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WATER RATES IN LATIN AMERICA

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Four years ago Dr. Abel Wolman and I had an opportunity to visit most of the countries of Latin America and many of the cities represented here today. On that occasion discussions were held with waterworks officials, leading sanitary engineers, Ministers of Finance and Public Works; the subject of our discussions - water supply finance, administration, and water rates. Perhaps some of you were present at one or more of those meetings and will recall that some of the questions we most frequently asked were why water supplies were not being built to keep pace with the growth of cities; and why, each year, more and more people were unable to get water in their homes; and why, year by year, water service seemed to be getting worse, with less pressure, with longer periods of no water, and why the high rates of water-borne disease were continuing. You will recall the answer which was nearly identical in each conference and in each country - "no money". The question that usually followed this answer was, "What are you charging for water?". I need not tell you the answer to this question. You can guess, possibly based on some of your own past experience, that the charge for water frequently did not even return operation costs. Each year the national budget had to include money for operation and maintenance plus new construction with the result that each year less money was available for new construction. The revolution which has taken place in the thinking and actions of Latin American engineers, waterworks and governmental officials during these past four years has been truly amazing. Four years ago, with only a few exceptions, the view prevailed that water was a social commodity and should be provided free or at less than cost. Today, it is the exception rather than the rule to find waterworks officials who hold to the old view. Unfortunately, not all officials believe yet as do the waterworks people. Waterworks constitute a business and, like any business, the merchandise it sells has to carry a price which will cover costs of manufacturer, sales and administration. I think it is obvious that if the price is too low we go out of business unless some rich relative keeps giving us a subsidy as central governments have been doing. With too many poor businesses, however, no one gets enough and consequently all the businesses have trouble. Only when we charge enough for the merchandise to pay for all costs, with enough to put some money away for use in extensions and expansions, can we know that our business is going to function. The fact that all of you present at this symposium come from water organizations which have received international loans for extensions and expansions to your water systems, is indicative of the fact that you subscribe to this philosophy.

While reviewing the various types of rate structures used in Latin America, and while discussing some of the strong points and particular merits of certain systems, I wish at the very beginning to stress the fact that it is not so much the system of rates employed that

is important, but rather that whatever system is used must provide the means by which the needed revenue can be collected for the water sold. It is unnecessary to mention that even with the best of rate systems, if the meters are not read, if the bills are not put out on time, and if the bills are not collected, you might as well admit to operating a business headed for bankruptcy. We therefore get immediately into the subject which is one of the more controversial in the water business, the subject of what is the best system for charging for water.

I should like to refer to a report on water rates prepared by one committee of a national waterworks association and to paraphrase the first paragraph of their report as it might have read if prepared for international consideration. It should read as follows: "The subject of water rates has been involved in controversy for many decades, and it is not possible to resolve this controversy now by any simple set of rules. Not only are divergent views concerned, but differences in culture, social outlook, laws, governmental philosophy, local conditions (between countries and within countries), ownership (private or public), control (national, provincial, local boards, etc.) and other matters must also be considered". Confusion and controversy occur largely as the result of trying to equate charges and provide for a just means of assessing each consumer for his fair share of the costs.

In the following few minutes I will attempt to present comments along the following broad lines:

a) Definition of water rates;

b) Sources of revenue other than water rates;

c) The objective of water rates;

d) Present Latin American practice in water rates and systems employed;

e) Rate systems where meters are not employed;

f) Rate systems where meters are used;

g) Variable rate structures;

h) Uniform or Straight-line structures;

i) A guide for evaluating adequacy of rates.

Definition of Water Rates

I will use the definition of water rates agreed to by the seminar on this subject convened by the Pan-American Health Organization. in Montevideo in 1960. This is: "A water rate is the basis of a system which permits the establishment of charges for water consumed".

It may be argued, according to this definition, that in those cases where water meters are not used, charges for water are not directly or entirely based on water consumed, and therefore the system of charges could not be called water rates. Nevertheless, for this discussion we will use "water rates" in the broad sense to cover all systems of charging for water, whether metered or not.

Sources of Revenue other than from Water Rates

Before discussing water rates, per se, it may be worthwhile to mention other sources of revenue which can be usefully employed to supplement those collected from water rates. So far as I know, in Latin America little or no use is made of property improvement taxes and front foot assessments as means for covering the costs of distribution system construction. Where these are used, the burden placed on water rates can be reduced. There are many arguments to support the use of such assessments which time does not permit to be discussed here. I will touch on the use of these assessments later in this paper. In a few countries special taxes, such as those on beverages and new building construction, are used to provide revenue to the water departments. Of these the tax on new construction seems to have particular merit in that it can reflect the cost of the water distribution line serving the property and is, in a sense, a front foot assessment.

It is well to keep in mind that special taxes and assessments are not water rates.

Objective of Water Rates

Because of inherent differences in the philosophies of governments, it may be somewhat presumptuous to set forth what is the objective of a water rate system. Nevertheless, if we hold to the view that a waterworks operation should function as any well-run business, we must accept the premise that all the financial requirements of the system must be covered by revenue. By financial requirements I mean operation and maintenance costs, taxes, interest, depreciation or loan repayments (whichever is the greater), and costs for normal extension and expansion of the system. By revenue I mean all money coming to the water department from taxes, special assessments, connection fees, water rights, and water sales. The objective of water rates is therefore to provide that income over and above other revenues which will permit the water organization to cover all expenditures.

Present Latin American Practice

One peculiarity of water systems in Latin America which influences rates and has a bearing on the type of structure to be used is that of the way by which almost all systems were initially financed. Government financing by subsidies of up to 100% of costs was the rule, not the exception. I will refer to this later on as it concerns water rates.

A review of the water rate systems employed leads to a few broad conclusions which may be summarized as follows:

1. The economic status of consumers is frequently reflected in the rate system, placing higher rates on those able to pay more. This characteristic is seen in such procedures as grouping of consumers according to property value; ascending rates proportioned to the volume of water consumed; and higher base rates for industrial and commercial consumers.

2. No standard pattern for water rates appears to exist.

3. Some water rate structures are extremely complex while others are simple; some attempt to provide revenue sufficient to cover all costs of operation, maintenance, and loan payments; others cover only operation and maintenance; while still others provide revenue insufficient to meet operating costs.

4. Most rates, regardless of the system, are calculated without provision for creating a reserve for future extensions and expansion and with no provision for depreciation.

Systems of Water Rates

Two distinct types of water rate systems are employed throughout Latin America. These are:

1. Water rate systems where water meters are not used and where other approaches are taken to establish charges for water.

2. Water rate systems based on volume of water consumed - that is where water meters are employed.

It should be mentioned that most Latin American cities are at present not 100% equipped with meters and, therefore, both of these types of general water rate systems are employed at the same time.

A. Systems Without Meters

Water rate systems where meters are not employed base their water charges on one or more of the following factors:

1. Size of service line;

2. Value of the property;

3. Type of establishment, i.e. commercial, industrial, domestic;

4. Number of faucets or number and type of fixtures;

5. Location of property;

6. Size of house or establishment.

All of the foregoing attempt to set charges on a basis of something which roughly indicates the volume of water which each property may be expected to use and ability to pay. Obviously such measures are not able to reflect volume accurately and therefore are not only inequitable but usually cause the water company to lose money by wastage since there is no incentive to be economical in the use of water. Also there is no way of knowing the amount of losses from leakage.

Probably the number and type of plumbing fixtures in a house or establishment are as good an index of water use as any. The size of service line or size of house might be next, although being so subject to great variations they, like property value, are of little practical worth if relative water consumption is to be reflected.

Managers faced with the necessity of accounting for all water used and for adoption of procedures which simplify good administration will find that in spite of all the arguments against metering, there is still no better means by which they can resolve the problem of selling water than that of 100% metering of a water system.

B. Systems with Meters

Meters as the mechanism for establishing charges for water service are used in every country of Latin America, more in some than in others. The basis on which the charges are established vary considerably from one country to another and between cities within countries.

You are aware that there are various ways of measuring water. The method of preference for piped water is a meter which permits registration of the volume of water that passes through it. Two types of registration meters are in general use, the positive displacement type and the propeller type. Where low flows are encountered as in domestic use, the positive displacement type is to be preferred. One other way of measuring water used rather extensively in some parts of Latin America is the orifice. The hydraulic characteristics of water flow through restricted sections of a pipe, through tapered sections, and through small parts or orifices have been extensively studied and it is known that at a given pressure a certain volume of water will pass through the section or orifice. This principle is used where water departments wish to avoid the cost of registration type meters but still wish to have some assurance that any particular service does not use unlimited quantities of water. It is not possible to discuss this aspect of water metering further in a paper devoted to rates and I will therefore say no more except to mention that because there is no such thing as a water system with constant pressure, and because use of orifices for domestic

service does not provide for registration of quantities used, they cannot be considered a mechanism for utilization by water departments which are interested in high efficiency and in knowing where all water produced is used. In other words orifices cannot be recommended for use on systems which are of any appreciable size and which are attempting to be self-financing operations. The discussions which follow on water rates in metered systems are based on the assumption that registration type meters are employed.

Elements Found in Metered Rate Structures

I hope to point out some of the difficulties encountered through use of various rate systems in trying to meet the numerous factors which must be considered in equitably apportioning the costs of water between the different consumers and to suggest that no system is free of criticism. An ideal rate system, in my opinion, would be one which is simple, which takes into account local characteristics, and which equitably assigns the charges for water on the basis of costs incurred in providing water to each consumer. It is in trying to meet this last objective, the equitable distribution of costs, that one encounters diverse and controversial approaches. Theoretically, one could argue that no two consumers impose the same costs to the water company and that a different rate should be applied to each. For example, a consumer living next door to the water storage reservoir does not cost the system the same as one living at the other side of the city because the pipe supplying him is less. The people living in a low section of a city can be supplied with water at a less cost than those living in an area of high elevation where pumping is required. A factory taking water continuously over 24 hours a day can be provided with water more cheaply on a unit basis than one which uses all its water in one hour but which necessitates the water company to provide facilities for the one hour demand even though such facilities will be unused for the other twenty three hours. One industry requires a water of high purity while another would be satisfied with raw water. A small consumer living at the periphery of the city requires higher administrative costs for meter-reading and billing per unit of water used than a large consumer. We could mention an infinite number of variables which set one consumer apart from another. A system of charges, therefore, practically has to assess the many variables and to arrive at a compromise which can be effectively administered and which does not place undue charges against any one group or individual.

As we review various types of metered rate structures used in Latin America, certain elements will be more or less common in each. A few of these are:

1. Minimum monthly charges with fixed volumes of water provided within the minimum charge.

2. Charges assigned for excess water used over the minimum, and calculated on an ascending, descending, or mixed scale.

As part of the charges billed to customers, but not an element in the rates, will be found such items as:

1. Meter rental charges.
2. Service charges.
3. Connection fees.
4. Payments on costs for installation of service lines and meters.

In order to differentiate between different rate systems employed in Latin America, names are given to each type of system, based on the general method employed for calculation. Undoubtedly better terminology can be found, but for our purposes I have elected to classify the systems into two large classes, Variable and Uniform rates, and to break down the Variable class into the following sub-classes: Consumer type, Consumer income, Volume type.

Variable Rates

Consumer Type

Consumer type rates establish a different basic rate for water sold to domestic, commercial, and industrial consumers. These may be reflected in the designation for the latter of a larger size of service line and meter with rates based accordingly, or simply by the establishing of a rate by type of installation without regard to size of service.

At least two countries classify consumers into groups according to whether they are domestic, commercial, industrial, and other, and establish a minimum rate per volume of water to be charged each month. For example, in one country, the following classes are shown (1960). (Note: All figures shown in the following tables are U.S.$).

Tariff 1 - Small consumer ($15m^3$/month), public housing projects, employees of the water department. $\$0.026/m^3$.

Tariff 2 - Intermediate consumers ($15m^3$-$20m^3$ and $20m^3$), $\$0.026/m^3$ up to $15m^3$, $\$0.057/m^3$ over $15m^3$.

Tariff 3 - Consumers who are served by State electricity and telephones, $\$0.065/m^3$.

Tariff 4 - Industries, commercial establishments, Banks and State enterprises, $\$0.087/m^3$.

Comments on Consumer Type Rate Structures

1. They attempt to provide a method of assigning costs of service on an "ability to pay" basis and also to assign proportion of charges according to apparent rightful share of the cost of facilities to meet demand or capacity requirements.

2. Rate charges, billing of new users, and predicition of revenues can be made with less difficulty than by the "consumer income" method.

3. They cannot accurately reflect proportional share of costs of the water system assignable to each consumer and are unable to distinguish within each category between those of high and low demand. There is consequently some discrimination between users.

Consumer Income - Variable Rates

These are rates which vary according to some formula that attempts to reflect "ability to pay" of various classes of consumers.

One country has adopted a water rate structure which classifies users on the basis of value of the property which each occupies. A typical schedule of rates according to this classification is as follows:

Value of Property	Minimum m^3	Monthly Charge
$4,000	40	$0.58
4,001 to 8,000	40	$1.00
8,001 to 12,000	50	$1.45
12,001 to 16,000	60	$1.75
16,000 and above	70	$2.00

Excess charge = $\$0.037/m^3$

Under a classification based on the economic capacity of consumers to pay, any number of steps can be employed. Obviously the more steps the more complex is the structure.

Comments

1. Variable rates based on consumer classification reflecting income places a greater burden on those economically stronger to cover the cost of water service. Socially speaking, this has certain advantages.

2. Consumer income rates usually provide for sale of a certain volume of water at less than cost.

3. Such rates are more difficult to develop and involve the water department in much more paper work, administrative expense, and possible controversy.

4. Changes in property value are frequently not reflected in changes of water rate classification. Value of property occupied does not necessarily reflect consumption.

5. Such rate structures usually are complicated and depart from the principle of simplicity.

Variable Rates - Volume Classification

Many of the rate systems in Latin America include, within systems following other classifications, provision for separate rate classes based on the volume of water used. One example of this type of classification is as follows:

Bi-monthly Consumption	Rate/m^3
Up to 40 m^3	U.S.$0.024
" " 100 m^3	0.028
" " 150 m^3	0.032
" " 200 m^3	0.036
" " 250 m^3	0.040
" " 500 m^3	0.044
" " 750 m^3	0.048
" " 1,000 m^3	0.052
" " 5,000 or more m^3	0.056

The same pattern of charges will be found in many countries of Latin America. That is, as the amount of water used increases, the rate per cubic meter increases.

In at least two countries the reverse of this pattern is followed and as water use increases, the rate per cubic meter decreases.

In certain cities of one country a combination of these two types of rates can be observed in which the unit charge for water increases as the volume used increases up to a point, following which additional water used is reduced in price per cubic meter.

Comments

1. Where charges per unit of water increase as volume increases, the rates favor the small consumer and discriminate against the large. Under conditions where the water system has been financed by heavy

government subsidy, and where charges decrease as volume increases, there may be discrimination against the small consumer. The mixed structure may possibly discriminate against the intermediate consumers.

2. It is important to note that customers can be classified according to the average amount of water used per month and rates established for each classification, or that other means of classification can be employed to establish minimums and only excess water charged for on an increasing, decreasing, or mixed scale.

3. A decreasing scale of water charges can be defended if the distribution system has not been already paid for by the domestic consumer and/or if it can be shown that water production for large consumers is substantially less costly than for the small users.

Other Means of Classification

In at least one country customers are classified according to whether they own a "water right" and the size of the "water right". Thus the following schedule prevails:

Water Right Size	Monthly Charge	Excess Charge/m^3
10 m^3	$ 0.50	$ 0.10
30 m^3	1.00	0.10
60 m^3	1.50	0.10

If the consumer does not own a water right, he pays for water at a higher charge according to a classification based on volume used.

Comments

1. The question of water right sales cannot be discussed in detail as part of a water rate paper. Nevertheless this device is pointed out as having considerable merit for use in areas where local investment in water systems is to be stimulated as would appear to be the case in every country. The use of a higher water rate for those not owning a "right" will do much to encourage the purchase of rights.

2. The same comments regarding the classification within the system using volume of water as the guide can be offered as in the previous comments on "Variable Rates - Volume".

Uniform or Straight Line Rates

So far as I know, no water system in Latin America utilizes a completely straight line method of setting water rates. This method presumes that all water will be charged for at the same price, with no difference between the types of consumers nor any difference between the first cubic meter and the last.

Information available shows that in one city of Latin America the rates in effect in 1960 provided that in areas of the city served by meters and where pumping was required, a uniform rate of $.04 per cubic meter was charged. Therefore for those customers so served a straight line structure can be said to exist.

Under a uniform rate structure, the various factors such as demand, customer service, capacity, and commodity charges are all grouped together and assigned against each unit of water sold without regard to the variables which exist between one consumer and another. In so doing the small consumer bears a lesser cost for, among others, the customer service charges than may be his rightful share. The capacity charges are reflected in the rate since the larger the volume of water used each month, the greater the amount paid by the consumer. Under a uniform system, there is no category of excess water and there need be no minimum. A monthly service charge can be established which covers administration and meter charges if this is considered desirable.

One of the reasons for reducing the unit charge for water as consumption increases is that the large users should not have to pay for distribution facilities provided to serve the domestic group. This position has validity in those cases where the distribution system construction is paid for entirely out of water rates. However, in Latin America where nearly every system has been constructed, at least in part, by funds appropriated from general revenue, it can be said that the general consumers have already paid for the distribution system there being then less justification for a declining rate. On systems where water is in short supply and where water conservation is desirable, an increasing rate has merit.

The point to be brought out from the foregoing is that because of the impossibility, under present practices, to equitably distribute the various demand charges between consumers and because a number of the inequities against big consumers have already been provided for when distribution system costs have been paid for by special charges outside the rate structure, there appears to be merit in uniform rate systems which include all costs and assign them against each unit of water at exactly the same price for all water used. Such a process need not rule out the establishment of different charges if it can be shown that such charges can be accurately fixed.

When considering the question of peak demand, it is desirable to point out that if waterworks operation could utilize "demand type" meters which would give a preferred water rate for off-peak usage,

as the power companies do, then a rate differential would be worthwhile since idle plant capacity could be utilized.

Uniform Rate Application

In the discussion above it has been pointed out that the variable costs frequently reflected in existing rate systems can be consolidated and assigned on a uniform basis with a fixed charge for each cubic meter of water sold, beginning with the first cubic meter consumed, and with no minimum charge or excess charge. The small consumer who has little money can use as little water as he wishes and is not forced to pay for more water than needed. He may pay even less than that which he now pays. If his minmum is now $15m^3$ per month, his minimum charge has to reflect at least most of the $15m^3$ even though he might get along on $8m^3$. The use of connection fees, service charges, front foot assessments, new building taxes, and property improvement taxes can be employed with the uniform rate system where it is found desirable to apportion costs of distribution to properties and where other taxes assigned to the water department do not exist.

It is pertinent to mention that the minimum quantities of water now provided within the monthly minimum charges in most countries of Latin America are, in my opinion, too high. The reasons for dispensing with a monthly minimum altogether have been presented. However, where such minimums do exist, and it is desired to continue them, it is apparent that many families could and would use less water if it were in their interest to do so. It is also in the interest of the water company because the water sold under the minimum does not usually carry the same unit cost as that above the minimum. Revenue is thereby lost, the amount being a function of how near the unit cost is to the production and distribution cost.

Reducing the minimum and increasing unit costs will also prove of value when periods of high water demand are encountered which may exceed source or plant capacity. This is a seldom used device but in cities faced with immediate problems of water shortage, very high temporary rates can be an effective deterrent on water consumption.

Although having presented some reasons for supporting uniform rates to the extent that I will probably be chastised by many of my learned colleagues who disagree with this type of system, I would like to leave you with the idea that for new water companies just gaining experience, a simple rate structure has much to commend it. After a number of years have passed and sufficient data has been accumulated, it then becomes possible to see changes which may be undertaken and which may lead to a more just distribution of charges between users. I would not have you go away with the impression that your existing rate systems should be immediately changed. It is better to make haste slowly and to use what you know will work under local conditions until real advantages are seen in a different system.

Criteria for Measuring Adequacy of Water Rates

There is usually a question raised by public officials, consumers, and politicians, as to what constitutes an adequate water rate. In order to permit an assessment of water rates on some basis, the following guide is called to your attention.

The ratio of operating costs to revenues for any well-run water facility should be in the range of 50% to 65%. This ratio can be expressed as follows:

$$.50\text{-}.65 = \frac{\text{Operating Expenses - (taxes, if any, plus depreciation, and all operational and maintenance costs) but not including interest.}}{\text{Revenues - all revenues but excluding meter and service installation charges.}}$$

The difference in the ratio between .65 and 1 reflects the margin within which interest payments, repayments on loans over and above depreciation, and surpluses for normal plant expansion, can take place.

General Comments

Before closing this discussion, I should like to make a few general comments on water rate practice in Latin America which are believed important. The first of these is that in certain countries where national water authorities either exist or are proposed, or where a public work agency carries responsibilies nationally for recommending water rates, there is considerable support for the policy of establishing a single water rate for the entire country. I should like to be recorded as opposed to this practice. The only argument to support it is that it is simple and that everyone in the country pays the same according to the classification set up in the rate structure. This practice is economically unsound because it subsidizes one area at the expense of another. If one area is short of water and a long, expensive, transmission main has to be constructed with pumping cost added, and if people pay the same there as in another area where water is cheap, the tendency is for the water short community to continue to grow, increasing demands for water and requiring ever more subsidy to supply the needed water. Looking at the country as a whole and assuming that resources are limited, it is in the interest of the government to encourage growth of those communities which contribute the most and cost the least for services. To artificially unbalance the growth of communities by providing water at less than cost for some communities and at higher than cost for others is not in the national interest. It is believed that water rates should be

developed for each community based on its costs of operation and its need for revenue. A uniform national rate should not be considered.

Another general comment is that water companies should not provide free water to anyone but should be reimbursed for all water consumed. This implies that where for particular reasons water service is provided to selected installations, the responsible agency should pay to the water department the full cost of all water used by such installations.

Review and change of rates is a continuing responsibility of management. When periods of 5 to 10 years pass before a rate is increased, not only is the enterprise probably operating at a deficit for some years, but the political reaction to the new rate becomes very great because the increase has to be great. More frequent and less severe increases in rates provide a much more effective mechanism for keeping the operation solvent and avoiding undue public reaction.

Finally, I return to the statement made earlier. Some rate structures appear to have advantages over others. However, the important thing is that each water system have a rate structure which reflects the cost of water and which produces the revenue necessary to meet all expenses and allow the accumulation of capital for normal extensions and expansion.

January 21, 1963.

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Simposio Sobre Administración
de
Servicios de Agua y Alcantarillado

Medellín, Colombia 11-23 Febrero 1963

Sistemas de tasas y tarifas en los servicios de agua y alcantarillado en América Latina.

Ventajas y desventajas.

Recomendaciones generales para mejorar las prácticas y sistemas en uso.

por
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Patrocinado por

Organización Panamericana de la Salud

Banco Interamericano de Desarrollo

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Sistemas de tasas y tarifas en los Servicios de agua y alcantarillado en América Latina.

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Hace cuatro años, el Dr. Abel Wolman y el autor del presente trabajo tuvieron ocasión de visitar la mayoría de los países de América Latina y muchas de las ciudades que hoy figuran en estas líneas. En la mencionada ocasión nos entrevistamos con funcionarios de los servicios de abastecimiento de agua, ingenieros sanitarios principales, Ministros de Hacienda y Obras Públicas, y tratamos con ellos de las cuestiones referentes a financiamiento, administración y tarifas de los sistemas de abastecimiento de agua. Tal vez algunos de Uds. asistieron a una o más de dichas reuniones y recordarán que algunas de las preguntas que hicimos más frecuentemente fueron, por qué no se construían sistemas de abastecimiento de agua adaptándose al ritmo de crecimiento de las ciudades; por qué aumentaba todos los años el número de personas que no podían tener agua en sus hogares; por qué, año tras año, los servicios de abastecimiento de agua parecían empeorar, con menos presión y períodos más prolongados de corte de agua, y por qué continuaban las elevadas tasas de enfermedades transmitidas por el agua. Ustedes recordarán la respuesta, que era casi idéntica en todas las conferencias y en todos los países: "falta de dinero". La pregunta que de ordinario seguía a esa manifestación era: "Cuánto cobran ustedes por el agua?". No necesitamos decirles cuál era la respuesta a esta pregunta. Es posible, que por propia experiencia, les conste a ustedes que lo que cobran por el agua, a menudo no basta ni para cubrir los gastos de funcionamiento del servicio. Todos los años, los presupuestos nacionales tienen que asignar fondos para funcionamiento, mantenimiento y nueva construcción de sistemas, con el resultado de que cada año se dispone de menos dinero para nuevas construcciones. La revolución ocurrida en la forma de pensar y actuar de los ingenieros, funcionarios gubernamentales y de los servicios de abastecimiento de agua latinoamericanos durante los últimos cuatro años, ha sido realmente asombrosa. Salvo raras excepciones, hace cuatro años que predominaba el criterio de que el agua era un artículo social y debía facilitarse gratis o a precio menor del costo. Actualmente, constituyen la excepción más bien que la regla los funcionarios de sistemas de

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abastecimiento de agua que mantengan el punto de vista antiguo. Por desgracia, no todas las autoridades comparten todavía la opinión del personal de los sistemas de abastecimiento de agua. Estos constituyen un negocio comercial y, como todo negocio de esta índole, la mercancía que vende ha de llevar un precio que cubra los gastos de producción, venta y administración. Esta materia es la que vamos a analizar ahora durante breves minutos: los medios de determinar el precio del agua. A nuestro juicio, es indudable que si el precio es demasiado reducido iremos a la quiebra, a menos que algún pariente rico continúe concediéndonos un subsidio, como han venido haciendo los gobiernos de los países. Sin embargo, cuando el número de negocios ruinosos es excesivo, ninguno de ellos consigue lo bastante y, en consecuencia, todos tienen problemas. Solamente cobrando por la mercancía lo suficiente para sufragar todos los gastos, con un margen que permita acumular fondos para ampliaciones y mejoras, podemos tener la convicción de que nuestro negocio dará buen resultado. El hecho de que todos ustedes, los que participan en este simposio, procedan de organizaciones encargadas del abastecimiento de agua que han recibido empréstitos internacionales para mejoras y ampliaciones de sus respectivos sistemas, indica que ustedes comparten este criterio.

Al analizar las diversas clases de estructuras de tarifas utilizadas en latinoamérica, y mientras examinamos algunas de las firmes características y ventajas particulares de ciertos sistemas, deseamos, desde el principio, subrayar el hecho de que lo importante no estriba tanto en el sistema de tarifas empleado, sino más bien en que el método utilizado, sea cual fuere, debe facilitar los medios que permitan reunir los ingresos necesarios mediante la venta del agua. No es preciso mencionar que incluso empleando los mejores sistemas de tarifas, si la lectura de contadores no se efectúa, o las facturas no se envían a tiempo, o no se cobran, ha de reconocerse que estamos explotando un negocio encaminado a la bancarrota. Por consiguiente, ocupémonos acto seguido del tema que es uno de los más discutibles en materia de abastecimiento de agua: cuál es el mejor sistema de cobro del agua.

Refiriéndonos a un informe relativo a tarifas de abastecimiento de agua, preparado por un comité perteneciente a una asociación nacional de sistemas de abastecimiento, parafrasearemos el primer párrafo del mismo tal y como hubiera quedado de haberse redactado para someterlo a consideración internacional.

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Diría así: "La cuestión de las tarifas del abastecimiento de agua ha sido objeto de controversias durante muchas décadas y actualmente no es posible solucionar esa controversia por medio de una serie de reglas simples. No sólo intervienen criterios divergentes, sino que deben considerarse asimismo diferencias de cultura, apariencias sociales, leyes, criterios gubernamentales, condiciones locales (entre los países y dentro de los mismos), propiedad (privada o pública), control (juntas nacionales, provinciales, locales, etc.) y otras cuestiones". La confusión y la controversia ocurren en gran parte como resultado del intento de igualar la facturación y proporcionar medios justos de asignar a cada consumidor la parte de los costos que equitativamente le corresponde.

A continuación, y en pocos minutos, formularemos observaciones acerca de los puntos generales siguientes:

a) Definición de las tarifas de agua;
b) Fuentes de ingresos distintas de las tarifas;
c) Objeto de las tarifas;
d) Procedimientos y sistemas empleados actualmente en Latinoamérica en materia de tarifas de agua;
e) Sistemas de tarifas donde no se emplean contadores;
f) Sistemas de tarifas donde se emplean contadores;
g) Estructuras de tarifas variables;
h) Estructuras uniformes o directas;
i) Orientación para evaluar la idoneidad de tarifas.

Definición de las tarifas de agua

Nos serviremos de la definición de tarifas acordada por el seminario reunido a este respecto por la Organización Panamericana de la Salud, en 1960, en Montevideo. Es la siguiente: "Una tarifa de agua potable es la base del sistema que permite la facturación de los consumos".

Según esta definición, puede aducirse que en los casos en que no se emplean contadores, la facturación por agua no se basa íntegra ni directamente en el agua consumida y, por lo tanto, el sistema de facturación no puede llamarse tarifas de agua. No obstante, a los efectos de la presente discusión emplearemos la expresión "tarifas de agua" en su sentido amplio, que comprende todos los sistemas de facturación de agua, medida o no por contador.

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Fuentes de ingresos distintas a las tarifas

Antes de analizar las tarifas de agua, en sí, convendría mencionar otras fuentes de ingresos que pueden emplearse útilmente como complemento de los obtenidos mediante las tarifas. Que nosotros sepamos, en América Latina no se aplican, o muy poco, los impuestos por mejora de propiedad y los prorrateos por pie de fachada como medios de cubrir el costo de las obras del sistema de distribución. Utilizando estos medios puede reducirse la carga colocada sobre las tarifas de agua. Múltiples razones abonan el uso de tales prorrateos, que la premura de tiempo no permite analizar aquí. Más adelante nos referiremos ligeramente en este informe al empleo de los mismos. En unos cuantos países, impuestos especiales como los que gravan las bebidas y la construcción de edificios nuevos se utilizan para facilitar ingresos a los organismos encargados del abastecimiento de agua. De estos impuestos, el aplicado a las construcciones de nueva planta parece tener la ventaja especial de que puede reflejar el costo de la línea distribuidora de agua que presta servicio a la propiedad y es, en cierto sentido, un prorrateo por pie de fachada.

Conviene tener en cuenta que los prorrateos e impuestos especiales no son tarifas de agua.

Objeto de las tarifas

Teniendo en cuenta las naturales diferencias de criterio entre los Gobiernos, tal vez resulte algo atrevido el intento de establecer cuál es el objeto de un sistema de tarifas de agua. No obstante, si nos atenemos al punto de vista de que la explotación de un sistema de abastecimiento de agua debe funcionar como cualquier negocio bien dirigido, hemos de aceptar la base de que todas las necesidades financieras del sistema deben cubrirse mediante los ingresos. Por necesidades financieras entendemos los costos de explotación y mantenimiento, impuestos, intereses, depreciación o reembolsos de empréstitos (la más elevada de ambas cantidades) y los costos de las mejoras y ampliaciones normales del sistema. Por ingresos entendemos todos los fondos que cobra el departamento de abastecimiento de agua en concepto de impuestos, prorrateos especiales, primas de conexión, derechos de agua y venta de ésta. Por consiguiente, el objeto de las tarifas de agua es el de facilitar esos ingresos, además de cualesquiera otros, que permitan a la organización encargada del abastecimiento de agua cubrir todos sus gastos.

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Procedimientos empleados actualmente en América Latina

Una particularidad de los sistemas de abastecimiento de agua en América Latina que influye en las tarifas y afecta a la clase de estructura a utilizar, es la forma en que casi todos los sistemas fueron financiados inicialmente. El financiamiento gubernamental mediante subsidios de hasta el 100% de los costos era la regla, no la excepción. A esto nos referiremos más adelante en lo que concierne a tarifas de agua.

Un análisis de los sistemas de tarifas de agua empleados, conduce a unas cuantas conclusiones extensas que pueden resumirse en la forma siguiente:

1. La situación económica de los consumidores se refleja con frecuencia en el sistema de tarifas, que asigna tarifas más elevadas a los que pueden pagar más. Esta característica se observa en procedimientos tales como el agrupamiento de usuarios según el valor de la propiedad; tarifas ascendentes en proporción al volumen de agua consumida, y tarifas base más altas para usuarios industriales y comerciales.
2. No parece existir norma uniforme alguna para tarifas de agua.
3. Algunas estructuras de tarifas de agua son complejas en extremo y otras son sencillas; algunas procuran facilitar ingresos suficientes para cubrir todos los gastos de explotación y mantenimiento, y los pagos de empréstitos; otras cubren solamente los gastos de explotación y mantenimiento; otras, en fin, ni siquiera proporcionan ingresos suficientes para cubrir los gastos de explotación.
4. La mayoría de las tarifas, sea cual fuere el sistema adoptado, están calculadas sin prever la formación de una reserva destinada a futuras mejoras y ampliaciones, y sin asignación alguna para depreciación.

Sistemas de tarifas de agua

Dos clases distintas de sistemas de tarifas de agua se emplean en toda América Latina. Son las siguientes:

1. Sistemas que no utilizan contadores y en los cuales se adoptan otros procedimientos para la facturación.
2. Sistemas basados en el volumen de agua consumida, en los cuales se usan contadores.

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Debe mencionarse que, actualmente, la mayoría de las ciudades latinoamericanas no están por completo equipadas de contadores y, por consiguiente, se emplean simultáneamente ambas clases de sistemas generales de tarifas de agua.

A. Sistemas sin contadores

Los sistemas que no emplean contadores se fundan para la facturación en uno o varios de los factores siguientes:

1. Tamaño de la línea de servicio;
2. Valor de la propiedad;
3. Clase de establecimiento, por ejemplo: empresa comercial, industrial, hogar doméstico, etc.;
4. Número de grifos o número y clase de accesorios;
5. Emplazamiento de la propiedad;
6. Tamaño de la casa o establecimiento.

Con todo eso se intenta fundar la facturación en algo que indique el volumen de agua aproximado que lógicamente puede consumir y pagar cada propiedad. Pero es indudable que tales medidas no pueden reflejar el volumen con exactitud y, por consiguiente, no sólo no son equitativas, sino que de ordinario causan a la compañía abastecedora de agua pérdidas económicas por uso excesivo, ya que no existe incentivo alguno para economizar el consumo de agua. Tampoco existe medio alguno de saber la cantidad de pérdidas por fugas.

Probablemente, el número y clase de accesorios de fontanería de una casa o establecimiento son tan buenos indicadores del consumo de agua como cualesquiera otros. Le siguen en importancia, a estos efectos, el tamaño de la línea de servicio o el de la casa, si bien, por estar sujetos a grandes variaciones, resultan poco prácticos, como el valor de la propiedad, para deducir el consumo de agua relativo.

Los administradores que necesiten contabilizar toda el agua utilizada y adoptar procedimientos que simplifiquen la buena administración hallarán que, a pesar de todos los argumentos contrarios a los contadores, aún no existe medio mejor de resolver el problema de la venta de agua que el de instalar contadores en la totalidad de un sistema de abastecimiento.

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B. Sistemas con contadores

En todos los países de América Latina, en unos en mayor grado que en otros, se emplean contadores como mecanismos para la facturación por servicio de agua. La base de la facturación varía considerablemente de un país a otro y entre las ciudades de un mismo país.

Ustedes saben que existen diversos modos de medir el agua. El método preferido para el agua distribuída por tubería, consiste en un contador que permita registrar el volumen de agua que pasa a través del mismo. En general, se utilizan dos tipos de contadores de registro: el de desplazamiento positivo y el propulsor. Donde circulan caudales reducidos, como los destinados al consumo doméstico, es preferible el tipo de desplazamiento positivo. Otro medio de medir el agua, bastante empleado en algunas partes de América Latina, es el orificio. Las características hidráulicas de la fluencia de agua a través de secciones limitadas de una tubería, de secciones en forma de huso y de piezas pequeñas u orificios, han sido muy estudiadas y se sabe que, a una presión determinada, cierto volumen de agua pasará a través de la sección u orificio. Este principio se emplea cuando los servicios de abastecimiento de agua desean evitar el costo de contadores de registro, pero quieren tener alguna seguridad de que un servicio determinado no utiliza cantidades de agua ilimitadas. En un trabajo dedicado a tarifas es imposible discutir con mayor amplitud este aspecto de la medición del agua; por consiguiente, no nos extenderemos más sobre este punto salvo para mencionar que, debido a que no existen sistemas de abastecimiento de agua con presión constante y a que la medición por orificios no registra las cantidades utilizadas, en el servicio doméstico, esta medición no puede ser utilizada por servicios de abastecimiento de agua interesados en una gran eficiencia y en saber dónde se emplea todo el agua producida. En otras palabras: la medición por orificios no puede recomendarse en sistemas de tamaño apreciable y que pretendan financiarse con su propio funcionamiento. El análisis que a continuación se acompaña, relativo a tarifas de agua en sistemas con contadores, se basa en el supuesto de que se emplean contadores de registro.

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Elementos que intervienen en las estructuras de tarifas por contador

Esperamos poner de manifiesto algunas de las dificultades con que se tropieza en el uso de diversos sistemas de tarifas cuando se intenta hacer frente a los numerosos factores que deben considerarse en el prorrateo equitativo de los costos del agua entre los distintos consumidores, y señalar que ningún sistema está libre de crítica. A nuestro juicio, para ser ideal un sistema de tarifas debería ser sencillo, tener en cuenta las características locales y facturar equitativamente el agua sobre la base de los gastos en que se ha incurrido para facilitar agua a cada consumidor. Cuando tratamos de alcanzar este último objetivo, la distribución equitativa de costos, nos encontramos con puntos de vista diversos y contradictorios. Teóricamente, podría aducirse que no hay dos consumidores que causen los mismos costos a la compañía abastecedora de agua y que, por lo tanto, debieran aplicarse a cada uno tarifas diferentes. Por ejemplo: un consumidor que vive cerca del depósito de agua no le cuesta al sistema lo mismo que otro usuario que vive en el otro extremo de la ciudad, porque la tubería que suministra agua al primero es más corta. Los habitantes de los sectores de menor altitud de una ciudad pueden ser abastecidos de agua a menor costo que los residentes de una zona de mayor altitud en la que se necesita impulsar el agua a bomba. Una fábrica que consume agua continuamente en las 24 horas del día, puede ser abastecida a un precio unitario más barato que el correspondiente a otra fábrica que consume en una sola hora todo el agua que necesita, obligando a la compañía, para servir una hora de demanda, a hacer instalaciones que no se utilizarán durante las restantes veintitres horas del día. Una industria precisa agua de gran pureza mientras que a otra le basta con agua cruda. Un pequeño consumidor que reside en los alrededores de la ciudad causa mayores costos administrativos de lectura de contador y facturación por unidad de agua consumida, que un usuario de mayor importancia. Podríamos mencionar un incontable número de variables que diferencian a un consumidor de otro. Por consiguiente, un sistema de facturación tiene, en realidad, que evaluar las múltiples variables y llegar a una solución que pueda administrarse eficazmente y que no asigne gravámenes indebidos a ningún grupo o individuo.

Analizando diversas clases de estructuras de tarifas con contador empleadas en América Latina, se observan determinados elementos más o menos

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comunes a cada una de ellas. Entre estos elementos se encuentras los siguientes:

1. Tanto alzado mínimo mensual por volúmenes de agua fijos suministrados a precio mínimo.
2. Facturación del exceso de agua consumida además del mínimo y calculada en escala ascendente, descendente o mixta.

Como parte de los cargos facturados a los consumidores, pero sin ser elementos que afecten a las tarifas, se encontrarán las partidas siguientes:

1. Cargos por arriendo de contador.
2. Cargos por servicio.
3. Primas de conexión.
4. Pagos por los gastos de instalación de líneas y contadores de servicio.

Con el objeto de distinguir entre los diferentes sistemas de tarifas empleados en Latinoamérica, se han asignado a cada tipo de sistema, nombres basados en el método general utilizado para el cálculo. Indudablemente, puede hallarse una terminología mejor, pero, para los fines que nos ocupan, hemos optado por clasificar los sistemas en dos grandes clases: tarifas variables y tarifas uniformes, y dividir las tarifas variables en las sub-clases siguientes: por tipo de consumidor, tipo de ingresos del consumidor y tipo de volumen.

Tarifas variables:

Por tipo de consumidor

Las tarifas por tipo de consumidor establecen una tarifa básica distinta para el agua vendida a usuarios domésticos, comerciales e industriales. Estas pueden reflejarse asignando a los últimos una línea de servicio y contador mayores, con las correspondientes tarifas, o simplemente estableciendo una tarifa por tipo de instalación sin tener en cuenta el volumen del servicio.

Por lo menos dos países clasifican los usuarios en grupos según sean domésticos, comerciales, industriales o de otra naturaleza, y establecen una tarifa mínima por volumen de agua a facturar cada mes. Por ejemplo, en un país, se indican las clases siguientes (1960):

(Nota: Todos los valores monetarios que figuran en los cuadros siguientes representan dólares E.U.A.).

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Tarifa 1 - Pequeño consumidor ($15m^3$/mes), urbanizaciones de viviendas económicas, empleados de los servicios de abastecimiento de agua. $\$0,026/m^3$.

Tarifa 2 - Consumidores intermedios (15 a $20m^3$ y más de $20m^3$), $\$0,026/m^3$ hasta $15m^3$, $\$0,057/m^3$ lo que exceda de los $15m^3$.

Tarifa 3 - Consumidores que son usuarios de los servicios telefónicos y eléctricos del Estado, $\$0,065/m^3$.

Tarifa 4 - Industrias, establecimientos comerciales, bancos y empresas del Estado, $\$0,087/m^3$.

Observaciones acerca de las tarifas por tipo de consumidor

1. Constituyen un intento de establecer un método de asignación de los costos del servicio sobre la base de la "capacidad de pago", así como de calcular la facturación en proporción a la parte legítima aparente del costo de las instalaciones para atender las necesidades de demanda o capacidad.
2. Los cargos correspondientes a la tarifa, la facturación de nuevos usuarios y la predicción de ingresos pueden hacerse con menos dificultad que mediante el método de "ingresos del consumidor".
3. No pueden reflejar exactamente la parte proporcional de costos del sistema de abastecimiento de agua asignable a cada consumidor, ni pueden distinguir dentro de cada categoría entre los usuarios de demanda grande y pequeña. Por consiguiente, dan lugar a cierta discriminación entre los usuarios.

Tarifas variables: por tipo de ingresos del consumidor

Estas son tarifas que varían de acuerdo con alguna fórmula que refleje en lo posible la "capacidad de pago" de diversas clases de consumidores.

Uno de los países ha adoptado unas tarifas de agua que clasifica a los usuarios fundándose en el valor de la propiedad que cada uno ocupa. Un plan de tarifas característico, según esa clasificación, es el siguiente:

Valor de la propiedad	Mínimo de m^3	Facturación mensual
$4,000	40	$0.58
4,001 a 8,000	40	1.00
8,001 a 12,000	50	1.45
12,001 a 16,000	60	1.75
16,000 en adelante.	70	2.20

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Facturación de crecedentes, a razón de: $0,037/m^3$

En una clasificación basada en la capacidad económica de los consumidores para pagar, puede emplearse cualquier número de escalones. Indudablemente, a mayor número de escalones mayor complejidad de la estructura.

Observaciones

1. Las tarifas variables basadas en una clasificación de los consumidores según sus ingresos, asignan un gravamen mayor a los económicamente más fuertes, al objeto de cubrir los costos del servicio de abastecimiento de agua. Desde un punto de vista social, esto tiene ciertas ventajas.

2. De ordinario, las tarifas por ingresos del consumidor permiten vender un determinado volumen de agua a un precio inferior a su costo.

3. Tales tarifas son más difíciles de establecer y exponen a los servicios de abastecimiento de agua a muchos más trámites, gastos administrativos y posibilidades de reclamaciones.

4. Con frecuencia, los cambios de valor de la propiedad no se reflejan en cambios de clasificación en la tarifa de agua. El valor de la propiedad ocupada no refleja necesariamente el consumo.

5. Dichas estructuras de tarifas son de ordinario complejas y se apartan de todo principio de simplicidad.

Tarifas variables: por tipo de clasificación por volumen

Muchos de los sistemas de tarifas latinoamericanos establecen dentro de sistemas que obedecen a otras clasificaciones, clases de tarifas aparte basadas en el volumen de agua consumida. Un ejemplo de este tipo de clasificación es el siguiente:

Consumo bimensual	Tarifa por m^3
Hasta 40 m^3	U.S.$0.024
" 100 m^3	0.028
" 150 m^3	0.032
" 200 m^3	0.036
" 250 m^3	0.040
" 500 m^3	0.044
" 750 m^3	0.048
"1,000 m^3	0.052
"5,000 m^3 o más	0.056

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La misma pauta de facturación se encontrará en muchos países de América Latina. Es decir, a medida que la cantidad de agua consumida aumenta, es más alta la tarifa por metro cúbico.

Por lo menos en dos países, se sigue la norma contraria y a medida que el agua consumida aumenta, la tarifa por metro cúbico se reduce.

En determinadas ciudades de uno de los países puede observarse una combinación de ambos tipos de tarifas, en la cual el precio unitario del agua aumenta a medida que el volumen consumido asciende hasta un punto determinado, y a partir de éste el agua adicional utilizada tiene un precio menor por metro cúbico.

Observaciones

1. En los casos en que los precios unitarios del agua aumentan a medida del volumen, las tarifas favorecen al pequeño consumidor y perjudican al grande. En circunstancias en que el sistema de abastecimiento de agua ha sido financiado mediante fuertes subsidios gubernamentales y el precio disminuye a medida que el volumen aumenta, puede quedar perjudicado el consumidor modesto. Es posible que la estructura mixta perjudique al consumidor intermedio.

2. Es importante observar que es posible clasificar a los usuarios según el promedio de agua que consumen al mes y establecer tarifas para cada clasificación o emplear otros medios clasificadores para determinar mínimos y cobrar sólo el exceso de agua aplicando una escala creciente, decreciente o mixta.

3. La escala decreciente de precios de agua puede defenderse si el sistema de distribución no ha sido ya pagado por el consumidor doméstico; si puede demostrarse que la producción de agua para el usuario grande es substancialmente menos costosa que con respecto al usuario modesto; o cuando concurren ambas circunstancias.

Otros medios de clasificación

Al menos en uno de los países, los consumidores se clasifican según posean o no "derecho de agua" y según la cuantía de este derecho. Así, pues, prevalece el plan siguiente:

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Cuantía del derecho de agua	Facturación mensual	Facturación por exceso/m^3
10 m^3	$ 0.50	$ 0.10
30 m^3	1.00	0.10
60 m^3	1.50	0.10

Si el usuario no posee derecho de agua, paga por ésta un precio mayor, de acuerdo con una clasificación basada en el volumen consumido.

Observaciones

1. La cuestión de la venta de derechos de agua no puede analizarse detalladamente en un trabajo relativo a tarifas. No obstante, se considera que este sistema ofrece considerables ventajas en zonas en que la inversión local de fondos en sistemas de abastecimiento de agua necesita estímulo, como parece ser el caso en todos los países. La aplicación de tarifas más altas a los que no poseen un "derecho", alentará mucho la compra de estos títulos.

2. Con respecto a la clasificación utilizada en el sistema que emplea el volumen de agua como pauta, caben las mismas observaciones que las hechas anteriormente acerca de "Tarifas variables", por tipo de clasificación por volumen".

Tarifas uniformes o directas

Que nosotros sepamos, ningún sistema de abastecimiento de agua latinoamericano utiliza un método de establecer tarifas de agua completamente directo. Un método de tal naturaleza se funda en que todo el agua se cobrará al mismo precio, sin distinción alguna entre clases de usuarios, ni diferencia alguna entre el primer metro cúbico y el último.

La información existente al respecto, indica que en una sola ciudad de América Latina las tarifas vigentes en 1960 disponían que en las zonas urbanas dotadas de servicio de contador y en las cuales era preciso impulsar el agua a bomba, se cobraría una tarifa única de $0,04 por metro cúbico. Por consiguiente, puede decirse que existía una estructura de tarifas directa con respecto a los consumidores servidos en esas condiciones.

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En el caso de una estructuración de tarifas uniforme, los factores diversos tales como la demanda, servicio al usuario, capacidad y precio del producto se agrupan conjuntamente y se asignan a cada unidad de agua vendida, sin tener en cuenta las variables que existen entre un consumidor y otro. Al hacer esto, se cobra del pequeño usuario una cantidad menor de la que en justicia le corresponde por la parte que tendría que pagar de los costos. Los cargos por capacidad se reflejan en la tarifa, puesto que a mayor volumen de agua utilizada cada mes, mayor cantidad a pagar por el usuario. En un sistema uniforme, no existe categoría alguna por exceso de agua y no es preciso que haya mínimos. De considerarlo conveniente, puede establecerse un recargo mensual por servicio, que cubra los gastos de administración y contadores.

Una de las razones para reducir el precio de agua unitario, a medida que el consumo aumenta, es la de que los grandes usuarios no deberían pagar las instalaciones de distribución construídas para prestar servicio al grupo doméstico. Esta afirmación sería valedera en los casos en que la construcción del sistema de distribución se paga íntegramente con el producto de las tarifas. En cambio, en Latinoamérica, donde casi todos los sistemas se han construído, al menos en parte, con fondos procedentes de los impuestos generales, puede decirse que el consumidor ordinario ya ha pagado el sistema de distribución, existiendo entonces menor justificación para una tarifa decreciente. En los sistemas en que el agua escasea y es preciso conservarla, conviene implantar tarifas crecientes.

De todo lo anterior se deduce que, resultando imposible con los métodos actuales una distribución equitativa de los diversos costos por demanda entre los consumidores y habiéndose cometido ya varias injusticias contra los grandes usuarios cuando los costos del sistema de distribución se han pagado mediante cargos especiales ajenos a la estructura de tarifas, parecen convenientes los sistemas de tarifas uniformes que incluyen todos los costos y los distribuyen entre las distintas unidades de agua, exactamente al mismo precio para todo el agua consumida. No es preciso que semejante sistema renuncie a facturas de diferentes modos, si puede demostrar que tal discriminación se funda en hechos concretos que la pueden justificar.

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Al considear la cuestión de la demanda máxima, conviene señalar que si en la explotación de sistemas de abastecimiento de agua cabe utilizar contadores especiales "de demanda", que ofrecen tarifas reducidas para el consumo fuera de las horas de máxima demanda, como hacen las compañías de energia eléctrica, podria ser conveniente una tarifa diferencial, puesto que dicho consumo permitiría utilizar la capacidad de la instalación mantenida en reserva.

Aplicación de tarifas uniformes

En el análisis anterior se ha mencionado que los costos variables frecuentemente reflejados en los sistemas de tarifas existentes, pueden consolidarse y asignarse sobre una base uniforme; de esta manera se cobraría un precio fijo por cada metro cúbico de agua vendido, a partir del primer metro cúbico consumido, y sin facturación mínima ni por excedente. El pequeño consumidor que tiene poco dinero, puede consumir agua en cantidad tan escasa como desee y no está obligado a pagar más de la necesaria. Puede pagar incluso menos de la que paga actualmente. Si el mínimo que le corresponde hoy es de 15 m^3 al mes, en su facturación mínima se reflejará al menos la mayor parte de los 15 m^3, aún cuando el consumidor no necesita más de 8 m^3. El cobro de primas de conexión, cargos de servicio, prorrateos por pie de fachada, impuestos a los edificios nuevos e impuestos por mejora de la propiedad, puede aplicarse al sistema de tarifas uniformes si se considera conveniente asignar los costos de distribución a las propiedades y no existen otros impuestos asignados al departamento de servicios de abastecimiento de agua.

Es oportuno mencionar que las cantidades mínimas de agua suministradas actualmente dentro de la facturación mínima mensual en la mayoría de los países latinoamericanos, son, a nuestro criterio, demasiado elevadas. Ya se han expuesto las razones para eliminar por completo el mínimo mensual. Sin embargo, donde dichos mínimos existen y se desea que continúen, al parecer muchas familias podrían y querrían utilizar menos agua si eso les resultara ventajoso. Esto interesa también a la compañía abastecedora de agua porque el agua vendida dentro del mínimo no suele tener el mismo precio unitario que la vendida a partir del mínimo. Por tanto, se pierden ingresos, en cantidad, en función de lo aproximado que los costos unitarios estén de los costos de producción y distribución.

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La reducción de los mínimos y el aumento de los precios unitarios resultarán también útiles cuando se presenten períodos de gran demanda de agua que pueda exceder la capacidad de la fuente o las instalaciones. Este método se usa muy raramente, pero en ciudades que se encuentran con problemas inmediatos de escasez de agua puede restringirse eficazmente su consumo por medio de una fuerte elevación de tarifas durante los mencionados períodos.

Si bien hemos presentado algunas razones en apoyo de las tarifas uniformes, hasta el punto de que probablemente nos criticarán muchos de nuestros doctos colegas no partidarios de esta clase de sistema, desearíamos dejar en ustedes la idea de que una estructura de tarifas simple es muy recomendable para las nuevas compañías abastecedoras de agua, que apenas empiezan a adquirir experiencia. Transcurrido un determinado número de años y acumulados los datos suficientes, es posible entonces considerar cambios factibles que conduzcan a una distribución más equitativa de los costos entre los consumidores. No quisiéramos que ustedes se fueran con la impresión de que sus sistemas de tarifas existentes deben cambiarse inmediatamente. Es mejor no apresurarse y utilizar lo que ustedes saben que dará resultado en las condiciones locales, hasta convencerse de qué otro sistema ofrece verdaderas ventajas.

Normas para estimar la idoneidad de las tarifas de agua

Los funcionarios públicos, los consumidores y los políticos, suelen suscitar la cuestión relativa a qué se entiende por tarifa idónea de agua. Con el objeto de contar con una base que permita evaluar las tarifas de agua, se les ofrece a ustedes la orientación siguiente:

En todo sistema de abastecimiento de agua bien dirigido, la proporción de los gastos de funcionamiento con respecto a los ingresos debe fluctuar entre el 50 y el 65%. Esta proporción puede expresarse como sigue:

$$0.50 - 0.65 = \frac{\text{Gastos de funcionamiento - Impuestos, si los hubiere, más depreciación y todos los costos de explotación y mantenimiento, pero sin incluir intereses.}}{\text{Ingresos - Todos los ingresos, salvo los recibidos por alquiler de contadores e instalación del servicio.}}$$

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La diferencia en la razón entre 0,65 y 1 refleja el margen dentro del cual pueden entrar el pago de intereses, los reembolsos de empréstitos además de la depreciación y los excedentes para la ampliación normal de las instalaciones.

Observaciones generales

Antes de concluir este análisis, desearíamos hacer algunas observaciones generales acerca de los usos en materia de tarifas de agua en América Latina que se consideran importantes. El primero de estos es que en determinados países en que existen o se ha propuesto el establecimiento de organismos nacionales encargados de los servicios de abastecimiento de agua, o en los cuales un organismo de obras públicas es competente para recomendar tarifas de agua, goza de considerable apoyo la norma de establecer una sola tarifa de a agua para la totalidad del país. Deseamos hacer constar que somos opuestos a ese procedimiento. El único argumento en su favor estriba en su simplicidad y en que cada habitante del país paga lo mismo, según la clasificación establecida en la estructura de tarifas. Este procedimiento es económicamente poco sólido puesto que subvenciona a una zona a expensas de otra. Si un sector sufre de escasez de agua y es preciso construir una línea principal de distribución extensa y costosa, a lo cual se han de añadir los costos de la impulsión a bomba, y si el consumidor paga allí lo mismo que en otro sector en que el agua resulta barata, la colectividad escasa de agua tenderá a continuar creciendo, aumentará la demanda de agua y se necesitarán más subvenciones para suministrar el agua precisa. Considerando el país en su totalidad y suponiendo que los recursos son limitados, el interés del gobierno exige que se dé estímulo al crecimiento de las colectividades que contribuyan al máximo y cuesten lo mínimo con respecto a los servicios. Desequilibrar artificialmente el crecimiento de colectividades mediante la provisión de agua a menos de su costo a unas colectividades y a más de su costo a otras, no va en favor del interés nacional. Se considera que las tarifas de agua deben establecerse para cada colectividad a base de los costos de funcionamiento y las necesidades de ingresos del servicio de abastecimiento. No debe calcularse con una tarifa nacional uniforme.

Otra observación de carácter general es la de que las compañías abastecedoras no deben suministrar agua gratis a nadie, sino cobrar toda el agua consumida. Esto significa que si por razones particulares se suministra agua

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a instalaciones seleccionadas, el organismo de quien éstas dependan reembolsará al servicio de abastecimiento de agua el costo íntegro de todo el agua consumida por dichas instalaciones.

La administración debe cuidar constantemente del estudio y modificación de las tarifas. Cuando transcurren períodos de 5 a 10 años sin que una tarifa aumente, no sólo es probable que la empresa lleve funcionando algunos años con déficit, sino que la reacción política a la tarifa nueva es mucho más intensa porque el aumento tiene que ser grande. Con aumentos más frecuentes y menos elevados en las tarifas, la explotación resultará mucho más eficaz sin que haya déficits en su financiamiento y sin necesidad de proceder a buscar aumentos de tarifas con las consiguientes protestas del público.

Finalmente, volvemos a lo manifestado anteriormente. Hay estructuras de tarifas que parecen tener ventajas sobre otras. Sin embargo, lo importante es que cada sistema de abastecimiento de agua tenga una estructura de tarifas que refleje el costo del agua y produzca los ingresos necesarios para cubrir todos los gastos y permitir la acumulación de capital para mejoras y ampliaciones normales.

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Water Rates in Latin America.
Advantages and Disadvantages.
Recommendations for Their Betterment.

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Four years ago Dr. Abel Wolman and I had an opportunity to visit most of the countries of Latin America and many of the cities represented here today. On that occasion discussions were held with waterworks officials, leading sanitary engineers, Ministers of Finance and Public Works; the subject of our discussions - water supply finance, administration, and water rates. Perhaps some of you were present at one or more of those meetings and will recall that some of the questions we most frequently asked were why water supplies were not being built to keep pace with the growth of cities; and why, each year, more and more people were unable to get water in their homes; and why, year by year, water service seemed to be getting worse, with less pressure, with longer periods of no water, and why the high rates of water-borne disease were continuing. You will recall the answer which was nearly identical in each conference and in each country - "no money". The question that usually followed this answer was, "What are you charging for water?". I need not tell you the answer to this question. You can guess, possibly based on some of your own past experience, that the charge for water frequently did not even return operation costs. Each year the national budget had to include money for operation and maintenance plus new construction with the result that each year less money was available for new construction. The revolution which has taken place in the thinking and actions of Latin American engineers, waterworks and governmental officials during these past four years has been truly amazing. Four years ago, with only a few exceptions, the view prevailed that water was a social commodity and should be provided free or at less than cost. Today, it is the exception rather than the rule to find waterworks officials who hold to the old view. Unfortunately, not all officials believe yet as do the waterworks people. Waterworks constitute a business, and, like any business, the merchandies it sells has to carry a price which will cover costs of manufacturer, sales and administration. This is what we are going to discuss today for the next few minutes, the means for placing the price tag on water. I think it is obvious that if the price is too low we go out of business unless some rich relative keeps giving us a subsidy as central governments have been doing. With too many poor businesses, however, no one gets enough and consequently all the businesses have trouble. Only when we charge enough for the merchandise to pay for all costs, with enough to put some money away

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for use in extensions and expansions, can we know that our business is going to function. The fact that all of you present at this symposium come from water organizations which have received international loans for extensions and expansions to your water systems, is indicative of the fact that you subscribe to this philosophy.

While reviewing the various types of rate structures used in Latin America, and while discussing some of the strong points and particular merits of certain systems, I wish at the very beginning to stress the fact that it is not so much the system of rates employed that is important, but rather that whatever system is used must provide the means by which the needed revenue can be collected for the water sold. It is unnecessary to mention that even with the best of rate systems if the meters are not read, if the bills are not put out on time, and if the bills are not collected, you might as well admit to operating a business headed for bankrupcy. We therefore get immediately into the subject which is one of the more controversial in the water business, the subject of what is the best system for charging for water.

I should like to refer to a report on water rates prepared by one committee of a national waterworks association and to paraphrase the first paragraph of their report as it might have read if prepared for international consideration. It should read as follows: "The subject of water rates has been involved in controversy for many decades, and it is not possible to resolve this controversy now by any simple set of rules. Not only are divergent views concerned, but differences in culture, social outlook, laws, governmental philosophy, local conditions (between countries and within countries), ownership (private or public), control (national, provincial, local boards, etc.) and other matters must also be considered". Confusion and controversy occur largely as the result of trying to equate charges and provide for a just means of assessing each consumer for his fair share of the costs.

In the following few minutes I will attempt to present comments along the following broad lines:

a) Definition of water rates;
b) Sources of revenue other than water rates;
c) The objective of water rates;

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d) Present Latin American practice in water rates and systems employed;

e) Rate systems where meters are not employed;

f) Rate systems where meters are used;

g) Variable rate structure;

h) Uniform or Straight-line structures;

i) A guide for evaluating adequacy of rates.

Definition of Water Rates

I will use the definition of water rates agreed to by the seminar on this subject convened by the Pan American Health Organization in Montevideo in 1960. This is: "A water rate is the basis of a system which permits the establishment of charges for water consumed".

It may be argued, according to this definition, that in those cases where water meters are not used, charges for water are not directly or entirely based on water consumed, and therefore the system of charges could not be called water rates. Nevertheless, for this discussion we will use "water rates" in the broad sense to cover all systems of charging for water, whether metered or not.

Sources of Revenue other than from Water Rates

Before discussing water rates, per se, it may be worthwhile to mention other sources of revenue which can be usefully employed to supplement those collected from water rates. So far as I know, in Latin America little or no use is made of property improvement taxes and front foot assessments as means for covering the costs of distribution system construction. Where these are used, the burden placed on water rates can be reduced. There are many arguments to support the use of such assessments which time does not permit to be discussed here. I will touch on the use of these assessments later in this paper. In a few countries special taxes, such as those on beverages and new building construction, are used to provide revenue to the water departments. Of these the tax on new construction seems to have particular merit in that it can reflect the cost of the water distribution line serving the property and is, in a sense, a front foot assessment.

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It is well to keep in mind that special taxes and assessments are not water rates.

Objective of Water Rates

Because of inherent differences in the philosophies of governments, it may be somewhat presumptuous to set forth what is the objective of a water rate system. Nevertheless, if we hold to the view that a waterworks operation should function as any well-run business, we must accept the premise that all the financial requirements of the system must be covered by revenue. By financial requirements I mean operation and maintenance costs, taxes, interest, depreciation or loan repayments (whichever is the greater), and costs for normal extension and expansion of the system. By revenue I mean all money coming to the water department from taxes, special assessments, connection fees, water rights, and water sales. The objective of water rates is therefore to provide that income over and above other revenues which will permit the water organization to cover all expenditures.

Present Latin American Practice

One peculiarity of water systems in Latin America which influences rates and has a bearing on the type of structure to be used is that of the way by which almost all systems were initially financed. Government financing by subsidies of up to 100% of costs was the rule, not the exception. I will refer to this later on as it concerns water rates.

A review of the water rate systems employed leads to a few broad conclusions which may be summarized as follows:

1. The economic status of consumers is frequently reflected in the rate system, placing higher rates on those able to pay more. This characteristic is seen in such procedures as grouping of consumers according to property value; ascending rates proportioned to the volume of water consumed; and higher base rates for industrial and commercial consumers.
2. No standard pattern for water rates appears to exist.
3. Some water rate structures are extremely complex while others are simple; some attempt to provide revenue sufficient to cover all

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costs of operation, maintenance, and loan payments; others cover only operation and maintenance; while still others provide revenue insufficient to meet operating costs.

4. Most rates, regardless of the system, are calculated without provision for creating a reserve for future extension and expansion, and with no provision for depreciation.

Systems of Water Rates

Two distinct types of water rate systems are employed throughout Latin America. These are:

1. Water rate systems where water meters are not used and where other approaches are taken to establish charges for water.
2. Water rate systems based on volume of water consumed that is where water meters are employed.

It should be mentioned that most Latin American cities are at present not 100% equipped with meters and, therefore, both of these types of general water rate systems are employed at the same time.

A. Systems Without Meters

Water rate systems where meters are not employed base their water charges on one or more of the following factors:

1. Size of service line;
2. Value of the property;
3. Type of establishment, i.e. commercial, industrial, domestic;
4. Number of faucets or number and type of fixtures;
5. Location of property;
6. Size of house or establishment.

All of the foregoing attempt to set charges on a basis of something which roughly indicates the volume of water which each property may be expected to use and ability to pay. Obviously such measures are not able to reflect volume accurately and therefore are not only inequitable but usually cause the water company to lose money by wastage since there is no incentive to be economical in the use of water. Also there is no way of knowing the amount of losses from leakage.

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Probably the number and type of plumbing fixtures in a house or establishment are as good an index of water use as any. The size of service line or size of house might be next, although being so subject to great variations they, like property value, are of little practical worth if relative water consumption is to be reflected.

Managers faced with the necessity of accounting for all water used and for adoption of procedures which simplify good administration will find that in spite of all the arguments against metering, there is still no better means by which they can resolve the problem of selling water than that of 100% metering of a water system.

B. Systems With Meters

Meters as the mechanism for establishing charges for water service are used in every country of Latin America, more in some than in others. The basis on which the charges are established vary considerably from one country to another and between cities within countries.

You are aware that there are various ways of measuring water. The method of preference for piped water is a meter which permits registration of the volume of water that passes through it. Two types of registration meters are in general use, the positive displacement type and the propeller type. Where low flows are encountered as in domestic use, the positive displacement type is to be preferred. One other way of measuring water used rather extensively in some parts of Latin America is the orifice. The hydraulic characteristics of water flow through restricted sections of a pipe, through tapered sections, and through small ports or orifices have been extensively studied and it is known that at a given pressure a certain volume of water will pass through the section or orifice. This principle is used where water department wish to avoid the cost of registration type meters but still wish to have some assurance that any particular service does not use unlimited quantities of water. It is not possible to discuss this aspect of water metering further in a paper devoted to rates and I will therefore say no more except to mention that because there is no such thing as a water system with constant pressure, and because use of orifices for domestic service does not provide for registration of quantities used, they cannot be considered a

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mechanism for utilization by water departments which are interested in high efficiency and in knowing where all water produced is used. In other words orifices cannot be recommended for use on systems which are of any appreciabl size and which are attempting to be self-financing operations. The discussions which follow on water rates in metered systems are based on the assumption that registration type meters are employed.

Elements Found in Metered Rate Structures

I hope to point out some of the difficulties encountered through use of various rate systems in trying to meet the numerous factors which must be considered in equitably apportioning the costs of water between the different consumers and to suggest that no system is free of criticism. An ideal rate system, in my opinion, would be one which is simple, which takes into account local characteristics, and which equitably assigns the charges for water on the basis of costs incurred in providing water to each consumer. It is in trying to meet this last objective, the equitable distribution of costs, that one encounters diverse and controversial approaches. Theoretically, one could argue that no two consumers impose the same costs to the water company and that a different rate should be applied to each. For example, a consumer living next to the water storage reservoir does not cost the system the same as one living at the other side of the city because the pipe supplying him is less. The people living in a low section of a city can be supplied with water at a less cost than those living in an area of high elevation where pumping is required. A factory taking water continuousl over 24 hours a day can be provided with water more cheaply on a unit basis than one which uses all its water in one hour but which necessitates the water company to provide facilities for the one hour demand even though such facilities will be unused for the other twenty three hours. One industry requires a water of high purity while another would be satisfied with raw water. A small consumer living at the periphery of the city requires higher administrative costs for meter-reading and billing per unit of water used than a large consumer. We could mention an infinite number of variables which set one consumer apart from another. A system of charges, therefore, practically has to assess the many variables and to arrive at a compromise which can be effectively administered and which does not place undue charges against any one group or individual.

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As we review various types of metered rate structures used in Latin America, certain elements will be more or less common in each. A few of these are:

1. Minimum monthly charges with fixed volumes of water provided within the minimum charge.
2. Charges assigned for excess water used over the minimum, and calculated on an ascending, descending, or mixed scale.

As part of the charges billed to customers, but not an element in the rates, will be found such items as:

1. Meter rental charges.
2. Service charges.
3. Connection fees.
4. Payments on costs for installation of service lines and meters.

In order to differentiate between different rate systems employed in Latin America, names are given to each type of system, based on the general method employed for calculation. Undoubtedly better terminology can be found, but for our purposes I have elected to classify the systems into two large classes, Variable and Uniform rates, and to break down the Variable class into the following sub-classes: Consumer type, Consumer income, Volume type.

Variable Rates.

Consumer Type

Consumer type rates establish a different basic rate for water sold to domestic, commercial, and industrial consumers. These may be reflected in the designation for the latter of a larger size of service line and meter with rates based accordingly, or simply by the establishing of a rate by type of installation without regard to size of service.

At least two countries, classify consumers into groups according to whether they are domestic, commercial, industrial, and other, and establish a minimum rate per volume of water to be charged each month. For example, in one country, the following classes are shown (1960).

(Note: All figures shown in the following tables are U.S.$.).

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Tariff 1 - Small consumer ($15m^3$/month), public housing projects, employees of the water department. $\$0.026/m^3$.

Tariff 2 - Intermediate consumers ($15m^3$-$20m^3$ and $> 20m^3$), $\$0.026/m^3$ up to $15m^3$, $\$0.057/m^3$ over $15m^3$.

Tariff 3 - Consumers who are served by State electricity and telephones, $\$0.065/m^3$.

Tariff 4 - Industries, commercial establishments, Banks and State enterprises, $\$0.087/m^3$.

Comments on Consumer Type Rate Structures

1. They attempt to provide a method of assigning costs of service on an "ability to pay" basis and also to assign proportion of charges according to apparent rightful share of the cost of facilities to meet demand or capacity requirements.
2. Rate charges, billing of new users, and prediction of revenues can be made with less difficulty than by the "consumer income" method.
3. They cannot accurately reflect proportional share of costs of the water system assignable to each consumer and are unable to distinguish within each category between those of high and low demand. There is consequently some discrimination between users.

Consumer Income - Variable Rates

These are rates which vary according to some formula that attempts to reflect "ability to pay" of various classes of consumers.

One country has adopted a water rate structure which classifies users on the basis of value of the property which each occupies. A typical schedule of rates according to this classification is as follows:

Value of Property	Minimum m^3	Monthly Charge
$4,000	40	$0.58
4,001 to 8,000	40	1.00
8,001 to 12,000	50	1.45
12,001 to 16,000	60	1.75
16,000 and above	70	2.20

Excess charge = $\$0.037/m^3$

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Under a classification based on the economic capacity of consumers to pay, any number of steps can be employed. Obviously the more steps the more complex is the structure.

Comments

1. Variable rates based on consumer classification reflecting income places a greater burden on those economically stronger to cover the cost of water service. Socially speaking, this has certain advantages.
2. Consumer income rates usually provide for sale of a certain volume of water at less than cost.
3. Such rates are more difficult to develop and involve the water department in much more paper work, administrative expense, and possible controversy.
4. Changes in property value are frequently not reflected in changes of water rate classification. Value of property occupied does not necessarily reflect consumption.
5. Such rate structures usually are complicated and depart from the principle of simplicity.

Variable Rates - Volume Classification

Many of the rate systems in Latin America include, within systems following other classifications, provision for separate rate classes based on the volume of water used. One example of this type of classification is as follows:

Bi-monthly Consumption	Rate/m^3
Up to 40 m^3	U.S.$0.024
" " 100 m^3	0.028
" " 150 m^3	0.032
" " 200 m^3	0.036
" " 250 m^3	0.040
" " 500 m^3	0.044
" " 750 m^3	0.048
" " 1,000 m^3	0.052
" " 5,000 or more m^3	0.056

The same pattern of charges will be found in many countries of Latin America. That is, as the amount of water used increases the rate per cubic meter increases.

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In at least two countries the reverse of this pattern is followed and as water use increases, the rate per cubic meter decreases.

In certain cities of one country a combination of these two types of rates can be observed in which the unit charge for water increases as the volume used increases up to a point, following which additional water used is reduced in price per cubic meter.

Comments

1. Where charges per unit of water increase as volume increases, the rates favor the small consumer and discriminate against the large. Under conditions where the water system has been financed by heavy government subsidy, and where charges decrease as volume increases, there may be discrimination against the small consumer. The mixed structure may possibly discriminate against the intermediate consumers.

2. It is important to note that customers can be classified according to the average amount of water used per month and rates established for each classification or that other means of classification can be employed to establish minimums and only excess water charged for on an increasing, decreasing, or mixed scale.

3. A decreasing scale of water charges can be defended if the distribution system has not been already paid for by the domestic consumer and/or if it can be shown that water production for large consumers is substantially less costly than for the small users.

Other Means of Classification

In at least one country customers are classified according to whether they own a "water right" and the size of the "water right". Thus the following schedule prevails:

Water Right Size	Monthly Charge	Excess Charge/m^3
10 m^3	$0.50	$0.10
30 m^3	1.00	0.10
60 m^3	1.50	0.10

If the consumer does not own a water right, he pays for water at a higher charge according to a classification based on volume used.

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Comments

1. The question of water right sales cannot be discussed in detail as part of a water rate paper. Nevertheless this device is pointed out as having considerable merit for use in areas where local investment in water systems is to be stimulated as would appear to be the case in every country. The use of a higher water rate for those not owning a "right" will do much to encourage the purchase of rights.
2. The same comments regarding the classification within the system using volume of water as the guide can be offered as in the previous comments on "Variable Rates - Volume".

Uniform or Straight Line Rates

So far as I know, no water system in Latin America utilizes a completely straight line method of setting water rates. This method presumes that all water will be charged for at the same price, with no difference between the types of consumers nor any difference between the first cubic meter and the last.

Information available shows that in one city of Latin America the rates in effect in 1960 provided that in areas of the city served by meters and where pumping was required, a uniform rate of $.04 per cubic meter was charged. Therefore for those customers so served a straight line structure can be said to exist.

Under a uniform rate structure, the various factors such as demand, customer service, capacity, and commodity charges are all grouped together and assigned against each unit of water sold without regard to the variables which exist between one consumer and another. In so doing the small consumer bears a lesser cost for, among others, the customer service charges than may be his rightful share. The capacity charges are reflected in the rate since the larger the volume of water used each month, the greater the amount paid by the consumer. Under a uniform system, there is no category of excess water and there need be no minimum. A monthly service charge can be established which covers administration and meter charges if this is considered desirable.

One of the reasons for reducing the unit charge for water as consumption increases is that the large users should not have to pay for distribution

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facilities provided to serve the domestic group. This position has validity in those cases where the distribution system construction is paid for entirely out of water rates. However, in Latin America where nearly every system has been constructed, at least in part, by funds appropriated from general revenue, it can be said that the general consumers have already paid for the distribution system there being then less justification for a declining rate. On systems where water is in short supply and where water conservation is desirable, an increasing rate has merit.

The point to be brought out from the foregoing is that because of the impossibility, under present practices, to equitably distribute the various demand charges between consumers and because a number of the inequities against big consumers have already been provided for when distribution system costs have been paid for by special charges outside the rate structure, there appears to be merit in uniform rate systems which include all costs and assign them against each unit of water at exactly the same price for all water used. Such a process need not rule out the establishment of different charges if it can be shown that such charges can be accurately fixed.

When considering the question of peak demand, it is desirable to point out that if waterworks operation could utilize "demand type" meters which would give a preferred water rate for off-peak usage, as the power companies do, then a rate differential would be worthwhile since idle plant capacity could be utilized.

Uniform Rate Application

In the discussion above it has been pointed out that the variable costs frequently reflected in existing rate systems can be consolidated and assigned on a uniform basis with a fixed charge for each cubic meter of water sold, beginning with the first cubic meter consumed, and with no minimum charge or excess charge. The small consumer who has little money can use as little water as he wishes and is not forced to pay for more water than needed. He may pay even less than that which he now pays. If his minimum is now $15m^3$ per month, his minimum charge has to reflect at least most of the $15m^3$ even though he might get along on $8m^3$. The use of connection fees, service charges, front foot assessments, new building taxes, and property improvement taxes can

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be employed with the uniform rate system where it is found desirable to apportion costs of distribution to properties and where other taxes assigned to the water department do not exist.

It is pertinent to mention that the minimum quantities of water now provided within the monthly minimum charges in most countries of Latin America are, in my opinion, too high. The reasons for dispensing with a monthly minimum altogether have been presented. However, where such minimums do exist, and it is desired to continue them, it is apparent that many families could and would use less water if it were in their interest to do so. It is also in the interest of the water company because the water sold under the minimum does not usually carry the same unit cost as that above the minimum. Revenue is thereby lost, the amount being a function of how near the unit cost is to the production and distribution cost.

Reducing the minimum and increasing unit costs will also prove of value when periods of high water demand are encountered which may exceed source or plant capacity. This is a seldom used device but in cities faced with immediate problems of water shortage, very high temporary rates can be an effective deterrent on water consumption.

Although having presented some reasons for supporting uniform rates to the extent that I will probably be chastised by many of my learned colleagues who disagree with this type of system, I would like to leave you with the idea that for new water companies just gaining experience, a simple rate structure has much to commend it. After a number of years have passed and sufficient data has been accumulated, it then becomes possible to see changes which may be undertaken and which may lead to a more just distribution of charges between users. I would not have you go away with the impression that your existing rate systems should be immediately changed. It is better to make haste slowly and to use what you know will work under local conditions until real advantages are seen in a different system.

Criteria for Measuring Adequacy of Water Rates

There is usually a question raised by public officials, consumers, and politicians as to what constitutes an adequate water rate. In orde to permit an assessment of water rates on some bases, the following guide is called to your attention.

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The ratio of operating costs to revenues for any well-run water facility should be in the range of 50% to 65%. This ratio can be expressed as follows:

$$.50\text{-}.65 = \frac{\text{Operating Expenses - (taxes, if any, plus depreciation, and all operational and maintenance costs) but not including interest.}}{\text{Revenues - all revenues but excluding meter and service installation charges.}}$$

The difference in the ratio between .65 and 1 reflects the margin within which interest payments, repayments on loans over and above depreciation, and surpluses for normal plant expansion can take place.

General Comments

Before closing this discussion, I should like to make a few general comments on water rate practice in Latin America which are believed important. The first of these is that in certain countries where national water authorities either exist or are proposed, or where a public work agency carries responsibilities nationally for recommending water rates, there is considerable support for the policy of establishing a single water rate for the entire country. I should like to be recorded as opposed to this practice. The only argument to support it is that it is simple and that everyone in the country pays the same according to the classification set up in the rate structure. This practice is economically unsound because it subsidizes one area at the expense of another. If one area is short of water and a long, expensive, transmission main has to be constructed with pumping cost added, and if people pay the same there as in another area where water is cheap, the tendency is for the water short community to continue to grow, increasing demands for water and requiring ever more subsidy to supply the needed water. Looking at the country as a whole and assuming that resources are limited, it is in the interest of the government to encourage growth of those communities which contribute the most and cost the least for services. To artificially unbalance the growth of communities by providing water at less than cost for some communities and at higher than cost for others is not in the national interest. It is believed that water rates

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should be developed for each community based on its costs of operation and its need for revenue. A uniform national rate should not be considered.

Another general comment is that water companies should not provide free water to anyone but should be reimbursed for all water consumed. This implies that where for particular reasons water service is provided to selected installations, the responsible agency should pay to the water department the full cost of all water used by such installations.

Review and change of rates is a continuing responsibility of management. When periods of 5 to 10 years pass before a rate is increased, not only is the enterprise probably operating at a deficit for some years but the political reaction to the new rate becomes very great because the increase has to be great. More frequent and less severe increases in rates provide a much more effective mechanism for keeping the operation solvent and avoiding undue public reaction.

Finally, I return to the statement made earlier. Some rate structures appear to have advantages over others. However, the important thing is that each water system have a rate structure which reflects the cost of water and which produces the revenue necessary to meet all expenses and allow the accumulation of capital for normal extensions and expansion.

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Water Supply Problems in Developing Countries

Harold R. Shipman

A paper presented on Jan. 31, 1967, at the New York Section Meeting by Harold R. Shipman, Chief, Water Supply Sec., Projects Dept. Utilities, International Bank for Reconstruction and Development, Washington, D.C.

TO provide a background for the water supply situation today throughout the world, a few estimated figures have been compiled. The combined population of 86 countries of the Bank's total membership of 106 (eliminating the United States and 18 others of the developed countries) is around 1.746 billion. This will increase to around 2.3 billion by 1981 (based on a 2 per cent per year increase). Of this total, 24 per cent reflects urban population (420,000,000) in 1966, while the balance of 76 per cent is rural (urban and rural being defined along lines used by each country). Urban population figures obtained from certain countries suggest that about 50 per cent of this population is served by municipal water systems. The question of whether the people within this group have water piped into the house or transported from a public hydrant is not easily answered from available data. Assuming, however, that 50 per cent of urban populations is now reasonably supplied, there are still 210,000,000 unserved people living in urban centers. This total will probably be around 483,000,000 by 1980.

The problem confronting governments and cities is how to meet this demand.

Need for Investment

If one looks at the sewerage situation, it is far worse and, in general, far more costly when measured on a per capita basis. This is because with sewerage, there will be many instances where no system now exists and extensions cannot be made. As one looks at the next decade, it becomes apparent that there will be need for large investment by countries to meet the needs of their people for both water and

sewerage. One can say, therefore, at the outset of this discussion, that the first problem is money and where to find it.

World Bank and IDA

The International Bank for Reconstruction and Development, otherwise known as the World Bank, and its affiliate, The International Development Association, commonly referred to as IDA, are international organizations. The Bank was created at the Breton Woods Conference in 1946 and began operations in 1947. At the present time, 106 governments are members. Each is a shareholder. The IDA was organized by the Bank members in 1960 to provide a channel for multilateral lending on easy terms to countries capable of faster development. IDA is administered by the Bank's officers and staff. It finances projects which are appraised and supervised with the same standards applied to those financed with Bank funds. The Bank raises the largest part of its funds through the sale of bonds in the private capital markets. It, therefore, makes loans on conventional terms to reflect the cost of the money it borrows. IDA funds, however, are in the form of contributions, chiefly from the eighteen wealthier nations among its membership of 97. Its loans are for 50 years without interest, except for a service charge of 0.75 per cent.

IDA's resources are much more limited than those of the Bank. They have been reserved for countries with relatively good economic policies, but very low per capita income. Although these countries benefit from the lenient IDA terms, the projects usually receive the funds on re-loan from the government on terms similar to those of conventional Bank projects. To give one example: in the case of Managua, Nicaragua, the water supply system was appraised by the staff of the Bank and until the last moment it was not decided whether the project would be financed by IDA or the Bank. The Bank loan, as proposed, would have been for 6 per cent at 20 years. The IDA terms on re-lending to the project were identical, the only difference being that in the case of IDA financing, which was finally decided upon, the money was made available to the government on a 50-year basis at the 0.75 per cent charge. However, this was re-lent to the project at the 6 per cent, 20-year figure, and made no difference to the water department. This example clearly illustrates that the criteria and financial arrangements for Bank/IDA investment on projects are essentially the same.

Background

From 1947 through 1966, the Bank made 473 loans totaling about $10 billion in 79 countries. IDA, since its inception in 1960, has extended 95 credits totaling $1.7 billion in 33 countries. It has made credits available for water supply construction in Taiwan, Jordan, Nicaragua, Pakistan, and Burundi. The Bank has made loans for water supply in the Philippines, Singapore, Iceland, and Venezuela. These credits and loans total $88.3 million.

Presently, the water supply section of the Bank employs nine sanitary engineers from six countries and seven financial analysts from five. These people have had many years of professional experience in water supply and utility matters and, in most instances, are proficient in more than one language.

Qualifications for Loans

The policy of the Bank is that water projects for which Bank and IDA funds will be made available should be of high priority in the country's development program, technically designed to provide maximum benefits at least cost, and capable of being supported, operated, and maintained by local personnel. The organization should have maximum opportunity to operate without undue political interference. It should be able to function as a well-run public utility, and should meet all expenses and costs out of its operating revenues.

Obtaining Local Funds

There are certain differences between financing a water project in the United States and in developing countries. Water utility managers in the United States have recourse to funds obtained from the sale of revenue and general obligation bonds. These sources are seldom available in the developing countries. Problems in obtaining local capital for financing are in part related to the lack of confidence that investors have in water systems. The rate of return on investment will normally be lower for utilities than for other types of projects, and security must, therefore, be a major consideration if the utility is to attract capital. The role of the World Bank is to help countries develop projects which will establish patterns, and pave the way for financial viability for entire water operations. In effect, this means that water has to be sold at prices which will generate needed revenue and permit systems to accumulate reserves. Because of this, the financial practices of water departments in the developing countries have to adhere more strictly to sound business policies than those in developed countries.

Technical Resources

Within the 106-member governments of the World Bank, the range of technical competence extends from those having no local engineering resources to those having an imposing list of consulting engineering firms specializing in water supply. Between these two extremes are countries which have been provided with fellowships for the training of sanitary engineers in leading universities throughout the world. These engineers have returned and are in various stages of developing professional competence. Therefore, the type of engineering assistance required differs from country to country. Local engineers understandably object when foreign firms come in and take over big projects. On water projects which they have financed, the Bank and IDA have attempted to take a position fully recognizing the capacity of the local engineers. At the same time, because of the importance to both the Government and the Bank in obtaining and operating a soundly engineered project and ensuring high quality workmanship, it is usually necessary to utilize foreign consultants. Consulting firms from the developed countries are finding it increasingly expedient to join forces with competent local engineering firms. This gives maximum benefits to the local firms, permits the foreign firm to obtain knowledge of local conditions, and ensures that works will be constructed properly.

Preliminary Studies

Before the Bank and IDA will appraise a project, preliminary engineering, feasibility studies, and cost esti-

mates have to be completed. The developing countries frequently encounter great difficulty in preparing these studies. When funds are made available from bilateral sources and the United Nations Development Program, individual engineering studies are being produced. However, at the present time, this appears to be on a city-by-city basis. The net effect of all this is that projects now filter in to the financing institutions on a one-by-one basis, without much regard for a national long-range plan. It would be far more logical and desirable if governments could develop their entire water supply plan in a manner in which they anticipate what water systems they would like to construct or expand within a given period, and to have these engineered to a point where financial institutions could give them consideration. To the author's knowledge, this is not being done to any extent in many of the developing countries.

Design of Projects

In capital-scarce countries, it is not possible to tie up large sums of money for facilities which remain unused over an extended period. Staging of construction using design periods of around 10 years has proved realistic for most facilities. There is a need for long-range plans, the knowledge of where the second stage construction will fit in, the approximate time when this may be necessary, and the facilities that will be required. It is necessary to design facilities capable of being operated by local personnel. As operation and maintenance of even the simplest equipment is usually difficult because of the shortage of trained technicians it is obvious that highly automated works with electronic controls and complex equipment demand a high level of sophistication. In a recent visit to Africa, the author was impressed to find small, simply designed water treatment plants equipped with hand-operated valves with a minimum of equipment capable of creating problems in maintenance. Many of these plants were built by the British and the French when they were faced with the necessity of operating plants with local personnel. The use of slow sand filters in installations in other parts of the world is noteworthy. The Japanese have been particularly active in utilizing this type of treatment for water systems where technical capacity is limited. When it is not easy to obtain or apply chlorine or other disinfectants, a substantial factor of safety is provided by the utilization of slow sand filters.

Types of Organization

In developing countries water systems are operated under every conceivible type of organization. These range from small systems under the jurisdiction of city councils to national organizations whose entire responsibility is water supply. In between are district public works departments, consolidated water, power, and gas agencies, autonomous municipal systems, and metropolitan authorities. Some of these operate efficiently, others lack only trained personnel, and others require major organizational changes. It is desirable to introduce as little change as possible because the creation of a new organization is always a traumatic experience, and should be avoided if possible.

Management Problems

Technical problems are usually easier to solve than management problems. Aside from policy, staffing, de-

cision making, and day-to-day operations present problems. Unemployment seems to be characteristic of most developing countries. It is aggravated by the continuous inflow of people to the cities. Water utilities managers are under continual harrassment by public officials, and others, seeking jobs. It is, therefore, not uncommon to find highly over-staffed organizations with a minimum of qualified people. Government regulations and red tape add to the problems of hiring and firing of staff. Although no water department is completely free of these problems, those in developing countries seem to have more difficulties. Other problems are created by departure of good personnel for better paying jobs and too frequent changes in top management.

Water organizations which continually fail to meet costs must seek relief annually from the budgeted funds of government. When new systems are built from such funds, and where operation and maintenance also have to be subsidized, the organization is faced with the new costs of maintenance every year. The result is less money for new construction.

In certain countries, where it is now common to operate technical facilities with an expatriate staff, a number of years will be required before local people can be educated and trained to manage their utilities successfully.

Operational Problems

Two operational problems which plague a majority of water systems in the developing countries are the high rate of delinquent accounts and unaccounted-for water.

Billing consumers by mail is done only to a limited extent in the developing countries. House-to-house collectors are used. Even where mail service is reliable, which it frequently is not, people do not have checking accounts and mailing-in of payments is therefore not feasible. Among the problems this situation creates are: No one at home when the collector calls; the woman does not have the money—the head of the household, the man, is the only one with money; the woman, being alone, will not let the collector into the yard; the collector, being low-salaried, or on a commission basis, pockets the money. Yet, with all these difficulties, and others, there are systems using these methods which consistently collect over 99 per cent of their accounts.

Unaccounted-For Water

Unaccounted-for water loss is the difference between water produced and water billed. In the US, according to Seidel and Bauman, the range for 289 cities was 0.1–40 per cent or more. In this group there were 60 cities (nearly one-fourth) with 20 per cent or more unaccounted-for water on distribution. There were 20 cities with over 30 per cent and seven over 40 per cent. The author's observations on a rather limited number of systems in developing countries, where sufficient data exists to justify a conclusion, is that unaccounted-for water losses range between 10–60 per cent, with the median around 35 per cent.

Among the common causes of unaccounted-for water in both the US and developing countries are: large numbers of unmetered services; broken and defective meters; and leaks in the distribution system. Less common in the US are: poor quality and poorly designed water meters; illegal connections; a large number of public hydrants; absence of maps showing water

lines, valves, and pipe sizes; and free service to hospitals, schools, public toilets, and city parks. Although it is not uncommon in the developed countries to find installations receiving water at no charge, in many of the developing countries the demand for free water is high. Public hydrants are practically nonexistent in the US. In a capital city of Africa over 60 per cent of the population are taking its water from public standpipes. No objection should exist to the supply of water from public hydrants provided the hydrants are metered and the city pays the water department for the water taken.

Investment Priorities

Another problem is national priorities for investment. In every developing country, there is demand for capital to invest in an endless list of projects ranging from the construction of ornamental fountains and show places to education, hospitals, roads, ports, hydroelectric plants, sewer systems, and water supplies. Decisions have to be made as to which projects have the highest priority. In considering the financing of water and sewer systems, the Bank wishes reasonable assurance that the project is of high priority and that it is in the country's interest to seek international financing for construction. When countries have a limit on the debt which can be serviced, they must make difficult decisions. However desirable a water supply loan might be, other requirements may have to take precedence.

Conclusion

Where funds are limited, technical capacity is in the process of development, and masses of people demand an improved standard of living, countries are faced with many problems. There are few elements which have a greater effect on the improvement of living standards than water. It is the hope of the World Bank and IDA that, through proper financial planning by governments and adoption of a sound utility approach in water supply, a start can be made in solving these problems.

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INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

INTERNATIONAL FINANCE CORPORATION

INTERNATIONAL DEVELOPMENT ASSOCIATION

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REMARKS

Mr. Weiner has suggested that a copy of the paper which I will present at the International Water Supply Meeting next September be sent you. He indicated that someone in the Bank was compiling such papers.

From: Harold R. Shipman

POLICIES AFFECTING THE FINANCING OF URBAN WATER SUPPLY IN DEVELOPING COUNTRIES

by

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Chief, Water Supply Division I
International Bank for Reconstruction and Development
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We have entered an era in water supply which creates considerable discomfort for those older engineers and public works officials who in the past, went their way rather independently. They designed and built water and sewerage facilities, taking such precautions as they felt necessary and complying with such regulations as Ministries of Health and others laid down and enforced. In general they were not too much concerned about such things as ecology, national planning, economic justification and systems analysis, which they did not ignore but simply took account of by exercising common sense and judgement. For those in the developing countries, the old era was further characterized by a dearth of planning, a dearth of local trained manpower and a general lack of interest. In these countries the new era brings with it the dilemma of trying to catch up with the demand for water and sewerage services at a time when competing requirements for water threaten future supplies, when there are pressures to reduce pollution and avoid environmental deterioration, and when competition for scarce investment funds is increasing.

The concern for the environment, the competition for resources, the need to maximize the benefits of investment and minimize waste, have all converged to create the need for water works officials who have a broader understanding of the many new factors which must be considered when making decisions. I am not suggesting that the common sense and sound judgement that have been brought to bear in the past should be abandoned now that the computer has arrived. On the contrary, there is even greater need to bring back common sense and to put an anchor out on the "computeritis" that is being inflicted on so many simple and otherwise healthy processes.

Because ability to finance water systems is one of the concerns expressed by those looking to the problems confronting urban growth in the developing countries, two points will be examined which bear on the approaches to be considered in meeting the problem. One concerns the proposal that standards to which systems are being built and operated are too high and will have to be reduced; the other that the solution lies not in blaming and changing standards, but rather in better engineering, better financial policy and better management.

Few will take issue with the view that most cities around the world are in financial trouble. Few water supply people even in the most fortunate cities are complacent about the future and their ability to cope with all the problems they foresee. Yet there are few water supply officials in my acquaintance who are likely to agree that solutions to their problems lie in adopting radical changes or in abandoning policies that have proven sound in the past. They would probably oppose any serious reduction in standards because substantial departure from present standards would not only create major problems but would likely result in no great savings.

* The statements and conclusions set forth in this paper are those of the author and do not necessarily reflect the views of the World Bank.

There is not now, and there never will be a "solution" to urban water problems. Every metropolitan area is in a continuing state of change which creates new problems for the water supply officials. This is particularly true in the developing countries where if it is not problems of supply, it's problems of distribution; if not leakage or illegal connections, it's broken water meters; if not labor unions, shortage of trained staff, political pressures, it's failure of the army or other government offices to pay their water bills. Few officials have to face the multitude of technical, financial, legal, political, economic, organizational and administrative problems that a water supply manager faces in an urban area. It seems reasonable then to repeat that there will never be a "solution" to his problems. What works one day will not the next. An approach which is effective in one country will not apply to another. We can only identify ways and means of dealing with these problems. Similarly, in facing the question of future urban water financing, there will be no pat solutions, no easy ways. But it will be the sense of this paper that of the various options open to engineers, water managers, and planners for meeting tomorrow's urban water supply problems, the public utilities approach which embraces sound business practice in the conduct of its affairs will be the one which, although difficult in application, offers the greatest promise. It will further be the sense of this paper that reduction of standards of water quality and service will not only be impracticable but, of more significance from the economic side, will result in little if any savings.

WATER UTILITIES AND THE URBAN PROBLEM

The objective of a city's water system at any stage of development is to provide a safe and convenient supply of water to all the people, at a price they can afford. Achievement of this objective is dependent to a great extent on the availability of funds to permit the system to expand on a continuing basis to meet growth in demand. Those who say that public savings to pay for the multitude of municipal services in the future will be too limited to permit cities to adhere to present standards could be correct for most of the services. They are not necessarily correct for water supply, which is one of the few purely municipal functions which can generate sufficient revenue to cover its own obligations. It is this characteristic which offers hope for the future of urban water supply and which needs to be emphasized at every opportunity.

The World Bank (IBRD) and its affiliate, the International Development Association (IDA) have, since making the first credit for a water supply system in 1961, held to the view that municipal water supply should be considered as a public utility and should be operated as a business in which the revenues generated by sales of water and by other sources should cover all costs and provide a surplus for the further expansion of the system. Long before the World Bank made its first loan for water supply, it recognized the problems facing other utilities in their struggle to find the finance necessary for their continued expansion. Around 1956, these problems were summarized by the then President of the World Bank, Eugene Black, who said:

"A steadily expanding supply of essential public utility services is a requisite of economic growth in all underdeveloped countries today. Over the next decade, many thousands of millions of dollars in capital for these services must be found. There is simply no practical way of raising this money unless a substantial part of it is generated by the utilities themselves through adequate charges to the users of their services.

"The Bank has been laboring this point for a very long time. We have held that it is dangerous for a developing country to be sentimental or practically expedient about things like railroads and power plants;" and urban water supply, he might have added, "that policies based on these attitudes only create an intolerable drain on the savings which are the lifeblood of every country's future prosperity. We have said that adequate utility rates are especially important in a country where there is no organized capital market. By 'adequate' rates we have meant rates which enable utilities not only to cover the real cost of their services, but also to retain out of earnings, substantial sums each year to help finance the expansion which inevitably will be needed to sustain future growth. And we have made no distinction in advocating adequate rates between privately-owned and publicly-owned utilities." Mr. Black concluded his statement by saying, "I feel the Bank's insistence on sound utility finance is being vindicated today by events in many member countries. All over Latin America and in many other parts of the underdeveloped world, officials charged with the job of finding capital for development are themselves struggling to get a recognition of the simple principle that utilities should pay their way."

At first sight, application of the principle expounded by Mr. Black and called here the "sound utility" approach seems to ignore the disproportionate numbers of poor people needing water service and their inability to pay high prices for water. However, in numerous cities where water systems are financed out of budgeted funds and where revenues collected from water sales do not even pay for operations, it is apparent today that the poor people are the first to suffer. It is in cities which have poorly-operated and badly-managed water systems where the poor are without water. The city which establishes a tariff structure for water that takes into account the type of service provided and the amount of water used, will be able to distribute costs equitably among all its people. If to this formula is added an emphasis on reducing the cost of water by good engineering, proper programming of new works and efficient operations, not only can the poor be taken care of, but also there will be a greater likelihood that the needs of tomorrow will be met. A substantial number of cities in developing countries around the world are today demonstrating that such an approach is feasible.

Before discussing further the elements of the "sound utility" approach the question of whether reduction of standards is the answer to the problems confronting urban water supply financing, needs to be explored and answered.

ARE PRESENT STANDARDS FOR WATER SUPPLY TOO HIGH?

What do we mean by standards for water supply? Do we mean standards of water quality, standards of service, standards of quantity, standards of maintenance, standards of management, or what? It is likely that those who argue the cause of reduced standards have in mind standards of quantity, quality and service. They certainly cannot mean reduction in standards of maintenance, financial policy, or management which would only add to, not solve, the problems of those concerned with financing.

Water Quality Standards

Water quality standards in their simplest terms can be divided into three groups. The first are those relating to substances and organisms which if present in water consumed by man or animal may cause physiological damage, illness and even death. A second group of standards includes those which concern substances and characteristics damaging to piping systems and materials or are unfavorable for certain commercial or industrial processes; and the third group relates to the substances which render water unattractive to use for cooking, drinking, washing and recreation. Among the latter are those which cause tastes, odors; cause discoloration of clothing and articles coming in contact with the water or which make the water cloudy and unattractive in appearance. The laboratory man will refer to the foregoing groups in other ways and will usually speak of physical, chemical, biological and radiological standards and qualities.

Most recognized quality standards for drinking water are based on experience and research. They have been established usually to reflect a compromise between perfection and what is economically feasible. Where toxic substances and impurities are involved, however, the limits are established to permit a margin of safety to allow for some operational variations and to accommodate differences in tolerance between individuals. For substances which are non-toxic the limits set by certain standards such as the WHO Recommended International Standards are presented only as suggested limits and nothing prevents going below the stated standards except the willingness of man and animal to accept the tastes, the odors and the appearance, and their ability to adjust and tolerate. Physical standards which concern taste, odor, color and appearance usually have little or no adverse effect physiologically on people and animals drinking the water. Costs involved in meeting most physical standards are usually incurred only because consumers want the better water and are willing to pay for it. Although it may be costly to meet high physical standards in areas where highly colored raw water or serious tastes and odor problems exist it is usual in most of the developing countries to find that no additional treatment is necessary over that normally provided to make the water safe since the latter processing also accomplishes at the same time the needed improvement in physical quality.

Efforts to lower or eliminate standards of water quality as a money-saving device have frequently been directed at the biological standards. The argument has been that the only thing that matters is that water be made available and that if it contains a few bacteria which might, on occasion, cause disease, the risk is worth the savings; that any water is better than no water and that money spent on providing safe water should better be expended on supplying more people with lower quality water. This argument has validity only if the people of the benefited city do not pay the full costs of water provided to them. If they do pay, no one in other cities is being deprived of water regardless of what standard is used in the benefited city. Of even more significance is the suggestion which comes out of this line of reasoning that water which does not meet standards of safety should be provided regardless of risk because it may reduce costs somewhat. It is necessary in this connection to recall recent events in several countries where engineers, architects and government officials have individually or collectively been indicted for negligence because through oversight or poor technical judgment, structures were designed and built which were unsafe and led to loss of life or injury. In none of these cases was there an intent to reduce standards. There was only miscalculation or lack of foresight. The consequences for intentionally designing and knowingly operating a water system which would distribute unsafe water as defined by even the most liberal

standard is easily predicted. Those who argue the cause of reduced biological standards for water should recognize at the outset the seriousness of the implications. These same views apply equally to chemical and radiological standards. Advocates of solving the water supply financial problems by reducing safety standards, champion a cause which few people in any country could accept. Of special note to the economist is the fact that the savings in costs which could be achieved by reducing the margin of safety usually built into the quality standards will likely prove negligible.

Water Quantity Criteria

Water systems show wide differences in the quantities of water provided to the people they serve. It is normal for engineers to examine the quantities of water being consumed in any one location and to use these figures as a guide for design. Such data however, are not to be construed as standards and there appears to be no point therefore in discussing the question of reducing standards of water quantity. What can be discussed however, is water conservation and the reduction of excessive use of water. A combination of good design, good maintenance, good management, metering, proper pricing policies, and possibly new technological developments is required to cope most effectively with the problem of excessive use and waste of water. However, after all steps have been taken it will no doubt be found that different people, different cultures, different climates and different conditions lead to wide variations in water consumption which not only defy establishment of standards of quantity but make precise comparisons of per capita consumption between cities a meaningless exercise.

One ill-advised practice which is proposed frequently as a device for reducing water use is that of designing for an intermittent supply of water to all or part of a city. This is an uneconomic practice which counteracts the benefits of the investment and makes good management a myth. It may well be that certain water systems which have outgrown their source and supply works have to provide water intermittently, but this is an emergency measure, not one to be sought intentionally in design.

Standards of Service

Most people served by municipal water systems in the developing countries may choose one of several patterns of water service. The poor may take water from public hydrants, some may have water in their courtyard, the average home may have water piped into it, and in most cases a choice of size of service line and meter is available. In each case the charges can be made to reflect the type of service.

The design of water systems has to take account of the economy and the character of the various areas of a city to be supplied and the likely type of service to be provided. For those who argue that a reduction in service standards must be considered it is necessary to point out that nearly every system today in the developing countries has no fixed service standard and that the present range of service open to the public can be reduced further only if it is decided to make the poor walk further to public hydrants or refuse water service to householders who can afford such service.

To refuse water service to domestic, commercial or industrial installations as a matter of planned policy for reducing future water system costs is not only to advocate a policy with which no public official could live but more important,

it proposes to cut off the principal source of revenue which makes it possible for water systems to extend and expand to meet the growing needs. This policy destroys the thing it started out to help.

Reuse of Water

It is paradoxical that in many of the developing countries today the water department and the water engineers are the strongest opponents of any proposal to consolidate water and sewerage operations. They should be in the forefront of the supporters of this approach, because it is far easier to plan the long-range water and waste-water needs of cities when all sources and all uses can be planned and considered together.

In my view, the day is far off when treated waste can be considered for use in the potable water systems of urban areas, because of the very high degree of treatment which will be required. On the other hand, numerous industries require water which does not need to meet the standards of potable use; through proper planning and directed location, treated waste-water can be piped and sold to such industries thus freeing high-quality water for other purposes. This needs to be done in the not too distant future, if cities are to keep pace most economically with their water requirements. Water supply officials who are concerned with sewerage operations and the reclamation of waste-water are better able to plan and better able to accommodate the needs of urban areas at the minimum cost.

THE 'SOUND UTILITY' APPROACH

The conclusion seems reasonable that reducing the standards of water quality or service will contribute little to the solution of future financial problems of urban water supply. On the contrary, it is my opinion that such reductions will only add to the financial problems. What hope therefore exists in the 'sound utility' approach? What does it embrace, and particularly how does it affect water supply financing?

Revenues and costs are particularly relevant here. A fair amount has been written about the need for adequate rates, proper tariff structures, and the generation of revenues sufficient to cover all costs with something left over to contribute towards extension of the system. Very little has been written and said about the cost side of the equation, and even less is done to reduce costs. The 'sound utility' approach requires that all costs be controlled and every aspect of the organization and of its operations has to be involved. If the rate charged for the sale of a cubic meter of water is to be kept as low as possible to permit low-income people to pay for the water they need, it is fundamental that engineers and water supply officials must do more to reduce costs. The principal points to be stressed concern good engineering, good planning, good operation, good financial policy and good management. Each of these points deserves particular comment; each is prominent in the criteria which the World Bank applies in appraising water projects.

Well-Engineered Projects

Engineering is the foundation of good projects. Engineering design establishes costs, and economic and financial feasibility. It sets the pattern of requirements for funds, the financial plan and, later, the charges which have to be made for the sale of water. It determines whether the facilities built are compatible with

the community's needs and within the technical ability of the personnel of the water department to operate and maintain. It is therefore surprising that, even today, insufficient recognition is given to designing a water system for the particular situation rather than merely adapting designs previously used for other communities.

Attention is directed to four characteristics of well-engineered projects, which materially influence costs.

Design and Ability to Pay

Projects are designed too frequently without regard to the means by which funds will be provided. If, at the outset, the engineer is told that the project will have to be paid for by revenues from the sale of its water, and that this limitation must be inherent in any design which he develops, then later on the problems of management in trying to pay for overly-expensive facilities, will be considerably reduced. In the long-range many more people will be served. This suggests that one of the first decisions to be taken is that of establishing the ceiling cost of the project. The more common approach is to do the engineering first and then determine the costs. In cities which adopt the "sound utility" approach and where water charges must cover all costs, this approach invariably leads to trouble. A well-engineered project consequently, must first establish the financial capacity of the people and the city, and this restraint must then be reflected in its design.

Most-Economic Alternative

A well-engineered project is one in which all the alternatives have been considered, and the most economic selected. It is quite common to observe projects in which only one alternative has been considered and has been pursued without regard to any other approach. An example which continually repeats itself is the project where utilization of a surface source of water with a treatment plant is proposed but no thought has been given to the use of ground water. Without going into the question of who is at fault or why this occurs, it is sufficient to point out that all sources of water have to be considered and the most economic source selected; all types of treatment, and all configurations of storage and distribution have to be considered and the most economic selected. It is the exception rather than the rule in reviewing projects for the developing countries to find that the engineers have considered all the alternatives of every aspect, and selected the ones which are the most economic.

Most-Economic Staging

A well-engineered project is one where the design period has been established to be the most economic. For staging and choosing the most economic alternative, the present worths of alternatives should be compared. The discounted cash flow or current worth technique is explained in most modern texts on engineering economics. Its major advantage rests on the ability to compare the future costs of alternates on a present cost basis, tailored to the particular country through the use of realistic discount rates.

Compatibility with Local Conditions

A well-engineered project takes into account the availability of local materials, the technical competence of the water department personnel, the geography of the area and all local factors. Elaborately designed plants which

have the most modern automated controls may be status symbols, but such plants are particularly unsuitable in a number of the developing countries because of the problems created when complex mechanical devices fail. Although it will be argued by some that the cost of automation is prohibitive, high initial cost is not the major reason why automation should be rejected. The prime objection is the effect on the quality of water and on operation when the automation breaks down. The argument is frequently heard that automation is needed most where there is the greatest shortage of trained manpower. A brief visit to automated plants about one year after the date of turnover by the contractor to local operations will usually demonstrate the weakness of this argument.

When raw waters are subject to rather frequent fluctuations in turbidity and quality, when chemicals are in short supply or difficult to obtain, and when the operating personnel are not of a high level of technical competence, it will usually be found that the fewer the operational controls, and the less sensitive the operations are to changes in raw water quality, power interruptions, and imported parts, the better.

The Financing Plan

Once the engineer's estimate of the cost of the project has been made, a financing plan needs to be developed which establishes the sources of funds for the full cost of the project. Normally such sources include funds which the water utility has accummulated from its earnings, funds which will be generated in the future during the course of construction and which can be applied against the cost of construction, funds borrowed locally and from the Government, and funds borrowed externally from such sources as the World Bank.

The financing plan, like the engineering design of the project, can take many forms, some of which are more advantageous to the water utility than others. It is, of course, not always possible for water utilities in developing countries to have a wide range of choice among sources of money. Also, it is likely that those sources which are available will provide funds on more or less their own terms. Even so, there is always some latitude within which to maneuver, and decisions can be taken which will result in the most favorable financing plan.

Funds which the utility has already saved, and funds it will generate during the period of construction, constitute the sources which should head the list, because almost always they will be the most favorable. Since such funds depend on revenues generated from water sales over and above direct operating costs, water tariffs need to be considered in the evaluation of any financing plan.

Government funds may be made available in the form of either loans or contributions. The latter may require no repayment or they may be equity contributions which require payment of dividends or repayment from future revenue when the borrower becomes able to repay. In any event, if urban water systems in the developing countries are to meet the challenge of keeping pace with population growth in the face of shortages of national and municipal funds, they must promptly cover all loan repayments from self-generated revenue in order to ensure confidence that investment in water supply is sound investment.

Although much could be said about how to prepare financing plans which are most favorable to the water utility, the best advice is to rely on a trained financial adviser, preferably on the payroll but otherwise employed as a consultant.

Financial Policies

It is quite possible for a water project to be well engineered, and have a good financing plan yet still fall short of meeting the requirements of many financial institutions for advancing their share of the money assigned in the financing plan. Of more importance, it may fall short of the objective of being able to supply tomorrow's water needs. Private investors and also development agencies may be reluctant to invest in water projects in developing countries, because they feel that the financial policies being followed by water utilities are weak or unsound, and will make the objectives of such projects difficult to achieve.

Of all public utilities in the developing countries, those concerned with water supply are consistently the weakest in matters of finance and in their financial policies. There are, of course, reasons for this which time does not permit to be reviewed. It is more profitable to identify some of the major departures from sound policy and to suggest what needs to be done. A sound financial policy is defined as one which requires the utility to meet all costs and generate some reserves from its revenues while permitting the utility to provide safe and dependable water to the people of the area served at the minimum cost, following operating and maintenance procedures which result in the most economic life and performance of all its facilities. In practice this means that water tariffs are set and adjusted whenever necessary to ensure that revenues are meeting the targets, and that there is maximum efficiency in all operations. In generalizing about water utilities and financial policy it is necessary to also stress management. Since policy has to be implemented -- it cannot be a set of nice printed platitudes hanging on the manager's door. Good management and sound financial policy go hand in hand. It is not possible to have one without the other.

SUMMARY

Reducing standards of water quality and water service offers little hope of substantial savings in costs while creating major problems. Opportunities do exist for conservation and for reduction of waste which will require increasing attention by water supply officials and the public.

For the cities of the developing world seeking solutions to the financial problems of meeting present and future needs -- for housing, transportation, education, urban renewal, health services, water supply, sewerage, municipal cleansing, drainage, solid waste collection and disposal, fire and police, street lighting, traffic control, etc. etc. etc. -- a universal approach even for one city appears unlikely. Excepting power, gas and telecommunications which normally are not operated as purely municipal functions, water supply is almost alone among urban services in being able to operate, maintain and expand its facilities, and service debt out of the revenues generated from its services. To examine the ability of growing cities to meet future requirements for other municipal services has been beyond the scope of this paper. It is concluded, however, that for water supply the problems are not insurmountable, provided that good engineering ensures minimum costs and optimum staging of new construction; provided that sound financial policies are followed; and provided that good management binds the two together. All of these elements make up the "sound utility" approach to water supply. For those with concern for the cities of the developing countries, assurance should be taken that although the "sound utility" path is difficult, it is the one which is the most equitable, and the most likely to succeed, and the one which many cities throughout the world are demonstrating as feasible.

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