is still widely used in France. The operations of *affermage* system in a developing country can be illustrated by the case of Abidjan.

The private firm responsible for water supply to Abidjan is the *Société des Eaux de Côte d'Ivoire* (SODECI) (Golladay, 1983; World Bank, 1983). A counterpart is responsible for sewage disposal. Until 1967 SODECI was wholly-owned subsidiary of a French firm, *Société d'Amenagement Urbain et Rural* (SAUR). Since 1967, SAUR has retained only 47% interest in SODECI, with the remaining 53% ownership being in the Ivory Coast (49% private, 4% state). SODECI began operations in the Ivory Coast in 1960 under a 30-year concession contract with the government to supply water to Abidjan. In 1973, the contract was converted to *affermage* and ammended to grant to SODECI responsibility for the remainder of the country—including 122 towns and several hundred villages.

The water supply systems operated by SODECI span a wide range of technology, from a large piped distribution system in Abidjan to lower technology systems based on wells in rural areas. A unit in the Ministry of Public Works is responsbile for planning and building all large new investments in water. This unit is also responsible for supervising SODECI. Under its contracts, SODECI is paid a fee related to the volume of water sold. The fee is calculated on the basis of agreed standards for staff, equipment, energy and other inputs, plus a margin based on agreed overheads and profits, whereas other (usually public) water supply companies in West Africa mostly operate at a loss. SODECI's fee is about a third of the water tariff, which is set to cover not only operation and maintenance costs but also debt service.

Despite rapid expansion, water supply in the Ivory Coast offers one of the highest standards in West Africa. The system are well designed, equipped, maintained and operated. Water quality and pressure are uniformly good. Consumption is metered and water losses are low. Several factors contribute to those good results:

— The institutional separation of investments from operations makes it easier to evaluate SODECI's performance and assures government control over the expansion of the system.

— By setting water tariffs to reflect total costs fully, the Ivory Coast can finance its existing services. Water rates are among the highest in Africa, which means that consumers, rather than taxpayers, pay for the service they receive. Rates for small quantities are low, which helps the poor to afford the water.

— During the periodic traffic reviews, the government can carefully scrutize SODECI's costs; between reviews, SODECI has a strong incentive to keep down its costs.

— As a private company, SODECI is free (within the contracted limits) to hire, fire and compensate its staff. This freedom, plus a strong emphasis on training (SODECI operates its own training centre), enables the company to attract, train and

keep qualified people.

The use of the private sector to supply water in developing countries is not limited to West Africa. In Santiago, Chile, and Guatemala City, Guatemala, regulated private companies are responsible for providing some water to the city. Santiago, the capital of Chile, has the distinction of accommodating two separate suppliers of piped water which, although covering different areas, actually overlap in one zone.

The *Empresa de Agua Potable Lo Castillo LTDA* has provided water and sewarage services in the high income district of 'Comuna LOS Condes'. It started operations with only 2000 connections. It now has 43 000 connections, almost all residential. Lo Castillo holds the water rights of the source. It has a staff of 300, and provides an integrated system which goes from planning and construction to supply and maintenance. Metering services are also fully covered by the firm. Tariffs are approved by the Ministry of Public Works, and are the same as those of Agua Potable Manguehue, another private water enterprise in Santiago. In August 1984 there was a fixed charge of US $30 a month for a 1-inch diameter supply, and of US $65 for a 1½ inch diameter supply. The variable charge was US $0.86 per cubic metre.

The other supplier of water, the *Empresa de Agua Potable Manquehue*, established in 1981, provides drinkable water in manquehue, in the east of Santiago, and the north of the Mapocho River. The company obtained a 30-year concession to supply water to the people of Manquehue. In one zone, Parque Institucional, Lo Curro district, their services overlap with 'Empresa de Agua Potable Lo Castillo Ltda.'. Competition is in terms of quality, because tariffs are the same. The Manquehue Company supplies domestic water to only 310 connections (8 people per connection on average, or 2400 users) which is a very small fraction of the total population of Santiago (3.6 million). The water is obtained from wells, for which the company has the water rights. It is chlorinated before pipe distribution. The enterprise has complete autonomy being responsible for invoicing and collecting. It installs, maintains and reads all the meters (each connection is metered) in Manquehue.

Quality control for both companies is enforced by three public agencies: *Empresa Metropolitana de Obra Snaitaria* (EMOS), *Servicio Nacional de Obras Sanitarias* (SENDOS), and *Servicio de Sanidad del Ambiente* (Ministry of Health).

In Guatemala City the *Compania de Agua Mariscal* is a fully private enterprise, which has provided water in the capital city for over 50 yers. Construction works, operation, equipment and the company's maintenance are all under its control, as is house metering. The charge is equivalent to US $0.20 per cubic meter for an initial supply, and US $0.45 for any excess. Quality control is enforced by the Ministry of Health. The enterprise shares the Guatemala City market with Empagua, an autonomous public sector water entity.

These examples show that private companies can construct and/or manage urban water systems in developing countries, with government agencies being responsible for monitoring water quality and for approving tariffs. In addition to private companies operating as regulated monopolies or as management contractors, there is a third means of providing piped water other than by government monopoly: that is the rural co-operative.

The organization and operation of water co-operatives, of which there are many, can be illustrated by the Saguapac Co-operative in Santa Cruz, Bolivia. Until 1979, Santa Cruz was served by a municipal company, but in that year it was converted into a co-operative to overcome inefficiencies that were blamed on government control. Since the establishment of the co-operative, water services are reported to have improved significantly and are currently (1984) provided without interruption. The co-operative provides drinkable water to a population of 350 000 in the District of Santa Cruz. Neighbouring areas are served by other, smaller, co-operatives. Saguapac has a staff of 250. Some services—e.g. pipe installations and meter readings—are sub-contracted to private firms in order to minimize overhead costs. Under the co-operative scheme, each household head has one share which provided voting power. There are currently 43 000 connections and the same number of shareholders. Saguapac provides a comprehensive water service. Water is extracted from subterranean sources with 13 pumps. The

raw water is considered to be safe to drink, but it is chlorinated as a precautionary measure. After extraction, it is transported to large storage tanks, from which it is finally distributed to the urban area through a network of pipes owned by the co-operative. Tariffs are proposed by Saguapac but have to be approved by a government agency. In 1984 the tariff was the equivalent to US $0.035 per cubic metre. In 1983 the co-operative was hit by a trebling of energy costs, and the government did not allow it to increase its tariff sufficiently to meet this increase. As a result, the co-operative is running a deficit; it has no public subsidy. It is trying to deal with the situation by negotiating for reduced energy costs and for tariff adjustments.

Water co-operatives, which are also common in Argentina and Chile, in the Philippines, and in the Middle east, offer another route to private sector provision of water. They can be particularly helpful at the village level, where informed consumers, sharing common interests within small communities, can take the place of the professional management that can only be afforded by large systems.

2.3 Exploitation of Ground Water for Irrigation

The extraction of water for irrigation from private wells has been carried on from prehistoric times. More recently, World Bank staff have followed with particular care the experience of private and public tubewells in India and Pakistan, of which it has been written 'there can be no doubt that the individually-owned private tube-wells and pump-sets played a major part in the Green Revolution—more correctly termed the Wheat Revolution—in India and Pakistan' (Carruthers *et al.*, 1981). Experience has shown that private wells tend to be cheaper and simpler than public ones, are better maintained, and obtain high operating efficiency. Additionally, private initiatives have produced a remarkable range of ingenious inventions for the use of cheap local materials. For example, a bamboo tubewell has been developed in Bangladesh which is so cheap that it can be used for small sections of land. With the engine and pump made mobile by being mounted on a bullock cart, each small section can be irrigated economically. It is not even necessary for every farmer to own a pump; pump contractors have emerged who will provide one for pumpless tubewells. The mobile engine technology has the further benefit that it can be used to power threshing machines and other farm equipment after the irrigation season (Carruthers *et al.*, 1981).

Probably the most dramatic private sector involvement in irrigation occurred in the vast Indus Valley of Pakistan in the 1970s. The area had extensive problems of waterlogging and salinity. Beginning in the 1940s, the government of Pakistan installed over 14 000 tubewells, mainly for drainage, although it was believed that improved irrigation would be a significant by-product. When the programme was being developed, a small number of Pakistani experts, particularly Dr. Ghulam Mohammad of the Pakistan Institute of Development economics argued that public tubewells should be confined to areas where the groundwater was too salty to be used for irrigation without dilution with river water, and that in areas of good-quality ground water, development should be left to private users with the Government facilitating development by providing electricity and cheap credit for the purchase of pumps and motors. However, the authorities decided to rely on public tubewells, presumably because at that time private tubewell development in the Indus Basin was insignificant. There was also a fear that the groundwater aquifer could be damaged through uncontrolled pumpage by private users.

In the event, the Indus Basin farmers preferred to have their own wells, and the performance of the 14 000 public tubewells was overshadowed by 186 000 private smaller-capacity tubewells which were installed by the private sector, 90% with no subsidy. Assessments by World Bank staff (World Bank, 1983) concluded that private tubewells had

(a) been managed efficiently, particularly in helping to meet peak water requirements;

(b) imposed a relatively insignificant burden on public resources;

(c) produced returns that were economically justified, as well as bringing significant financial returns to the farmers who benefitted;

(d) not lead to excessive exploitation of the aquifer; and

(e) provided sufficient drainage to maintain water tables at reasonable levels.

Groundwater pumped by private tubewells now accounts for nearly 80% of Pakistan's total 'pumpage'. The management patterns of private tubewell users are more efficient than those observed for public tubewell users, in terms of cropping intensities, yields and usages of inputs. Although the private tubewells are mainly owned by farmers who have access to capital, the existence of the tubewells has brought about an active 'water market' which enables the private tubewell owners to make irrigation supplies available to farmers who do not posses their own wells. The operation of such markets on a country-wide basis could do much to move excess water from areas of surplus to areas of shortage. Not surprisingly, suggestions have now been made that public tubewells should either be sold to owners of adjoining lands, or transferred to local private enterprise for their day-to-day operations and management.

3. OBJECTIONS AND DIFFICULTIES

If private enterprise can supply piped water, why does it not do so? What are the problems? Three difficulties are usually mentioned whenever it is proposed to supply water commercially:

a) It is uneconomic to provide more than one pipe network in any area, and that therefore water supply is a 'natural monopoly' suitable only for the public sector.

b) The 'externalities' associated with water are so pronounced, that is supply cannot be left to the 'whims' of the market and to decision motivated by private profit.

c) People are not prepared to pay for water.

To what extent can these objections be met?

3.1 'NATURAL MONOPOLIES'

In order for water to be utilized by consumers, it has to be derived from a natural source, purified and transported to the point of consumption. Each of these stages in the supply chain can involve monopoly of supply, but need not necessarily do so. The source of supply, be it for a large town or for a small village, can be from a single source or from a number of alternative sources. In Morocco there is a parastatal national water supply company [Office National d'Eaux Potable (ONEP)] which sells water in bulk to urban distribution systems. Additionally, many of the local authorties have developed their own sources of supply, so as not to be entirely dependent on the national company. There is therefore no monopoly of supply. Cities can be supplied from different rivers (for example, the city of Santiago is supplied from the Maipo and Mapocho rivers, and also from wells), or communities (e.g. in Saudi Arabia) can be supplied from different desalination plants, in which case, again, there is no monopoly of the source of supply. Where the source of water is underground, and where it belongs to the owner of the ground above it, there is in practice no monopoly in the water source, even if all the water derives from one common aquifer.

The purification process is not a 'natural' monopoly, as water can be purified in larger or small installations, and even in the home, by boiling and filtering. There might however be scale economies which would make it more economical to purify water in large plants.

If the distribution system is by means of pipes, the economies of scale in the supply of water through networks of pipes are so considerable that this is a textbook example of the 'natural monopoly'. However, where water is distributed by water vendors, or where it is carried by the consumer from its source, as is common in many developing countries, there is no natural monopoly even in the distribution system.

There can undoubtedly be substantial scale economies in the processes of purification, desalination or fluoridation. The distribution network itself is the most striking example: a five-fold increase in supply involves an average cost increase of only about 2.5 (Carruthers, 1973). As a result of these decreasing costs, it may be less expensive to have a community served by one large distribution network than by a number of overlapping ones. However, in large cities it is possible for different districts to be supplied from adjacent networks, as is now the case in Guatemala City and Santiago, with no substantial loss of scale economies in distribution. While this arrangement does not give users a choice of supplier, the existence of separate adjacent systems enables comparisons to be made of costs and service levels, from which consumers can benefit.

Thus, not all the processes in the water supply chain result in 'natural monopolies', but even where these do exist, or where there are scale economies, there can be, as we have already seen, substantial roles for the private sector.

3.2 EXTERNALITIES

Water supply is associated with both positive and negative externalities. On the positive side, to the extent that safe water improves health, improved water supply can benefit people other than those directly involved in providing or receiving the water. For example, flea-borne diseases are less likely to be transmitted where water for washing is readily available. To the extent that these positive externalities exist, it may be said that, in the absence of community action, too little water would be provided. To the extent that disease is also spread by inadequate sewerage (e.g. surface waste water disposal, poorly constructed cesspools or latrines), there are negative externalities that can be addressed either by measures to discourage pollution or by additional costs of purification.

There is, however, a further externality peculiar to water supply, which is due directly to its scarcity. Consider a city, such as Bangkok or Lagos, that is built over an aquifer that can be drawn upon from wells. If the supply of water in the aquifer were unlimited, so that it were completely replenished whenever drawn upon, the drilling of wells and subsequent pumping would result in costs for well construction and for pumping, but there would be no loss of water. If, however, the quantity of water in the aquifer were not replenished at a rate equal to that at which it is removed, each individual drawing water would reduce the quantity available to others, and this would involve a negative externality. Furthermore, the reduction in the water level could bring about earth movements and cause serious foundation problems, as a fact has happened in Mexico City and Bangkok. One approach to dealing with this externality would be to prohibit the drilling of wells, or to license it, as was the practice in London in the middle of the 19th century, and in Israel, Mexico and the Bahamas today. Another approach, which is followed in Israel, would be to levy a charge on water drawn from the aquifer, and to fix the price at whatever level is necessary to maintain a desired water level.

It may be noted that this type of 'externality' arises from the fact that the underground water does not belong to anybody, and its treatment as a 'free good' results in its overuse. Similar effects have been described in other fields: overgrazing on common grazing land, overfishing on the high seas, and traffic congestion in most cities. In all these cases the absence of ownership of a scare resource results in underpricing, and in too much of it being used, with resulting severe shortages.

Externalities in water supply are also common in rural areas. Water can be alternative uses—for industry, irrigation, power generation, transport and domestic use, for example—and its use for one purpose can effect other uses and other users. Water projects therefore generate more than their 'fair share' of external effects. As in the case of urban supplies, the absence of property rights in water precludes private sector intervention and exacerbates the difficulties in the allocation of this scarce resource. Thus, the existence of externalities in water supply calls for mechanisms (such as the vesting of property rights) which would enable more, rather than less, private sector involvement.

3.3 INABILITY TO CHARGE

When water is sold in containers by private vendors, as is common in France and throughout the developing world, there is no problem in charging for it: customers pay on delivery, as they do for milk, wine or fuel oil. But where water is delivered from pipes, the levying of payments imposes substantial problems—moral, political, technical and administrative.

The moral and political problems arise from the fact that some people believe that water, as a product of nature and a necessity of life, should be free to everyone. For this reason, many authorities in charge of piped water supplies are said to find it difficult to enforce payment, or to deny water to nonpayers. Even where there are no moral or philosophical qualms, political necessities make it difficult for governments to charge for water. Politically, it can be easier for a government to decline to provide water altogether, on the ground that its resources are constrained, than to supply

water and get involved in recriminations about the charges. Islamic law, however, explicitly recognizes the right to own and sell water, subject to the injunction that the thirsty are never to be denied drinking water, even if unable to pay (Encyclopaedia of Islam, 1983).

There are also substantial administrative difficulties in collecting payment for water. In a large urban area, the basic mechanics of assessing fees, collecting them, and accounting for them, are considerable. In some countries no attempt is made to charge for the amount of water actually used, but households are billed at rates proportional to property values (Britain) or to the diameter of the supply pipe (Chile). In some areas where water is supplied for irrigation (Pakistan), it is common to tax the farmers in proportion to the value of the additional crops that can be grown. But, whatever the method used, there can be no doubt that the levying of water charges on a large scale is a formidable task which requires a substantial effort for successful implementation.

Economic efficiency requires that water be charged for in proportion to the amounts used, and at a rate just high enough to cover the costs of replacement. This implies that charges must always be levied for the costs of operating existing systems as well for renewal or expansion costs when these operations are undertaken. Economic efficiency does not require that all users pay the same rate, as long as each pays at least the direct costs arising out of connection and use. There can be a case for levying higher charges from the rich than from the poor, and more in the dry season, when water is scarce, than in the rainy season, when it is plentiful and easily replaceable.

In order to charge in proportion to the amount used, some form of metering is necessary. The provision and use of household water meters involve costs. In Asia, West Africa and Latin America, where they are commonly used, their capital cost ranges from $15 to $25. Where meters are installed, the charges for water are invariably billed to individual households or companies. Where a village might have one standpipe serving a group of people, it is not practicable to charge individual users by the meter and, indeed, it is difficult to charge at all. This may explain why, in situations where villages are supplied by standpipes, it is common for the villagers themselves to be responsible for the maintenance of the system. For example, Van der Laak (1969) describes a water supply system in Tanzania for which local people contributed their labour to construct the system and, additionally, the costs for maintenance were obtained through the cultivation of one acre of cotton in a communal field. A committee was elected to be responsible for implementing the system, and a scheduled duty list of workers was agreed on. The system worked. On the other hand, in Tanzania a system in which the water supply system was paid for form local taxes, but from which not all of the taxpayers benefitted, while some non-taxpayers were served with water, failed.

In several regions in Kenya, villagers had not been paying the small monthly tax which was to be used to help operate and maintain their local water supply system. Furthermore, frequent acts of vandalism on taps, drainage facilities, protective fences and so on, made it financially costly and physically almost impossible to maintain many of the public standposts. To overcome this, public standposts in a few areas were converted to water vendor operations; a licensed vendor pays a subsidized rate for the metered standpost water and sells it to users by the container at a slightly higher fee. The result of the switch to kiosks are that vandalism has been greatly reduced, thus saving government funds for repair and replacement costs; a small amount of revenue has been generated; and the rate at which people apply for house connections has increased. Some people presumably felt that if they were going to have to pay for water, it might as well be convenient water (Kia, 1981).

One of the worst features of governmental control of the water supply, evident even in a country as progressive as the Ivory Coast, is the rule that water charges have to be uniform over the whole country. This rule results in low-cost customers being forced to subsidize high-cost ones, irrespective of income. As a consequence, system expansion involves constant tension between existing users (whose payments are apt to increase as the system costs increase) and potential new users who not only have to contend with existing users but also to vie against one another to obtain priority in the allocation of scarce governmental resources. Difficulties of this kind

are avoided when each installation is self-financing (Hanke, 1981).

Although it is not easy to charge for water, particularly for piped water, there are plenty of examples to show that it is practicable, and that therefore the difficulty of charging is no reason to exclude the private sector from providing water. Indeed, even when water is supplied by the public sector, great difficulties are encountered if water is not charged for at rates that cover all the costs.

4. THE ROLE OF GOVERNMENT

The shortcomings in water supply—in both quantity and quality—example, a study in Manila, the Philippines, showed that 48% of the water supplied in 1977 was 'unaccounted for' (Kirke *et al.*, 1984). Management in the public sector can often be improved, but the involvement of the private sector can bring quicker results, and the dimensions of the problem cry out for quick results.

Because of the universal tendency to politicize and municipalize piped water and sewerage systems, the private sector is unlikly to finance infrastructure in the water sector. However it can provide management, and the French *affermage* system provides a model that can be widely copied and developed. In this sector there is scope for public/private co-operation; the public sector (aided, as appropriate, by international financing agencies) provides the finance and the private sector provides the management. The tariffs to be charged would be of critical importance. They might possibly be determined by a process of bidding; certainly tariffs would have to be high enough to provide sufficient revenue to cover all capital and operating costs.

In the provision of non-piped systems, the private sector can (and does) provide both vended water in towns and villages all over the world. The role of government here can be confined to inspection to ensure that water sold for drinking is in fact safe to drink.

5. CONCLUSIONS

This brief review indicates that water supply, especially for drinking, is in a deplorable state in many countries. The private sector plays a relatively minor role in the provision of piped water and a significant (but unquantified) one in water vending. In view of the experience of the private sector in all continents, there can be no doubt that it is technically and financially feasible to supply water through piped systems, and that the main obstacles to its participation are political. Governments which prove to be incapable of providing facilities for which there is evident demand sometimes pursue policies that make it difficult for the private sector to provide the required services. The situation where rich people receive subsidized piped services, while the poor pay for expensive water from vendors, is likely to remain until governments allow economic markets to work in water supply, as they already work in many countries for the supply of food, clothing etc.

It is possible that the scope for competition in the distribution of piped water is limited because of the enormous cost of providing more than one distribution network. However, local authorites can use competitive techniques to select monopoly contractors to provide services for a fixed number of years, as is done in France and West Africa. In rural areas, or in small cities, local associations or co-operatives can be formed to provide facilities for which people can pay. In some situations, water vending might offer lower-cost solutions than piped systems; this activity deserves encouragement.

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