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WATER RATES IN DEVELOPING COUNTRIES

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A B S T R A C T

While utility finance is normally the primary concern in determining water rates in developing countries, other objectives of pricing policy, such as extension of service to the poor and avoidance of wasteful consumption tend to command a higher order of priority than in more affluent societies. In describing some of the efforts made to reconcile these objectives, the paper notes that in certain respects water rate policy in the developed countries would do well to follow the example afforded by experience in the developing world.

This is a slightly amended version of a paper to be presented at the American Water Works Association Annual Conference, 1977.

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WATER RATES IN DEVELOPING COUNTRIES

I. Introduction and Background

A widely held view concerning less developed countries (LDCs) is that their problems are similar to those faced by the United States and European countries 50 or 100 years ago. If this were so a simple transfer of technology and economic advice from the more developed countries (MDCs) would be the appropriate solution. It is the contention of this paper, however, that at least in the field of resource economics as manifested in the pricing of water, the reverse is often true: there is much we can learn from their experiences. The physical and financial constraints faced by today's LDCs may be cropping up in slightly different guises tomorrow in Los Angeles and New York. Similarly, the solutions worked out in Nairobi or Manila may provide valuable lessons for our public utility planners.

Before taking up the specific topic of water rates in LDCs, it is necessary to set the stage by saying a few words about the overall resource picture of those 111 countries1/ as it relates to water. Of course, any generalization is hazardous when we are discussing countries as economically diverse as Mexico and Tanzania and as hydrologically diverse as the Philippines and Chad. At the risk of completely misrepresenting the situation in a few exceptional cases, however, several important generalizations can be made which add perspective to the particular problems faced by the water utilities of most LDCs.

First, the one characteristic which unites LDCs by definition is their relatively low level of income. In addition to low average incomes, the distribution of incomes is generally more skewed than in the MDCs so that a large proportion of the total population is often living in absolute poverty2/ even in countries where the average income may be moderately high. For example, in the Philippines in 1971 the lowest 30% of households earned only 8% of total income

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1/ As used by the World Bank in World Tables 1976. With the exceptions of Israel, Greece and the oil producing countries, all had per capita incomes of under $1850 in 1973. Over 70 countries had annual per capita incomes of less than $500.

2/ As used in this paper the term absolute poverty refers to those without access to the basic requirements of a healthy life including safe water, adequate nutrition and sanitation facilities.

while in Japan the corresponding group accounted for 14% (in 1972).1/ This implies that the tax or revenue base of a water utility in an LDC is likely to be fairly narrow.

In many developing countries this problem is reinforced by rapid population growth rates that increase demands for service on the one hand while eroding the growth of per capita income (and thus ability to pay) on the other. This point is amply demonstrated by comparing the growth rates of developed and developing countries during the period 1965 through 1973. The real gross domestic product of LDCs as a group increased at an impressive average annual rate of 6% compared with 4.6% for the industrialized countries.2/ However, when one looks at per capita growth rates the figures are 3.5% for the LDCs and 3.6% for the MDCs. At such compounded growth rates the implications for demand growth and income constraints over time are severe.

The third important characteristic of LDCs which affects resource allocation is that the range of decision variables under consideration is generally broader than that in MDCs. Whereas few Western engineers would consider designing systems for consumption levels lower than 200-400 liters per capita per day (lpcd) or without sufficient pressure to meet peak demands, these are cost-saving alternatives that are feasible in LDCs. (Indeed, they may be the only feasible ones given some countries' tight budget constraints.) Since the technical relationship between cost and such design-specific parameters as pipe diameter, total pipe length, reservoir size, etc. are the same for LDCs as for MDCs (when comparing countries of similar geologic conditions) the differing budget constraints of the two groups often dictate different levels of service.3/

These three factors--the narrow revenue base, the rapidly growing demand, and the resulting necessity to explore alternative service levels--have helped shape the rate-making philosophy of water utilities in LDCs. These critical constraints on water policy leave little room for maneuverability and less for mistakes so that a tendency has emerged to take a longer run approach in setting tariffs than is usually done in developed countries.

II. Demand Growth, Supply Plans and Prices

A long run approach takes into account both economic and technical interactions between water demands and system supplies. The mediator on the economic side is, of course, the price charged for water. While the evidence on price elasticity effects at low consumption levels is mixed, there is almost unanimous support for the proposition that price changes have a significant impact on consumption patterns at

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1/ JAIN, SHAIL. See Distribution of Income. IBRD, 1975.

2/ World Tables 1976, p. 392. The industrialized countries group excludes centrally planned economies which grew at an average annual rate of 4.8%.

3/ It has been roughly estimated that at present price levels it would cost more than $60 billion to provide everyone in the LDCs with access to safe water and at least another $100 billion for waterborne sewerage.

higher levels.[1/] As discussed below, even in LDCs large water users account for a significant proportion of total water use. The impact of technical parameters on demand-supply interaction comes through cost. This is largely influenced by the selection of service levels and the resulting need for waste water disposal systems. The World Bank has begun several research projects which address these questions, and preliminary findings are discussed later in this section. The overall conclusion is familiar to us all: the way to equate demand with supply in the most economic and technically efficient manner is to set the price of water equal to its incremental supply cost. The purpose of this section is not to derive that well-known result but rather to indicate its significance for LDCs.

As a practical matter, the financial viability of a water utility is usually its most important concern. In the United States the main yardstick used to measure financial performance is the rate of return earned on assets employed. When compared with the cost of borrowing in local capital markets this provides a reasonably good measure of the enterprise's performance. In developing countries, however, local capital markets are often non-existent or highly regulated and subsidized so that the yields quoted bear little relationship to the actual availability of funds. Further, most water utilities are government or quasi-government enterprises and thus obtain their funding directly from public sources. With the well-known shortcomings of tax structures and collection rates in LDCs and the great shortage of funds for total public sector investment, this often makes it impossible to objectively determine a target or hurdle rate of return for a water utility in the usual manner. These are alternative financial covenants such as proportional contribution to investment which can circumvent this problem to some extent. However, the internal rate of return (IRR) on new investment is, in many cases, the only objective measure available by which to judge a utility's financial performance. Since the IRR is highly dependent upon the price charged for water this exerts additional pressure on the utility to set the price of water at or near its average incremental cost.[2/]

The evidence of water demand patterns in developing countries is very sketchy and little cross-country analysis has yet been undertaken since comparable data are hard to find. However, the water distribution of the capital city of an East African country where records are fairly good is illustrative of the general pattern in many other areas. This particular city classifies residential consumers by size and value of property so that it is possible to see the crude connection between relative incomes and water demand.

1/ See, for example, HOWE, C. W. and LINAWEAVER, F. P. Jr., "The Impact of Price on Residential Demand and its Relation to System Design and Price Structure." Water Resources Research, 3:1:13 (Feb. 1967); HANKE, S. H., "Demand for Water under Dynamic Conditions," Water Resources Research, 6:5:1253 (Oct. 1970); CLARK, R. M. and GODDARD, H. C., "Cost and Quality of Water Supply." Journal AWWA, 69:1:13 (January 1977).

2/ The IRR is defined as the discount rate which equates the present values of the cost and revenue streams generated by the new investment. The same input information can be used to calculate the average incremental cost (AIC) of the water sold since the AIC is simply the cost per thousand gallons, averaged over the investment's life and discounted back to the present using the opportunity cost of capital. Thus if the price of water is set equal to its AIC, the IRR of the investment will just equal the opportunity cost of capital.

Table 1

Water Demand Patterns by Consumption and Connection

Consumer Category	No. of Connect-ions	Average 1975 Monthly Con-sumption (1000 I gal.)	Total 1975 Consump. (1000 I gal)	% of Connect-ions	% of Consump-tion
Residential					
Type 1 (lowest income)	534	3.36	22,985	6	1
Type 2	5476	4.73	332,262	56	17
Type 3	171	8.49	19,709	2	1
Type 4	415	12.26	65,275	4	3
Type 5	1921	13.68	337,124	20	17
Type 6 (highest income)	61	19.84	15,524	1	1
Business, Institutional	1068	94.36	1,198,033	11	60
Total	9646		1,990,912	100	100

The most notable feature of Table 1 above is that 60% of the water sold is consumed by businesses and institutions which account for only 11% of total customers.

The sensitivity of business to increases in the price of an input is generally considered to be fairly high especially when that input is an important one as, for example, for bottling companies. Meanwhile over 60% of the connections (those in the lowest two income categories) consume less than 20% of the water. This relationship would be even more striking if we included the public standposts which supply a large part of the population that cannot afford private connections. It has been estimated that their average consumption is only 3 Igcd 1/ whereas even the lowest income category with a private connection uses an average of 22 Igcd. Thus water distributed through public standposts accounts for only two percent of total consumption but represents about 10% of the total population served.

These figures may sound reminiscent of the type of income distribution figures that one often hears quoted for LDCs and indeed the patterns are very similar. When one plots Lorenz curves for income and for residential water consumption in a given city the similarity is often striking. This implies that the income elasticity of water demand is close to unity and that the few largest consumers are responsible for a highly disproportionate share of total consumption. Since they are likely to be the most sensitive customers to price changes (on both empirical and theoretical grounds: declining marginal utility suggests less incentive would be needed to induce them to cutback consumption) the conclusion is that charging at least those customers the full marginal cost for their water can go a long way toward holding down the growth of total demand. In the next section we discuss the fiscal and income distributional implications of these demand patterns.

1/ Igcd= Imperial Gallons Per Capita Per day
1 Ig= 1.2 US gallons

On the supply side the major concern is that the least cost package of works be put together to meet the demand. Since the demand will vary according to the price charged, in developing countries this often means offering different standards of service for different consumers. Providing only for house connections usually excludes the poorer people from any service at all unless other consumers are willing and able to subsidize their connection and use. Even where a tariff structure with cross-subsidies exists, the poor are often unable to afford the cost of household plumbing necessary to make use of the potential water connection.

Alternatives to house connections include yard or patio connections and public faucets. A World Bank sponsored research project carried out by Professor Donald Lauria of the University of North Carolina compared the distribution costs of providing for patio connections with those of supplying public standposts at a 50 and 100 meter radius. Based on bid documents for a densely populated city in the Yemen Arab Republic his preliminary results indicated that going from a 100 meter to a 50 meter standpipe spacing more than doubled per capita distribution costs, while moving from 50 meter radii standpipes to patio connections more than quadrupled per capita costs.1/ Thus the willingness of people to pay these cost differentials must be carefully considered before a utility is justified in rejecting lower service alternatives for some customers.

From a longer run perspective the cost differentials implicit in different service levels are even more striking since provision for waste water disposal must be included, and per capita sewerage costs are often much greater than those of water supply. Another research project is just getting underway in the World Bank to explore alternative low-cost technologies for waste disposal. Many of these unconventional methods are only feasible, however, in areas where per capita water usage is relatively low. Therefore, unless the cost of disposing of wastewater is included in the original least cost calculation for water supply, the introduction of piped water into an area can actually cause a decline in health and environmental conditions.

Thus it is crucial when working in a developing country context to consider the long run implications of decisions taken today which affect system costs and future demand growth. Since many water supply systems are at an early stage of development and are situated in cities expecting rapid population growth over the next decade, an appropriate mix of service levels and proper pricing policy from the outset can go a long way toward easing the water utility's job of balancing burgeoning demand and strained resources in the future.

III. Financial and Income Distributional Trade-offs

Social goals which in developed countries are considered the province of the national government, are often left to lower levels and more

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1/ These figures assume a uniform average consumption of 50 lcd. Results from tests using 20 and 100 lcd were fairly similar with cost differentials growing slightly larger as per capita demand increased. Of course it is unlikely that people with patio connections would use only 20 lcd or that those using standpipes would use 100 lcd.

diverse groups in LDCs.1/ To build progressivity into a tax system, for example, requires an expensive and sophisticated machinery which is often lacking. As a second best alternative, prices at which public services are offered to various types of consumers can be designed to achieve a certain redistribution of income.

The financial objectives of a water utility, simply stated, can be met by making sure the average tariff level (i.e., the average revenue per thousand gallons sold) is high enough to yield the desired rate of return. The social or income distributional objectives require that even the poorest members of the community be able to afford access to safe water. The way to reconcile these seemingly conflicting objectives is through careful design of the tariff structure.

The pattern of water demand or the distribution of total water consumption across consumers discussed previously has important implications for the tariff structure. Basically it means that financial requirements can generally be met even if only the large consumers are charged the full marginal supply cost for their water.2/ Thus a typical tariff structure would consist of a social or "lifeline" block which would be sufficient to meet basic sanitation needs (say, 20-25 lcd) supplied at a very low price per cubic meter, and one or more larger consumption blocks where unit prices would approach or equal the incremental supply cost.

It is important to note that the emphasis in designing this increasing block (or "inverted") tariff structure is not one of charging higher unit costs to larger users but rather one of pricing most of the water at its full marginal cost while offering a subsidy for the first few litres consumed on social grounds.

This sort of increasing block tariff has been adopted by 21 of the 36 developing countries metered for connections that have borrowed from the World Bank in the water supply sector. In such countries, where the machinery of tax collection is usually ill equipped and alternative sources of revenue scarce, the proper pricing of utilities can make the difference between community solvency and public sector deterioration.

It is interesting to contrast this with the pricing behavior of water utilities in the U.S.--one of the few countries where declining block tariffs are still widespread. A recent survey of the tariff structures used by over 70 American utilities showed that more than 80% had decreasing

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1/ While water authorities in the U.S. often claim that such goals should be handled outside the realm of utility pricing, an analysis of the actual incidence of their user charges often reveals large inter-customer subsidies.

2/ An important exception, of course, is where marginal costs are below average costs due to significant economies of scale or large amounts of unutilized source capacity. However, such cases are relatively rare in both developing and developed countries where high urban growth rates and inflation persist and where new sources of water are progressively more expensive.

would be if the high initial block were needed to cover consumer related expenses like meter reading in areas where the production costs of water were so low that basing the tariff on supply costs would not cover non-production related expenses. With the rising costs of the last decade and the need to range further afield for new water sources there is little doubt that this situation no longer exists in the U.S. if indeed it ever did. In LDCs the rationale for offering lower prices for some levels of consumption is based on the welfare goal of providing minimal quantities of safe water to all. It is difficult to justify subsidizing large residential and industrial consumers on any similar grounds. In fact, U.S. utilities which continue using "quantity discount" tariff structures will not be able to escape bearing a major part of the blame for the water shortages which are occurring with increasing regularity.2/

The impression should not be conveyed, however, that developing countries as a group have been exemplary in their wholehearted adoption of marginal cost pricing. The use of increasing block tariffs does not, by itself, imply anything about marginal costs and indeed in some countries even the highest consumption block is priced well below incremental supply costs. In addition there has been a widespread unwillingness among public water authorities to permit pricing distinction between consumers on the basis of incremental costs for which they are responsible. The failure to adequately recognize the burden on system costs of peak season water consumption is an example.

A number of difficulties that are typically associated with the practical application of marginal cost pricing principles assume particular importance in LDCs. Income distributional constraints may be greater because of the absolute level of poverty; unemployment and overvalued local currencies raise a problem of shadow pricing, and administration of pricing schemes is particularly difficult--for example, metering of water supplies often presents acute management problems in LDCs. Administrative shortcomings also mean that knowledge of such critical variables for incorporating a redistributional element into pricing policy as beneficiaries' income status, population density, etc., is even less adequate than it would be in a developed country. The problem of technological lumpiness of investment, which always causes conceptual problems for the pricing analyst, is often greater in LDCs because optimally sized investments may, in comparison with developed countries, represent relatively large additons to limited existing capacity and output. This problem is sometimes compounded by financially induced lumpiness where, because

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1/ HELT, A. and CHAMBERS, D. L., "An Updated Hartford Metropolitan District Water Rate Survey," Journal AWWA, August 1976,pp.426-430.

2/ The declining block rate has also been a traditional feature of electricity tariffs in the United States. However, recent energy shortages have prompted a critical review of electricity pricing policies; as a result, rate "flattening" or "inversion" is widely advocated, and there are signs that a significant reform of electricity tariffs may now be under way in this country.

the economic awareness of American utility managers, is the impact of inflation on costs. The financial requirements necessary to meet increased operating costs and permit an adequate rate of expansion of capacity are growing at an unprecedented rate. The reasons include not only general inflation but also the especially large increases in the prices of fuel and chemicals, and the technical and environmental factors mentioned above. Unless tariffs are increased commensurately, a utility would soon face serious financial difficulties. Unfortunately, the solution often advanced has been to introduce a new type of charge1/ on new customers or special groups of existing customers while leaving the overall consumption charge far below marginal production costs. While this may be an adequate financial solution in the short run, it will not only prove infeasible over the longer term (since such charges fall upon a relatively small group of customers and cannot be increased indefinitely) but will also actually contribute to a worsening situation as demand grows unrestrained.

In developing countries, where resource constraints are tighter and demand growth is faster this problem is being faced today and dealt with through adopting a longer run and forward looking approach toward rate setting. The degree of success achieved through this philosophy will, no doubt, be followed with great interest by those of us who will face similar problems over the next decade.

1/ This goes by many names including availability charge, plant investment fee, meter and service fee, local facilities charge and others.