



## Cost-based water prices

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THIS PAPER ATTEMPTS to discuss some of the major economic and financial issues and problems facing water supply companies, governments and consumers in the developing world. It will try to identify these issues and to suggest economic solutions and approaches. Where appropriate examples will be drawn from the authors' working experience.

### Economic efficient allocation of water

There is widespread agreement between economists that a prerequisite of efficient water allocation is that the price charged for water should cover its marginal cost of production. An intuitive explanation of this requirement is that the demand curve for water (DD) which shows the relationship between quantity of water demanded and price charged can also be interpreted as the Marginal Benefit of successive increments of water consumption. It shows the maximum sum of money that would be paid

for each cubic meter. The Marginal Cost of water is the addition to the total cost of the utility caused by producing one extra cubic meter. Correctly specified this curve shows in money terms the value of society's resources used up in water production. The diagram illustrates that the optimal output of water is at  $Q_0$  where the curves intersect.

This is an optimum because to the left of this point Marginal Benefit from production and consumption is greater than the incremental costs used in the water's production. Hence on the units of water  $OQ_0$  a net benefit is earned and this adds to society's welfare. At outputs greater than  $OQ_0$  a net cost is incurred because MC is greater than MB. These considerations determine  $OQ_0$  to be an optimal output and this amount can be sold at a maximum price of  $OP_0$  which is the optimal price. Such thinking is the basis for the rule that price should be equal to marginal cost if outputs ( water in this case ) are

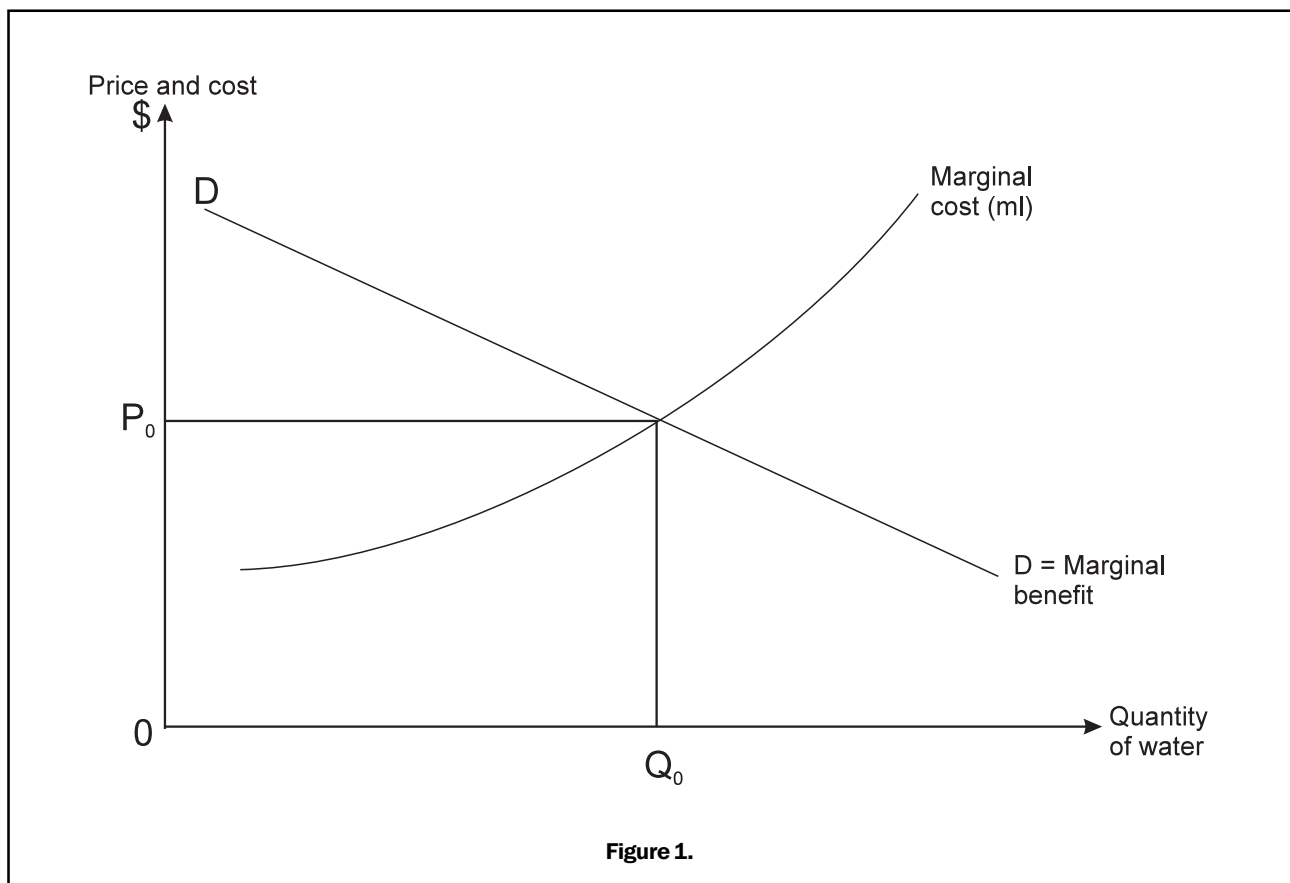


Figure 1.

to be produced efficiently. The rule has been widely adopted by international lending agencies and its application is often a condition of loans.

### Average Incremental Cost

For urban water supply schemes MC is difficult to calculate because additions to the supply system are not made in small increments but in large, ' chunky' or indivisible investments. An accepted approximation to MC is Average Incremental Cost which is a forward looking concept defined as the sum of the costs associated with the investment expressed in present value terms divided by the incremental output of the investment again expressed in present value terms. In effect this formulation treats output as a proxy or indicator of benefit.

$$AIC = \text{P.V. of Costs} / \text{P.V. of Output}$$

### Utility pricing

Most water supply companies in the developing world do not charge on Marginal Cost or its approximation A.I.C. In a recent study ( 1 ) of water supply improvements in 9 Ghanaian towns the author calculated A.I.C. to be in the range 195 cedis per cubic meter to 2800 cedis ( 4.4 to 60 U.S. cents. ) Cost is location specific and it is not possible to talk about typical costs. In general producing water in smaller towns is expensive. Small increments of water are produced at substantial capital cost . One Ghanaian town required 78 per cent of the capital cost of supplying the least cost town ( Kumasi ) but produced only 6 per cent of the water. Where extensive rehabilitation , distribution extension or pumping over distance is required costs per unit are high. These costs compare with the published tariff for domestic metered consumers of 336 cedis per cubic meter and the more commonly applied flat rate charge of 178 cedis.

Recent calculations ( 2 ) for additions to the water supply in major Indian cities put A.I.C. in the region of 4 to 7 rupees or 2.5 to 4.5 US cents. The residential rate at the time of the calculation was 1 rupee or 0.6 of a U.S. cent for the first 8 cubic meters rising by .25 rupees for each m3 up to 40 m3. Further evidence of prices failing to cover costs may be found in World Bank Staff Appraisal Reports.

### The desirability of cost based prices

The efficiency case for cost based prices was outlined above. Basically the pricing system makes sure that consumers get the right message that water is an expensive commodity to provide. Price tied to amount consumed encourages conservation and discourages waste. It encourages economical use because waste has to be paid for.

The problem of variability of costs at different locations alluded to above means that the marginal cost pricing rule may have to be tempered where its strict

enforcement would impose undue hardship for example on communities who are particularly expensive to serve or communities who have been greatly neglected in the past.

### Cost recovery

Setting price equal to MC in a constant cost industry will recover costs. If costs are correctly defined to include normal profit and an allowance for maintenance expenditures pricing water at MC will ensure that total revenue of the company will cover total costs. This is because average revenue is the same statistic as price and the product of price and quantity is total revenue. In a constant cost industry average cost and marginal cost ( MC ) are equal and multiplying average cost by quantity yields total cost. In summary,

AC = MC in a constant cost industry so  $P = MC = AC$  and  $AC \times Q = TC$  . Also  $P (= AC) \times Q = TR$ . Thus  $TR = TC$ , the firm covers its costs with marginal cost pricing.

It is easy to show that in an increasing cost industry ( ie. where long run average costs increase as output expands) setting price equal to MC generates surplus profit.

Cost recovery is important for a number of reasons :-

- It provides the potential pool of resources for maintaining and extending the coverage of the service. Therefore it promotes the ideas of sustainability and replicability.
- It reinforces the message that water provision is a costly activity and that water conservation is an important resource aim.

### Idea of cost containment

If prices are to be cost based for the reasons outlined it is important in low income countries that costs are contained to appropriate levels. Specifically, it is necessary at the design stage to ensure that costs of servicing debt, operating and maintaining facilities are compatible with the income and skills available in the beneficiary population. It is often the case that both lenders and borrowers are so preoccupied with issues of repayment of principal and interest that insufficient attention is given to O and M at the design stage. This tendency may be exacerbated by inappropriately high planning standards also sometimes by governments anxious to be able to demonstrate flashy symbols of progress.

Containing costs in the context of extending water coverage may require reducing unaccounted for water (UAW) thereby obviating or at least postponing the need for costly supply side additions. UAW imposes costs of collection, treatment and distribution but results in no additional revenue to the firm. A survey of UAW in developing countries ( 3 ) indicates the major wastage imposed by failure to turn production into revenue.

Brazil	Sao Paulo	40 per cent	Ivory Coast	17
Chile	Valparaiso	41	Gambia	27
Columbia	Bogata	40	Guinea	53
Costa Rica		45	Senegal	29
			Ghana	49
Pakistan	Karachi	40	Nigeria	44

Price and Affordability.

Pricing policy serves two purposes , the first is in promoting efficient resource use and contributing to the maximisation of the community's net benefits as outlined above. The second is the issue of equity or distributional fairness. This concern assumes more importance in the case of water than for many other products because of water's centrality in protecting public health. Apart from considerations of humanity pure self - interest dictates that water is provided in quantity and quality sufficient to protect the health of the community. Disease does not respect property boundaries; the rich man is as vulnerable as his poor neighbour. It is therefore important that water is affordable to the poorest and if charging at marginal cost threatens this requirement then at least for basic needs water this principle must be sacrificed . In the poorest communities it is widely held that expenditure on water and sanitation should not exceed 5 per cent of household income.

The Ghana study referred to earlier provided opportunity to see if this 5 per cent limit was breached for consumers in Kumasi. Data supplied by a British construction company showed that a labourer earned 3,000 cedis per day . Assuming that total household income is 4,000 cedis per day and a family of 5 persons consumed 100 lpcd yields a daily water expenditure of 168 cedis per day or 4.2 per cent of household income based on the metered tariff rate of 0.336 cedis per litre. The marginal cost of new water supplied to Kumasi was estimated at 0.195 per litre .

### The general undesirability of pricing below cost

Notwithstanding the comments in the previous section it is generally undesirable to price water at below cost for the following reasons :

- It is not consistent with maximising the community's net benefits as explained earlier.
- It encourages profligacy in use and sends the wrong signals to users. Most notably it conveys the message

that water is a cheap product in terms of resource use. It does nothing to encourage investment in water saving technology. This is especially important in irrigation which consumes 70 per cent of world water consumption. It is also increasingly an issue in countries which until very recently considered themselves water rich eg. the UK. The author recently worked in China on a waste minimisation project. Water prices to industry was as low as 0.06 Yuan per cubic meter (1.3 cents). At this price factories had little or no incentive to invest in water saving technology.

- It may detrimentally effect the location of industry for example encouraging water greedy industries to develop in areas of limited water resources. Equally it can encourage the development of water intensive agriculture in areas with no real economic advantage in particular corps for example, fruit growing in California or cattle rearing in Saudi Arabia. These activities are possible only because of the implicit subsidies occasioned by below cost water sales.
- By encouraging wasteful use of water pricing below cost may lead to the generation of harmful externalities. The most graphic example of this is land salinisation resulting from inundation as a means of irrigation. Other examples are subsidence caused by mining aquifers and escalated pumping costs as a result of declining water tables.
- The equity arguments for sub-cost water are often not strong. The main benefits of subsidised water ( ie. below cost supply) devolve not upon the poorest but upon those with the highest consumption levels and typically these are higher income consumers with multi-connections , irrigated gardens, consumer durables etc. Moreover, even for the poor unduly cheap water means inadequate supply for the equally poor neighbour.

### Utility finances and prices

The survey of water supply utilities previously referred to showed rates of return on assets in the range of 8 per cent down to - 22 per cent . For the entire group of 17 firms the average was 2 per cent with 13 firms showing positive returns. The profitability of most firms is marginal and the loss makers depend on government subsi-

Table 1.

dies. The rate of return was taken as the ratio of Net Operating Income to Net Fixed Assets. Improvement in Net Operating Income can be made by increasing revenue earned, reducing operating costs or both simultaneously.

Increasing revenue can be achieved by:

- Increasing tariffs to levels which at least cover costs. The problem for many utilities is that tariffs have become politicised and increases depend on government permission. Often cheap water is a means of currying political favour.
- Increasing the quantity of water produced and sold since total revenue is price times quantity.
- Reducing the amount of UAW which yields no revenue but incurs costs. This requires leak detection, repair, registering customers so that they can be billed, improving the collection / billing ratio and improving the ratio of revenue collected to water delivered.

Each of these expedients would increase the gross revenue of the utility. Table describes the recent history of the financial situation of Ghana Water and Sewerage Corporation in respect of these factors.

This paper as focused on the revenue side. In addition many countries have embarked upon forms of privatising to secure cost reductions which will in turn have a beneficial effect on profitability.

Output to Purpose Review. 2 Regions Ghana. ODA 1997.

See for example ' Pricing Water to Recover Costs ' P. J. Barker, WEDC Conference Accra 1993.

Waste and Wastewater Utilities. 2nd. edition.

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