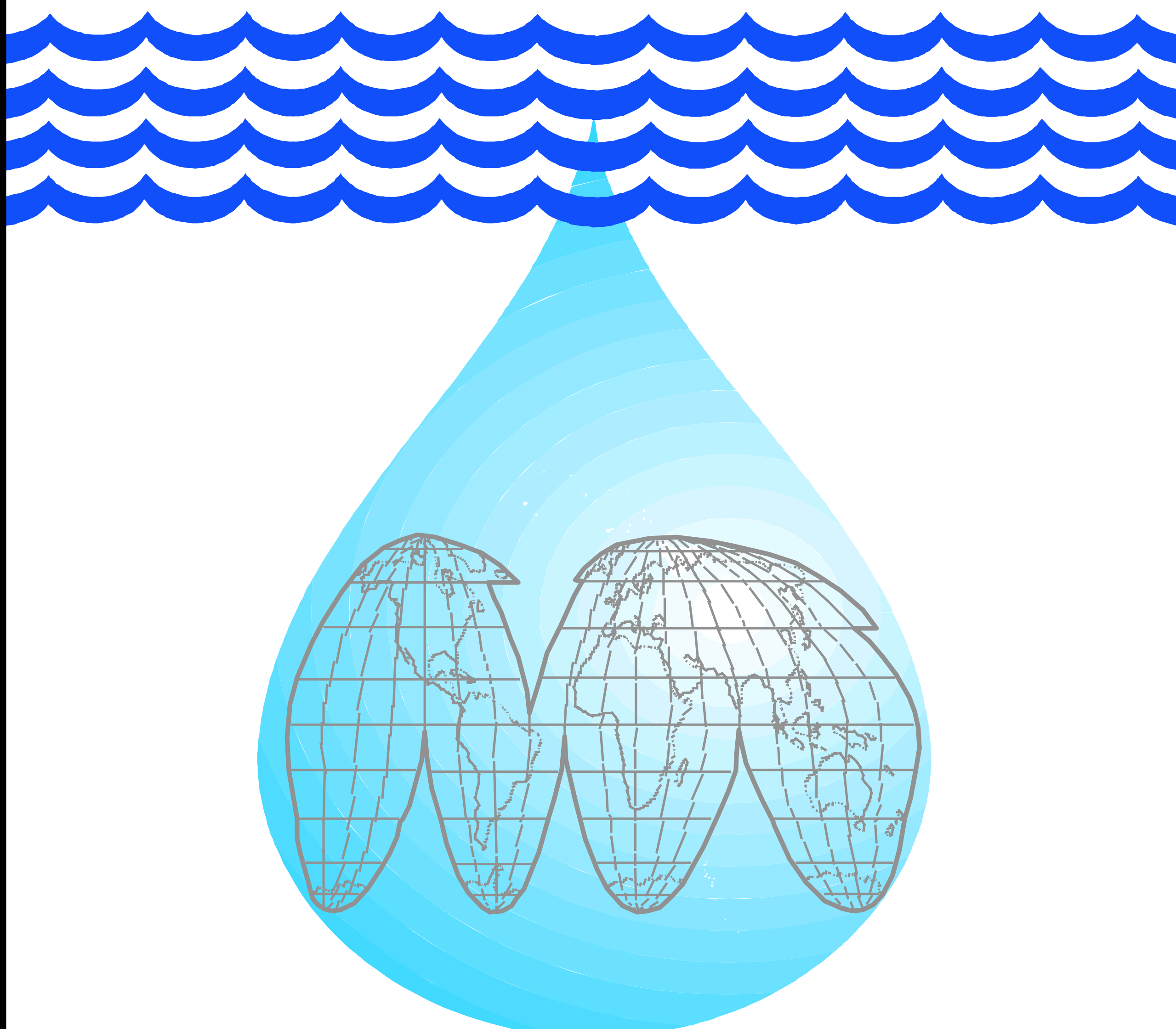
INDICATORS
2nd Edition

WATER & WASTEWATER UTILITIES



TWUWS

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The Water and Sanitation Division of the Transportation, Water and Urban Development Department is addressing the sectoral challenges articulated in the World Bank's Water Resources Management Policy and in the World Development Reports of 1992 and 1994. These challenges involve implementing key management principles:

- Water should be treated as both a social and economic good.
- Water should be managed within a comprehensive framework, taking into account cross-sectoral considerations.
- Water should be managed at the lowest appropriate level, employing a demand-based approach and facilitating participation of all stakeholders.
- Institutional and policy reforms should be linked to incentives influencing decision making.

The division's work program is therefore selectively focused on three distinct themes: water resources management, performance of water and sanitation utilities, and service provision through non-formal institutions.

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WATER AND WASTEWATER UTILITIES
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SET II. FINANCIAL INDICATORS

We hereby wish to extend our appreciation and thanks to Mr. Jorge A. Serraino for his assistance in the preparation of this report.

FOREWORD

Indicators can be a valuable tool to sector staff and practitioners working in the evaluation of operations and investments of water and sanitation utilities[1]. To make this job more manageable indicators on *Water and Waste-Water* services, mainly in urban areas, have been grouped into three sets:

1. Operational Indicators (first edition, April 1993)
2. Financial Indicators (first edition, June 1994), and
3. Overview of Tariff Rates and Structures (first edition, June 1994).

In response to the heavy demand, this second edition has been updated and expanded with additional information collected since the three sets were first published.

Indicators have been collected from a selected group of utilities from industrialized and developing countries. Indicators from the former group are believed to represent "acceptable" or "desirable" outcomes or best practice. General information about the utilities cited is presented in Tables 1 and 2.

Staff working in operations have day to day contact with utilities and therefore are in the best position to collect the information required to keep this information up to date. It is only through your collaboration and that of practitioners that we will be able to keep these indicators current and to expand them. We appreciate the inputs and feedback received from staff in operations after the first edition was published and look forward to continue receiving your comments, suggestion and additional data.

Guillermo Yepes
Augusta Dianderas

1 Sectoral and Project Performance Indicators in Bank financed Water and Waste-Water Operations. A First Edition Note, TWU Department, ESD. April 1995.

INFORMATION ABOUT CITIES AND UTILITIES CITED

All the companies in the sample are utilities responsible mainly for urban centers with service areas covering a city, region or country. The population to be served by these utilities ranges from about 0.2 million to over 17 million. In terms of the service provided these utilities can be divided into three groups: water (11), waste water (4 - all in Korea) and water and waste water (19).

All the public utilities have some degree of autonomy in the sense that they manage, at least, their own budget. However, their autonomy, regulatory system, sector policies and political forces that shape the behavior of these companies are not thoroughly documented in the source reports to allow a meaningful analysis. Therefore, information on these factors, important as they are, is not documented here.

Table 1

Country	*Name of Utility*	***Area Serviced***	*Type of Utility*
Latin America:			
Brazil	Sao Paulo State Water Co.	**State of Sao Paulo**	Regional/Public
Brazil	Sta. Catarina State Water Co.	**State of Sta. Catarina**	Regional/Public
Brazil	Minas Gerais State Water Co.	**State of Minas Gerais**	Regional/Public
Chile	Obras Sanitarias of Valparaiso	**Metropolitan Valparaiso**	Municipal/Public
Chile	Empresa Municipal Obras Sanitarias	**Metropolitan Santiago**	Municipal/Public
Colombia	Water & Sewage Co. of Bogota	**Metropolitan Bogota**	Municipal/Public
Costa Rica	Inst. of Water & Sewage of C. Rica	**70% of the Country**	National/Public
Africa:			
Algeria	Water Supply Co. of Oran	**Oran, Tiemcen, Ain &Mascara**	Regional/Public
Algeria	Water Supply Co. of Annaba	**Annaba & El Tarf Areas**	Regional/Public
Ghana	Ghana's Water & Sewerage Corp.	**40% of the Country**	National/Public
Morocco	National Office of Potable Water	**75% Urban Morocco**	National/Public
Nigeria	Katsina State Water Board	**50% of Katsina State**	Regional/Public
Nigeria	Kaduna State Water Board	**50% of Kaduna State**	Regional/Public
Europe/Central Asia:			
Turkey	Bursa's Water Supply & Sewrg. Auth.	**Metropolitan Bursa**	Municipal/Public
Turkey	Ankara's Water Supply & Sewrg. Auth.	**Metropolitan Ankara**	Municipal/Public
South & East Asia:			
Pakistan	Karachi Water & Sewerage Board	**Metropolitan Karachi**	Municipal/Public
China	Changchun Water Supply Co.	**Metropolitan Changchun**	Municipal/Public
Korea	Kwangju Cosntruct. Bureau (Sewrg. Div.)	**Metropolitan Kwangju**	Municipal/Public
Korea	Pusan City Govmt. (Sewerg. Division)	**Metropolitan Pusan**	Municipal/Public
Korea	Seoul Sewerage Division	**Metropolitan Seoul**	Municipal/Public
Korea	Taejon City Govmt. (Sewerg. Division)	**Metropolitan Taejon**	Municipal/Public
Philippines	Metrop, Waterworks & Sewrg. System	**Metropolitan Manila**	Municipal/Public
High Income Countries:			
Belgium	Compagnie Intercommunale Bruselloise des Eaux	**Brussels area and surroundings**	Municipal
England	Wessex Water	**Central/South**	Regional/Private
France	Banlieue	**Metro Area/Paris**	Private
France	Bordeaux	**City**	Private
France	Societe des Eaux de Marseille	**City**	Private
Germany	Hamburg	**City**	Public
Japan	Osaka	**City**	Public
Japan	Tokyo	**Capital City**	Public
Singapore	Public Utilities Board	**City/State**	Public
Spain	Aguas de Alicante	**City**	Municipal/Private
Spain	Aguas de Murcia	**City**	Municipal/Private
Spain	Aguas de Torrevieja	**City**	Municipal/Private

Table 2						
Utility	*Year of Information*	**Annual Water Production Mill. m^3**	*Connections '000*[a]/	***Service Provided***	*Population '000*	***Population* Served %**
Sao Paulo	1988	**1959**	5080	**W & S.**	17,500	**90** [b]/
S. Catarina	1990	**236**	529	**W & S.**	3,000	**85** [b]/
Minas	1990	**712**	1870	**W & S.**	7,600	**96** [b]/
Valparaiso	1990	**137**	526	**W & S.**	760	**97** [b]/
Santiago	1994	**475**	1811	**W & S.**	5,000	**100** [b]/
Bogota	1990	**537**	1542	**W & S.**	5,000	**94** [b]/
Costa Rica	1991	**194**	437	**W & S.**	1700	**84** [b]/
Oran	1992	**122**	204	**Water**	1,900	**68**
Annaba	1992	**85**	34	**Water**	600	**73**
Ghana	1988	**127**	197	**W & S.**	7,400	**60** [c]/
Morocco	1990	**460**	601	**Water**	11,300	**90**
Katsuna	1990	**13**	21	**Water**	520	**55**
Kaduna	1990	**68**	43	**Water**	1,600	**76**
Bursa	1991	**89**	307	**W & S.**	710	**91** [b/]
Ankara	1988	**176**	832	**W & S.**	2,200	**93** [b/]
Karachi	1989	**470**	1023	**W & S.**	6,300	**N.A.**
Changchun	1990	**170**	388	**Water**	1,600	**90**
Kwangju	1990		96 [d]/	**Sewrge**	1,100	**91** [d]/
Pusan	1990		287 [d]/	**Sewrge**	3,700	**95** [d]/
Seoul	1990		1575 [d]/	**Sewrge**	8,700	**72** [d]/
Taejon	1990		90 [d]/	**Sewrge**	1,000	**87** [d]/
Manila	1988	**172**	641	**W & S.**	5,000	**87** [d]/
Brussels	1991	**N.A.**	N.A.	**W & S.**	1,000	**N.A.**
Wessex	1991	**N.A.**	N.A.	**W & S.**	N.A.	**N.A.**
Banlieue	1987	**N.A.**	N.A.	**Water**	N.A.	**N.A.**
Bordeaux	1982	**N.A.**	N.A.	**Water**	N.A.	**N.A.**
Marseille	1992	**N.A.**	N.A.	**W & S.**	1,000	**N.A.**
Hamburg	1990	**N.A.**	N.A.	**Water**	1,900	**N.A.**
Osaka	1990	**N.A.**	N.A.	**Water**	1,200	**N.A.**
Tokyo	1990	**N.A.**	N.A.	**W & S.**	4,900	**N.A.**
Singapore	1994	**394**	760	**Water**	2,800	**100**
Alicante	1990	**35**	170 [b]/	**W & S.**	600	**100** [b]/
Murcia	1992	**32**	85 [b]/	**W & S.**	335	**100** [b]/
Torrevieja	1992	**6**	46 [b]/	**W & S.**	200	**100** [b]/

N.A: Not Available

a/ Includes W and S connections for W & S utilities

b/ Corresponds only to Water services

c/ Includes 2.1 million inhabitants in rural areas (17% of the total population)

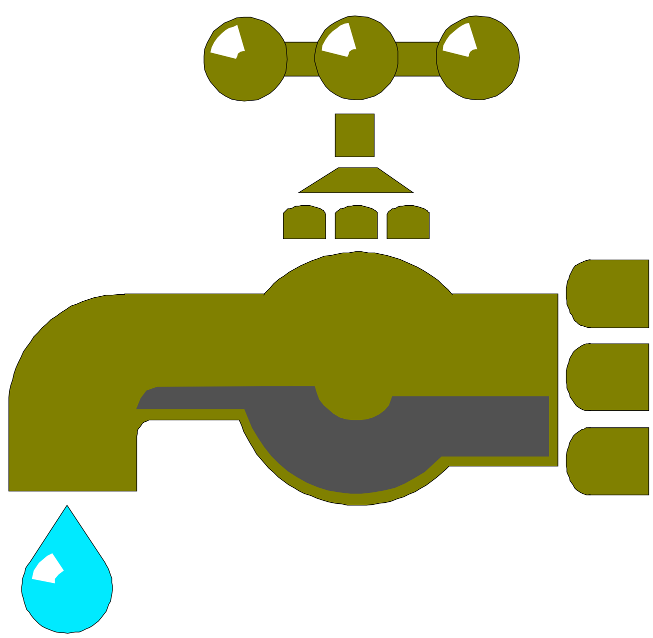
d/ Corresponds to sewerage services only.

INDICATORS
2nd EDITION

WATER & WASTEWATER UTILITIES

SET I

OPERATIONAL INDICATORS



Introduction

Operational indicators can be very useful in assessing the performance of water and waste-water utilities in the course of project formulation and supervision of Bank financed projects and in sector work.

Invariable, any indicator portrays an incomplete picture of an utility as it often excludes other contributing factors of performance such as accountability of institutions and incentives, that are not readily captured or quantifiable. In addition, utilities face different social, political and financial constraints. These factors and constraints need to be taken into account when evaluating the performance of an utility. It follows that indicators should not be used in a rigid prescriptive fashion, and judgment is required to interpret them or to set acceptable or desirable targets.

The idea of a comprehensive and up to date list of indicators from a large number of utilities world wide is attractive but probably not realistic due to the costs involved in collecting this information. We also recognize the interest in correlating indicators to other variables like city or utility size or to GNP. No attempt, however, has been made in this direction at this time as the data base is still small and, therefore, the conclusions reached form such correlations could be spurious.

Indicators should be used selectively. The use of too many is likely to dilute the power of all of them. Managers may become confused about priorities and burdened by paperwork and overwhelmed by detail. On the other hand, the use of too few may not adequately describe the utility's performance and progress in reaching its goals.

The quality of the management information systems should be assessed before discussing with sector officials about which indicators are important and relevant and to whom and how often they should be reported to. If the management information systems are deficient or information is not produced on time, it is important to develop a reliable system and the incentives to keep it relevant and up to date.

Indicators are as good as the data base from which they are derived. For instance, lack of metering of production or consumption casts doubts about the reliability of estimates on water consumption or water losses. There is also the danger of reducing performance evaluation to numbers and for utility managers and staff to play games with them. Therefore:

- watch out for "creaming", e.g., managers tend to produce the numbers they are asked to deliver.

- anticipate resistance. Hard information about efficiency and effectiveness can be threatening to insecure managers who doubt their ability to compete,

- involve the utility managers in developing corrective measures. This is probably the best way to deal with resistance. Managers need to "own" the specific measures to be implemented and the indicators to be generated and to be convinced that they will help them improve the service they are in charge of, and

- analyze the evolution of the indicators to assess progress or deterioration of utilities' performance.

A. WATER CONSUMPTION

A.1. Unit Consumption

Total water consumption, based on **metered** consumption, is reported as:

- average daily consumption per person served (liters per capita per day, lpcd),
- average consumption per connection per month (m^3/month/connection, m^3/m/c).

Countries		***Water Consumption***	
Country/City	***Year***	***lpcd***	***m^3/m/c***
Algeria (average)	1990	46	N/A
Brazil (average)	1989	151	25 a/
• Brasilia	1989	211	60 b/
• Sao Paulo	1988	237	38 c/
• Sta. Catarina	1990	143	22
• Minas	1990	154	25
Chile			
• Santiago	1994	204	34 d/
• Valparaiso	1992	N/A	23
China, Changchun	1990	260	33
Colombia, Bogotá	1992	167	30
Costa Rica	1991	208	29
	1994	197	26
Cote d' Ivoire, Abidjan	1993	N/A	34
Senegal, Dakar	1993	N/A	36
Belgium, Brussels	1991	N/A	29
Canada (average)	1984	431	82
France, Paris, C. Banlieue	1987	256	75 e/
Japan, Tokyo	1990	355	57
Spain			
• Alicante	1987	267	16
• Murcia	1992	268	33
UK (average)	1990	136	18
USA (average)	1984	666	89

N/A = data not available

Note: One connection serves more than one housing unit.

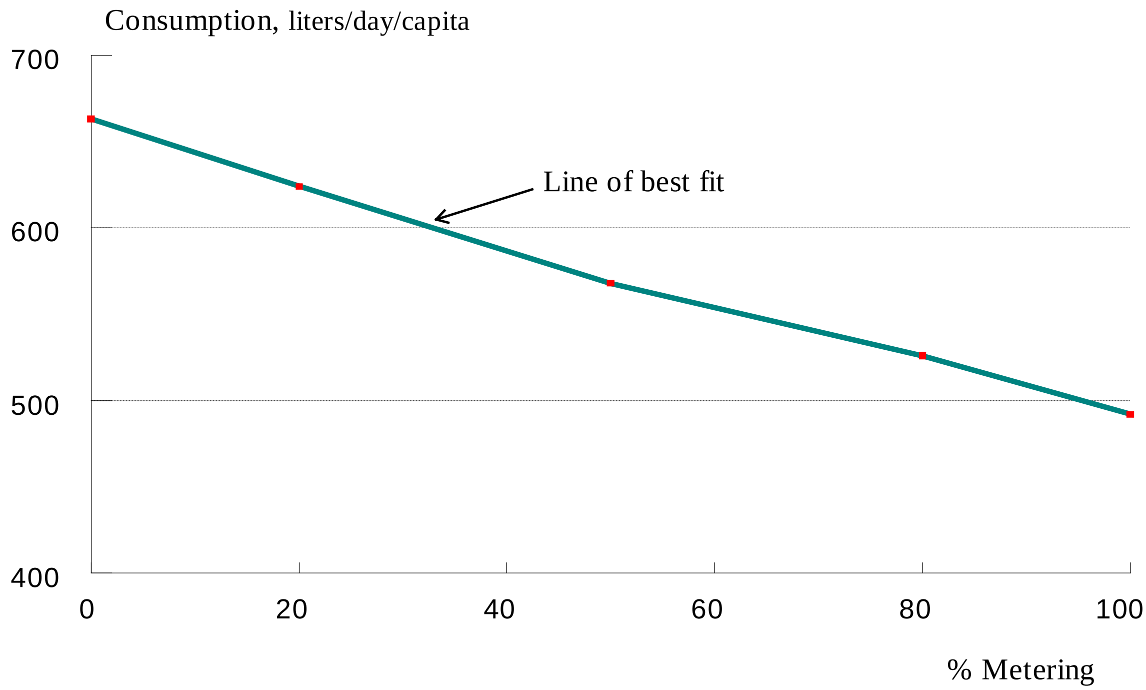
a/ 1.3 units/water connection
b/ 2.3 units/water connection
c/ 1.4 units/water connection
d/ 1.1 units/water connection
e/ 3.5 units/water connection

A.2. WATER CONSUMPTION AND METERING

The effect of metering, as a proxy for price, on water consumption is shown in the following graphs:

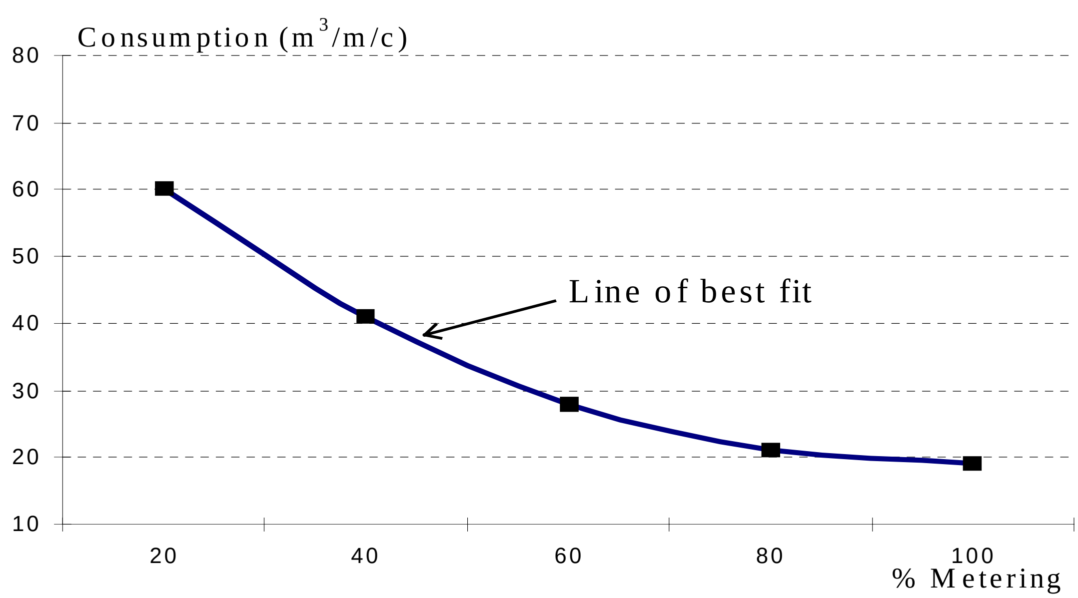
Water Consumption vs Metering

a) Canadian Utilities



Source: AWWA Water Util. Op. Data, 1985

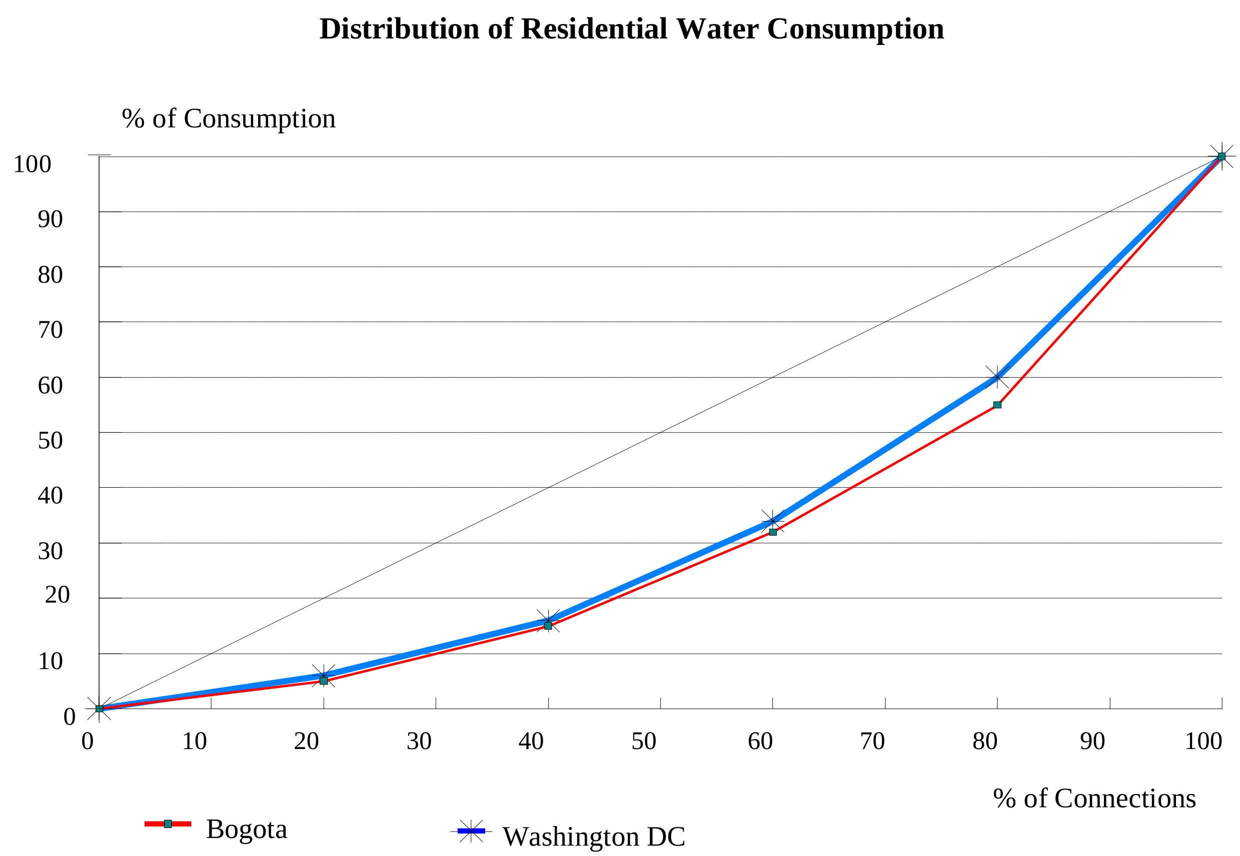
b) Brazilian Utilities



Source: Catalogo Brasileiro de Engenharia Sanitaria e Ambiental. CABES. 1990..

A.3. Distribution of Water Consumption

Distribution of water consumption as a function of the number of connections.

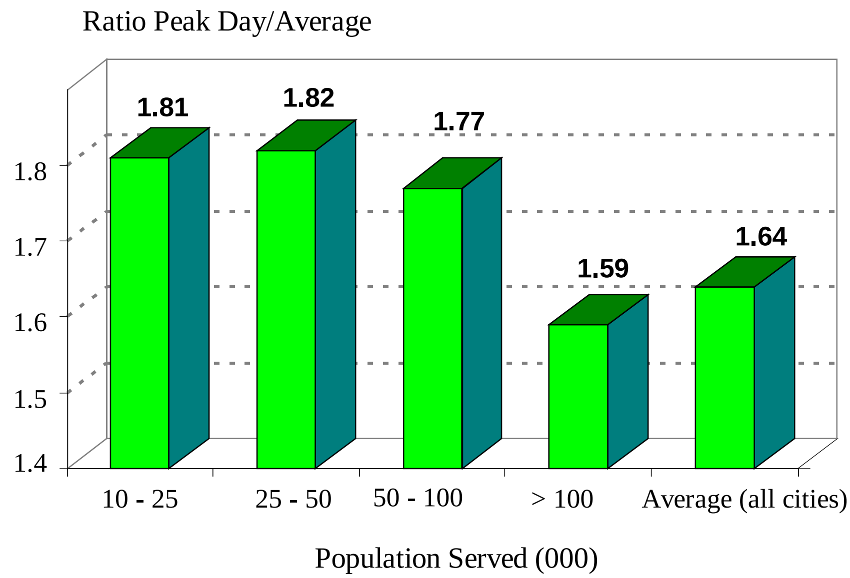


A.4. Water Consumption By Main User Category

USER	San Jose		S. Catarina		Bogota		Macao		Minsk	
	% Conn	% Cons.	% Conn	% Cons.	% Conn	% Cons.	% Conn	% Cons.	% Conn	% Cons.
Residential	91	71	90	73	94	79	85	43	92	63
Commercial.	6	8	8	11	5	9	14	50	---	---
Industrial	2	15	1	11	a/ 0.4	7	---	---	2	b/ 5 c/ 13
Official	1	6	1	5	0.2	5	1	7	6	19
TOTAL	100	100	100	100	100	100	100	100	100	100

a/ Industry has access to other supply sources [ground water]. Total industrial water consumption is not captured in the utility statistics.
b/ Drinking water. Includes commercial uses.
c/ Non-Potable water (technical)

A.5. Ratio of Peak Day to Average Day (USA Average 1990)



Source: AWWA. Water Industry Database: Utility Profiles, 1992.

A.6.a Water Price & Income Elasticities

Investigator	*Price Elasticity*	*Income Elasticity*	*Comments*
Neiswiadomy & Molina (1989)	- 0.55	0.14	Increasing block structures. Random sample of 101 customers' monthly water use records from the city of Denton, Ohio.
Neiswiadomy & Molina (1993)	- 0.63	0.64	Average price under an increasing block rate structure. Uses data from the 1984 AWWA survey, USA
Chi-Keung Woo (1992)	- 0.38	0.28	Average price. Uses monthly consumption data collected for Hong Kong during 1973 - 1984.
Neiswiadomy (1992)	- 0.11 - 0.28	0.44 0.25**(a)**	Marginal and average price. Uses 1984 AWWA survey of 430 utilities. Reported results correspond to the North Central Region, USA.
IWACO (1989)	- 0.29, - 0.33	0.40, 0.50	Monthly sales of metered domestic consumers in Bogor, Indonesia
IWACO (1992)	- 0.68	0.37	Average water price. Cross-sectional analysis of 100 households in Jakarta, Indonesia
Martin (1992)	- 0.70, - 0.60 - 0.49. - 0.32	0.18, 0.27 0.04, 0.17	Average and marginal prices. Cross-sectional analysis of 19,000 households in urban and suburban Columbia, USA.
Rizaiza (1991)	- 0.48	0.11	Average water price. Cross-sectional analysis of 400 households in Saudi Arabia.
Hubbell (1977)	- 0.48	0.36	Cross-sectional data for 230 households in Nairobi, Kenya

Note: (a) The variable is not statistically significant.

A.6.b Water. Short Run Price Elasticity for domestic users

Investigator	*Price Elasticity*	*Comments*
Carver and Boland (1980)	-0.1	Domestic use in Washington, D.C., USA, covering the period 1969 to 1974.
Agthee and Billings (1980)	-0.18, -0.36	Domestic use in Tucson, AZ., USA, for the period January 1974 through September 1977.
Martin et al. (1983)	-0.26	Domestic use in Tucson, AZ., USA, covering the period July 1976 through December 1979.
Hanke and de Maré (1982)	-0.15	Domestic use in Malmo, Sweden, covering the period 1971 - 1978..
Gallagher et al. (1977)	-0.26	Domestic use in Toowoonba, Queensland, covering the period 1972/3 to 1976/7.
Boistard (1993)	-0.17	Domestic use in France, covering the period between 1985 and 1990.

A.6.c Water. Price Elasticity for Industrial Users

Investigator	*Price Elasticity*	*Comments*
Williams and Suh (1986)	-0.74, -0.44	For the average price and the marginal price, USA.
Ziegler (1984)	-0.98	Paper and chemical plants, USA. Average price.
Rees (1969)	-0.96	Chemical water use, UK.
Gupta and Goldar (1991)	-1.32	Cross-sectional data for cotton, textile, paper, dairy, ball-bearing, and distillery, India (1983-84).
Tate et al.	-0.5 to -1.2	Cross-sectional data for different industrial subsectors, Canada (1981-1986).
Metaplanners (1992)	-0.45	Steel and related industries, India.

Source: Ramesh Bathia et al (1994).

B. WATER DISTRIBUTION SYSTEM

B.1. Length of Water Piped Systems

Length of the water distribution pipe system as a function of:

- the number of people served [meters/person],
- number of connections [meters/connection].

County/City	*Year*	*Unit Length (mts/person)*	*Unit Length (mt/connection)*
Brazil (average)	1989	2.3	12.5 a/
• Brasilia	1989	1.8	17.1 b/
• Saó Paulo	1993	2.6	10.7
Chile			
• Santiago	1994	1.6	8.7
• Valparaiso	1992	N/A	11.3
Colombia, Bogotá	1992	1.4	8.0
Costa Rica (average)	1990	N/A	11.6
Togo (country total)	1990	9.1 c/	74.6 c/
Philippines			
• Cabanatuan	1994	N/A	6.8
Romania, Bucarest	1994	1.3 d/	N/A
Belgium, Brussels	1991	N/A	9.8
France, Marseille	1992	2.6	N/A
Germany, Hamburg	1990	2.9	N/A
Japan (average)	1990	4.1	11.8
• Osaka	1990	3.9	N/A
• Tokyo	1990	N/A	9.4
Singapore	1991	1.6	5.5
Spain			
• Alicante	1992	N/A	7.6
• Murcia	1992	3.1	12.6
USA (average)	1984	4.9	24.0
	1990	6.4	N/A

Notes: a/ 1.3 units/connection
b/ 2.3 units/connection
c/ Significant number of standposts (56% of population served).
d/ 7% of population is served by standposts.

B.2. STORAGE VOLUME

a) Storage volume in the distribution system expressed as:

- m^3/person served,
- m^3/water connection.

Country/City	*Year*	*Storage Volume m^3/person*	*Storage Volume m^3/connec*
Chile,			
• Santiago	1990	n.d.	0.7
• Valparaiso	1992	0.5	1.9
Colombia, Bogota	1991	0.2	0.9
Mexico, Monterrey	1987	0.4	2.3
Belgium, Brussels	1991	n.d.	1.0
Canada (average)	1984	0.6	3.9
France, Bordeaux	1982	n.d.	0.8
Singapore	1990	0.4	1.2
Spain,			
• Murcia	1992	n.d.	0.7
• Torrevieja	1992	0.5	1.9
USA (average)	1984	0.6	3.0

b) Storage volume as a function of population served USA 1/.

Population Served ('000)	*m^3/person*
10 - 25	1.08
25 - 50	0.87
50 - 100	0.82
100 - 500	0.80
500 - 1000	0.71
> 1000	0.55

1/ AWWA - 1984 water utility operating data.

B.3. Pipe Breaks

Number of pipe breaks per year per 100 kms of pipes in the water system.

A higher number is indicative of problems due to materials, installation, age, soil conditions, traffic and of inadequate maintenance.

Country/City	*Year*	*Pipe Breaks Breaks/100km/yr.*
Chile, Santiago	1994	31[a/]
Colombia, Bogota	1994	187
Belarus		
• Minsk	1993	70
• Gomel	1993	25
Belgium, Brussels	1991	21
Singapore	1990	17
USA (average)	1990	17
• Denver, Colorado	76-83	7
• Oakland, California, EBMUD	73-82	16

Note: a/ Down from 39in 1991.

B.4. Pipe Breaks as a Function of Pipe Material

Information on different types of pipes materials. It is useful when designing strategies to reduce physical water losses.

Pipe Material	*Pipe Breaks/100km/yr. City*			
	Denver [a/]	*EBMUD* [a/]	*Bogota*	*Santiago*
A.C.	3.7	10.3	294	38
Cast Iron	7.5	2.6	---	23
Concrete	0.9	---	---	---
Ductile Iron	1.8	---	---	---
Galv. Iron	35.5	5.6	---	---
PVC	---	---	78	8
Steel	0.4	---	---	6
Other Materials	---	---	58	---
Average	6.8	16.8	187	31

Source: a/ Guiding Manual. Rehabilitation Criteria for Water mains. AWWA, 1986.

C. UNACCOUNTED FOR WATER (UFW)

C.1. WATER LOSSES

A major concern about operations of a water utility is the level of UFW. UFW reflects the difference between the volume of water delivered to the distribution system and the water sold. The level of UFW is considered a good proxy for the overall efficiency of operations of a water utility.

UFW includes physical losses [pipe breaks and overflows] and commercial losses [meter under-registration, illegal use including fraudulent or unregistered connections and legal, but usually not metered uses like fire fighting].

Unaccounted for water (UFW) is expressed as:

- a percentage of net water production (delivered to the distribution system, % UFW).
- as m^3/day/km of water distribution pipe system network (m^3/day/km d.s.).

The average rate of UFW in the developing countries of this sample is 37%, more than twice what is considered acceptable in industrialized countries (less than 20%). The highest rate is found in Bursa, Turkey, with 62% and the lowest in Abidjan, Ivory Coast with 17%.

Caution should be used in interpreting UFW data, however, as some reported UFW ratios are not more than gross estimates since full metering is not in place and utilities often do not adhere to the definition given above.

UNACCOUNTED FOR WATER (UFW)

Country/City	*Year*	*Water Losses % UFW*	*Water Losses m^3/day/km d.s.*
Brazil (average)	1989	39	42
• Brasilia	1989	19	27
• Sao Paulo Metrop. Area	1992	40 a/	70
• S. Catarina	1990	45	n.d.
• Minas	1990	25	n.d.
Chile			
• Valparaiso	1990	41	n.d.
• Santiago	1990	28	52
	1994	22	44
Colombia, Bogota	1991	40	135
Costa Rica	1991	45	n.d.
Ivory Coast, Abidjan	1993	17	n.d.
Algeria, Annaba	1992	35	n.d.
Gambia, Banjol	1993	27	n.d.
Guinea, Conakry	1993	53	n.d.
Senegal, Dakar	1993	29	n.d.
Ghana	1988	49	n.d.
Morocco	1990	32	n.d.
Nigeria			
• Katsina	1990	44	n.d.
• Kaduna	1990	41	n.d.
Togo	1990	22	7
Turkey			
• Bursa	1991	62	n.d.
• Ankara	1988	45	n.d.
Pakistan, Karachi	1989	40	n.d.
China, Changchun	1990	40	n.d.
Philippines, Manila	1988	59	n.d.
Thailand, Bangkok	1990	33	73
France, Bordeau	1982	15	n.d.
Canada (average)	1984	15	16
Japan (average)	1990	11	13
• Tokyo	1990	15	35
Macao	1991	11	n.d.
Singapore	1994	6	9
Spain, Murcia	1993	25 b/	22
USA (average)	1984	12	17

Notes: a/ Up from 25% in 1988.
b/ Down from 45% in 1989.

C.2. Composition of UFW

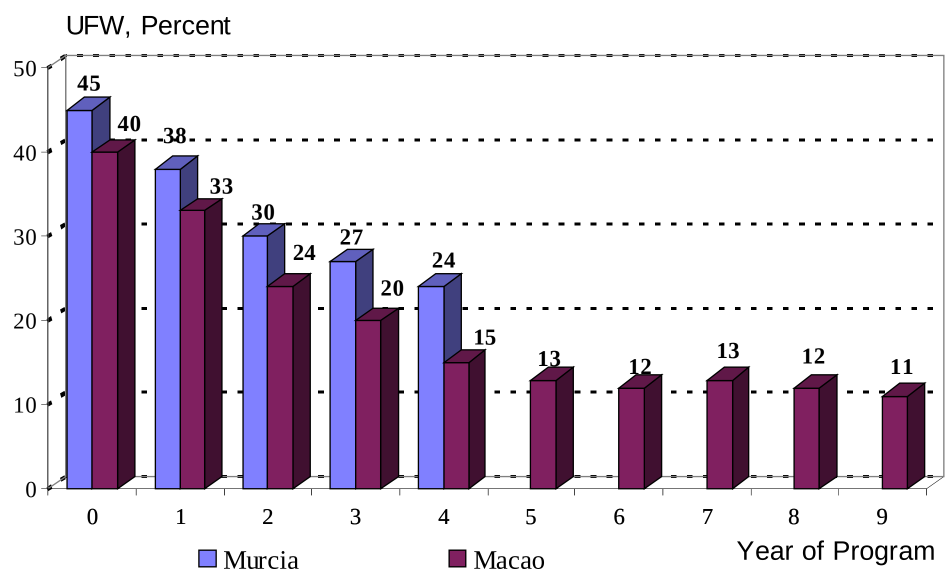
UFW is broken down by its two main components: physical [pipe leaks and storage tank overflows] and commercial [meter under-registration, illegal connections, etc.]. A good understanding of the relative weights of these components is a *sine-qua-non* condition for the development of a sound program to reduce UFW.

		Composition of UFW (%)		
Country/City	***Year***	***Physical***	***Commercial***	***Total***
Singapore	1989	4	7	11
Spain, Barcelona	1988	11	12	23
Colombia, Bogota	1991	14	26	40
Costa Rica, San Jose	1990	21	25	46

C.3. UFW Effective Reduction Programs

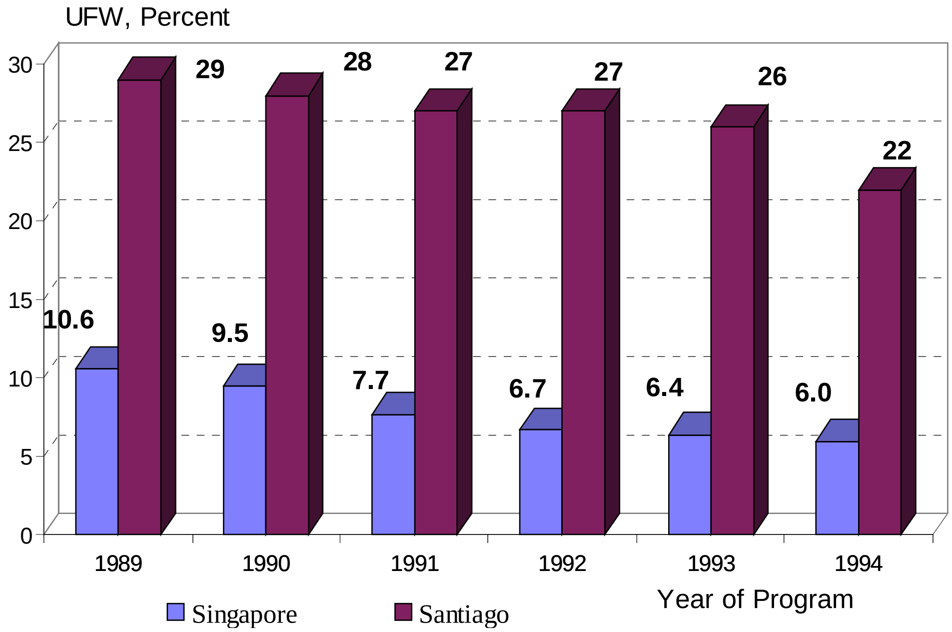
Information about four highly successful UFW reduction programs is presented here. These programs share one common approach: the initial effort was directed towards reducing commercial losses: users were identified, the commercial system (meter reading and billing) was revamped, defective meters were replaced and the number of metered connections was substantially increased. Reduction of leaks was also part of the UFW reduction program but secondary to the reduction of commercial losses.

a) Macao & Murcia



Note: Murcia: Year 0 = 1988
Macao: Year 0 = 1982

b) Singapore & Santiago

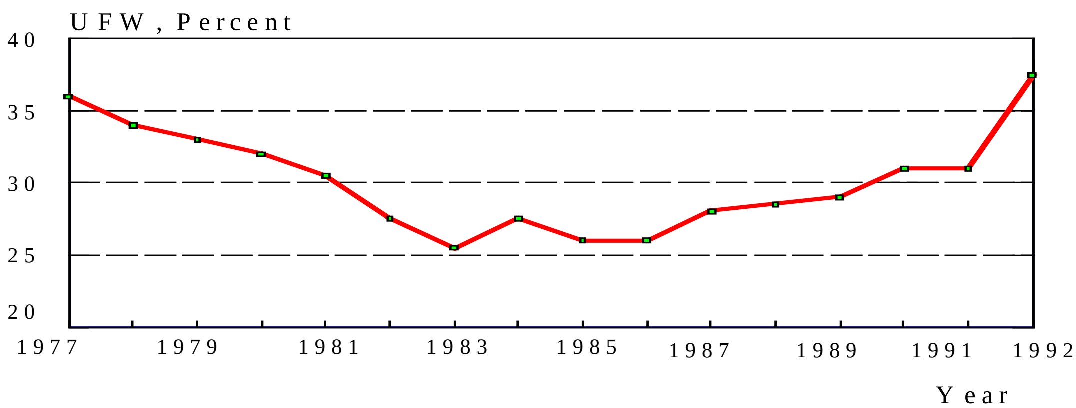


C.4. Sustainability of UFW Reduction Programs

UFW levels can easily deteriorate when a tight control on operations and maintenance and of the commercial system hard and software sub-systems that affect productivity levels, is not maintained. In this particular case, the deterioration is due to a relaxation of policies and accountability.

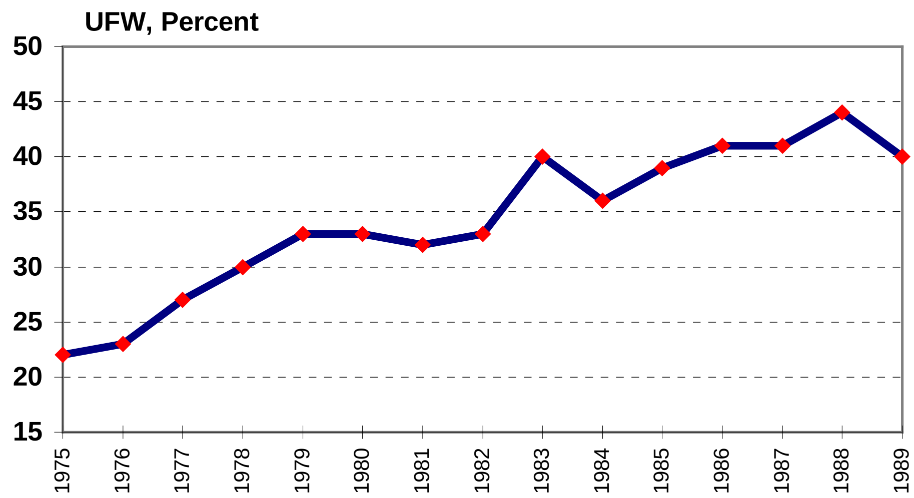
Evolution of UFW

a) Sao Paulo, Brazil, 1977-92



Source: SABESP. Contract 085/92-C Rep.1, 03/93.

b) Bogota, Colombia, 1975-89



Source: Yepes Guillermo, Infrastructure Maintenance in LAC. The Costs of Maintenance Neglect and Options for Improvement. Vol. 3, June 1992.

D. WASTE WATER COLLECTION SYSTEMS

D.1. Length of Sewer Systems

Length of the sewerage distribution system as a fuction of:

- the number of people served [meters of pipes/person],
- number of connections [meters/connection].

Country/City	*Year*	*Unit length:*	
		mts/person	*mts/connec*
Brazil (average)	1989	1.6	11.1 a/
• Brasilia	1989	1.2	11.9 b/
Chile			
• Valparaiso	1992	n.d.	9.8
• Santiago	1990	1.4	7.5
Colombia, Bogota	1992	0.9	6.0
France, Bordeaux	1982	n.d.	10.1
U.K ,Wessex.	1991	n.d.	5.2

Notes: a/ 1.7 units/sewerage connection.
b/ 2.4 units/sewerage connection.

D.2. Infiltration Flows in Sewer Systems

USA, EPA guidelines....less than 500 gallons/day/in-dia per mile
(465 liters/day/cm-dia per km)

E. WASTE WATER TREATMENT

E.1. Typical Composition of Untreated Municipal Wastewater

Constituent a/	*Concentration Range* b/:			*U.S. Average* c/
	Strong	*Medium*	*Weak*	
Solids (total)	1,200	720	350	---
Dissolved, total d/	850	500	250	---
• Fixed	525	300	145	---
• Volatile	325	200	105	---
Suspended	350	220	100	192
• Fixed	75	55	20	---
• Volatile	275	165	80	---
Settleable solids, ml/L	20	10	5	---
Biochemical oxygen demand, 5-day 20 ^{o}C	400	220	110	181
Total organic carbon	290	160	80	102
Chemical oxygen demand	1,100	500	250	417
Nitrogen (total)	85	40	20	34
• Organic	35	15	8	13
• Ammonia	50	25	12	20
• Nitrite	0	0	0	---
• Nitrate	0	0	0	0.6
Phosphorus	15	8	4	9.4
• Organic	5	3	1	2.6
• Inorganic	10	5	3	6.8
Chlorides d/	100	50	30	---
Alkalinity (as $CaCO_3$) d/	200	100	50	211
Grease	150	100	50	---
Total coliform bacteria (no./100 mL)	10^7-10^9	10^7-10^8	10^6-10^7	22x106 e/
Fecal coliform bacteria (no./100 mL)	---	---	---	8x106
Viruses, pfu/100 mL b/	---	---	---	500

Notes: a/ Values are expressed in mg/L, except as noted.
b/ After Metcalf & Eddy, Inc., 1991.
c/ Culp et al., 1979.
d/ Values should be increased by amount in domestic water supply.
e/ Geldreich, 1978.
pfu= Plaque-forming units/100mL.

Source: Water Reuse. Assessment Report Project 92 WRE-1. Environment Research Foundation 1994.

E.2. Typical Constituent Removal Efficiencies for Primary and Secondary Treatment

Constituent	*Average Percent Removal*		
	Primary Treatment	*Secondary Treatment*	
		Activated Sludge	*Trickling Filter*
BOD	42	89	69
COD	38	72	58
TSS	53	81	63
NH_3--N	18	63	---
Phosphorus	27	45	---
Oil and grease	65	86	---
Arsenic	34	83	---
Cadmium	38	28	---
Chromium	44	55	5
Copper	49	70	19
Iron	43	65	56
Lead	52	60	46
Manganese	20	58	40
Mercury	11	30	16
Selenium	0	13	0
Silver	55	7	---
Zinc	36	75	55
Color	15	55	56
Foaming agents	27	---	---
Turbidity	31	---	---
TOC	34	---	---

Source: Water Reuse. Assessment Report Project 92 WRE-1. Environment Research Foundation 1994.

E.3. Removal of Microorganisms

Expected Removal of Excreted Microorganisms in Various Wastewater Systems

Treatment Process [(a)]	**Removal (log 10 units)**[(i)]			
	Bacteria	**Helminths**	**Viruses**	**Cysts**
Primary sedimentation				
Plain	0-1	0-2	0-1	0-1
Chemically assisted[(b)]	1-2	1-3[(h)]	0-1	0-1
Activated sludge[(c)]	0-2	0-2	0-1	0-1
Biofiltration[(d)]	0-2	0-2	0-1	0-1
Aaerated lagoon[(d)]	1-2	1-3[(h)]	1-2	0-1
Oxidation ditch[(c)]	1-2	0-2	1-2	0-1
Disinfection[(e)]	2-6[(h)]	0-1	0-4	0-3
Waste stabilization ponds[(f)]	1-6[(h)]	1-3[(h)]	1-4	1-4
Effluent storage reservoirs[(g)]	1-6[(h)]	1-3[(h)]	1-4	1-4

Notes: (a) Conventional filtration is not included among the processes in the original table.
(b) Further research is needed to confirm performance.
(c) Including secondary sedimentation.
(d) Including settling pond.
(e) Chlorination or ozonation.
(f) Performance depends on number of ponds in series and other environmental factors.
(g) Performance depends on retention time, which varies with demand.
(h) With good design and proper operation, the recommended guidelines are achievable.
(i) A log 10 removal represents a 90 percent reduction; 2 log 10 units represents 99 percent removal.

Source: E.P.A. Manual Guidelines for Water Reuse, Sept. 1992.

F. PERSONNEL

F.1. NUMBER OF STAFF

Number of staff as a function of:

- staff per thousand water connections (W/000) or per thousand water plus sewerage connections ([W + S]/000).
- thousands of m^3 of water sold per year per staff (m^3[000]/staff).
- kms. of pipes in the water supply system per staff (km/staff).
- persons served [thousands] per staff (PS [000]/st).

Country/ City	*Year*	*Staff Ratios*				
		W/000	*W+S/000*	*000M³/staff*	*km/staff*	*000 PS/st*
Belarus						
• Minsk	1993	n.a.	n.d.	56	n.d.	0.7
• Gomel	1993	n.a.	n.d.	20	n.d.	0.3
Belgium, Brussels	1992	3.2	n.d.	105	3.3	3.0
Brazil (average)	1989	6.5	5.0	47	1.9 **a/**	0.8
• Brasilia	1989	13.5	7.1	54	1.3 **b/**	0.7
• Sao Paulo	1993	5.1	3.1	n.d.	2.1	0.8
Canada (average)	1984	2.0	n.d.	424	n.d.	1.7
Chile, Santiago	1990	2.1	1.1	191	4.1	2.5
Colombia, Bogota	1994	3.6	1.8	106	1.1	1.7
France, C. Banlieue	1987	4.5	n.a.	200	n.d.	2.2
Guinea (average)	1993	15.0	n.d.	8	n.d.	n.d.
Ivory Coast (average)	1995	4.8	n.d.	22	n.d.	n.d.
Japan (average)	1990	1.7	n.a.	n.d.	7.0	1.7
Macao	1991	2.2	n.a.	148	n.d.	n.d.
Mexico, Monterrey	1987	4.1	2.2	86	2.2	1.5
Romania, Bucharest	1994	n.a.	n.d.	75	n.d.	0.5
Senegal (average)	1993	8.6	n.d.	13	n.d.	n.d.
Spain						
• Alicante	1987	1.1	0.6	170	n.d.	1.9
• Murcia	1992	2.5	n.d.	165	4.9	1.6
Togo	1990	22.4	n.d.	26	3.3	0.5
Turkey, Bursa	1992	4.6	n.d.	40	0.4	0.9
USA (average)	1990	2.7	n.d.	370	8.6	1.5

n.d. = data not available;
n.a. = not applicable.
Notes: a/ 1.3 water units and 1.7 sewerage units per connection.
b/ 2.3 water units and 2.4 sewerage units per connection.

F.2. Staff Composition

Country/City	*Category/Level Percentage of Labor Force*			
	Management	*Professional*	*Clerical*	*Blue Collar*
Brazil (range)	0.1 - 0.4	7 - 9	17 - 44	46 - 76
• Brasilia	0.2	12	24	64
Chile, Santiago	3	18	37	42
Macao	25		75	

F.3. Training Effort

Country/City	*Year*	*Training*
Chile, Esval-Valparaiso	1992	41% staff trained/yr 1.2 days/staff/yr
France, C. Banlieue	1987	4% of salaries

G. MISCELLANEOUS INDICATORS

G.1. Vehicles/1000 Water Connections

This indicator includes all types of vehicles used in the operation and maintenance of the utility's system. When the utility also provides sewerage services the subscript (w + s) is added next to the figure.

Country/City	*Year*	*Vehicles/1000 connec*
Spain,		
• Murcia	1992	0.9 (w)
• Alicante	1992	0.6 (w)
Chile, Valparaiso	1992	0.4 (w+s)
Washington, WSSC	1992	0.6 (w+s)

G.2. Meter Reading

Number of consumption meters read per day per reader.

Country/City	*Meters read per day/reader*
Spain, Murcia (1992)	215
France (1986)	80 - 200

G.3. Meter Maintenance & Replacement Practices

Country	**Meter Replacement in Years**
Macao (1991)	15
Singapore (1991)	7 (domestic) 4 (large)

Country	**Meter Testing**		**Replacement**	
	Diameter (")	**Years**	**Diameter (")**	**Years**
USA (1984)**a/** (average) **1/**	5/8 -- 3/4	9	5/8 -- 3/4	17
	1	7	1	16
	4	4	4	13
	6	3	6	12
	8	3	8	11

1/. Meter costs are coming down. Therefore, in many cases it is most cost-effective to replace meters than to repair them.

Source: a/ AWWA, opus cit.

INDICATORS
2nd EDITION

WATER & WASTEWATER UTILITIES

SET II

FINANCIAL INDICATORS

INTRODUCTION

Only a selected group of financial indicators is presented in this report, since the objective is not to overwhelm the reader with information that, in most cases, is unlikely to be of relevance.

The technique of ratio analysis is a useful tool to analyze a utility's financial position. Ratio indicators presented here provide information about efficiency and operational performance, credit worthiness and liquidity and profitability. As such they provide insight into areas that merit further investigation but they do not, in themselves, provide definitive answers on the financial condition of a given utility. Some ratio indicators, such as contribution to investment and rate of return, can be very volatile from one year to the next. Therefore, to present a more realistic picture, they have been calculated as an average over an arbitrary three year period. Otherwise, the indicators reflect a one year performance, based on information available between 1988 and 1994.

The utilities represented in this paper are from Latin America, Africa, Europe/Central Asia, and South and East Asia. Sources of the data collected are recent Staff Appraisal Reports, Project Completion Reports and the utilities' annual financial reports. The sample was selected taking into consideration diversity in geographical location, type and size of the utilities and service provided by them. Not surprisingly, complete information needed to calculate all ratios was not available for all the utilities. Therefore, some of the tables and graphs present information only of a selected group of utilities.

For the purpose of comparison, information of W&S utilities in industrialized countries is presented in certain graphs and tables. Unfortunately, pertinent financial information available from these utilities is often consolidated thus making it impossible to obtain many of W&S financial indicators reported here for other utilities.

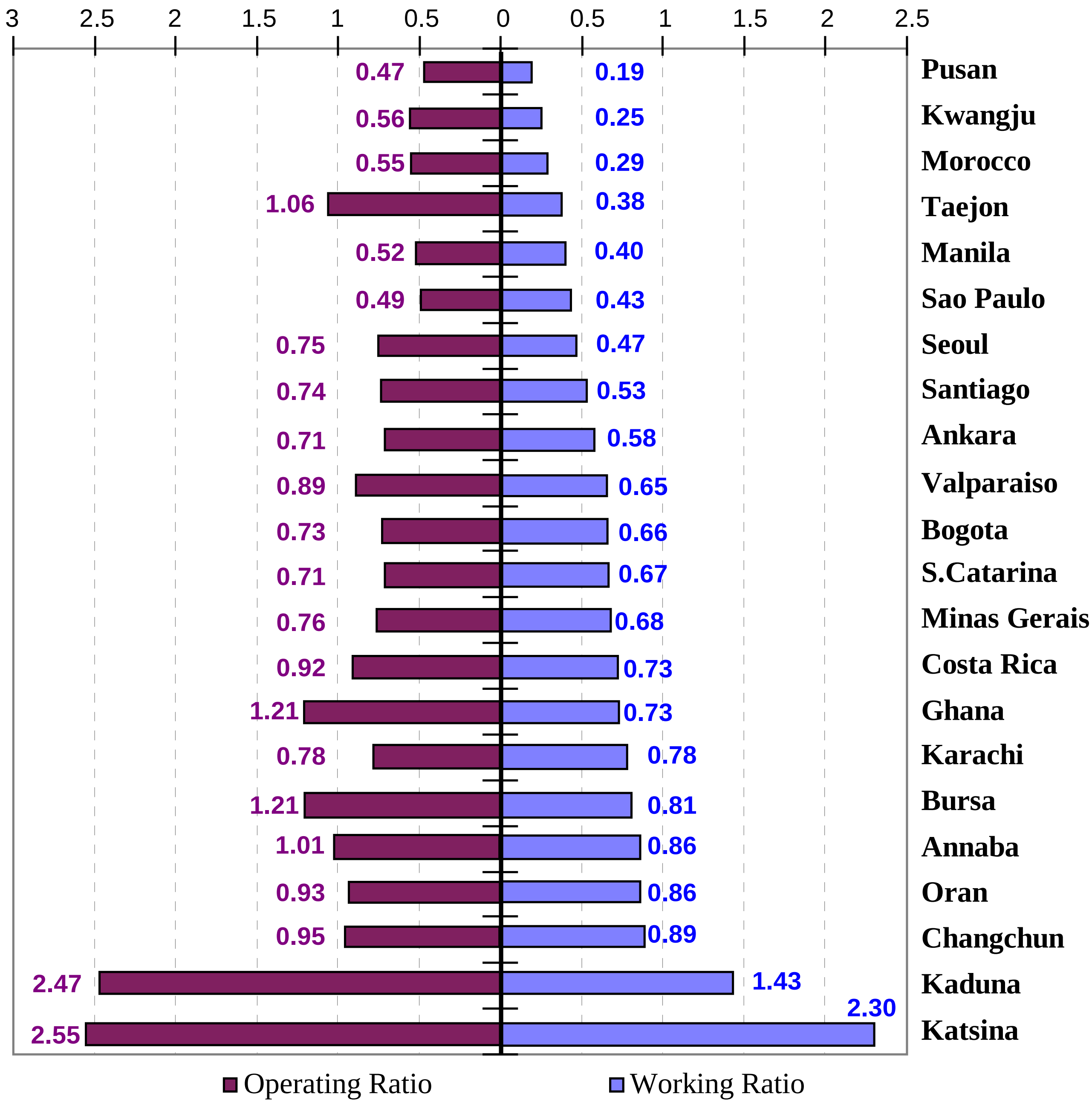
All monetary values are expressed in US dollars. The exchange rates used for conversion are the average annual exchange rates for each country as reported by the International Finance Statistics of the IMF.

A. EFFICIENCY INDICATORS

A.1. WORKING RATIO (WR)

The WR is the ratio of operating costs to operating revenues. Operating costs in this ratio exclude depreciation and interest payments (but no debt service payments), a key difference with the Operating Ratio (OR) that includes these costs. Operating revenues remain the same for both ratios. They include revenues from water and sewerage tariffs, connection fees, well abstraction fees and re-connection fees.

Working Ratio and Operating Ratio



Sound financial management requires the WR to be well below 1. About 30% of the utilities have a WR lower than 0.50; and two utilities (9%) have a ratio larger than 1. The four Korean sewerage companies are among the utilities that have a WR lower than 0.5. Otherwise, it does not seem to be any significant difference in working ratios between companies that provide W&S services and those that provide only one of these services.

Caution should be used in interpreting this ratio when there is evidence that utilities are cutting down on maintenance costs which would improve the WR but could lead to critical situations in the future.

A.2. OPERATING RATIO (OR)

The OR is the ratio of operating costs to operating revenues. In this case, operational costs include all the expenses together with depreciation and interest costs (but no debt service payments).

Sound financial management requires that this ratio should also be less than 1. Nine utilities (41%) have an OR less than 0.75, 32% an OR between 0.75 and less than 1 and 27% an OR greater than 1. The latter utilities, as in the case of Ghana and Nigeria, must rely on government subsidies to cover their operational expenses.

The same cautionary note made to the WR applies to the OR. In addition, caution should be exercised when assets are not revalued and therefore depreciation charges do not give a realistic value or when revaluation of assets is not consistently applied.

There does not seem to be any significant difference in ORs between companies that provide W&S services and those that provide only one of these services. Interestingly enough most of the utilities that have an OR larger than 1, also have an average UFW ratio larger than 40%.

A.3 ACCOUNTS RECEIVABLE/COLLECTION PERIOD (CP)

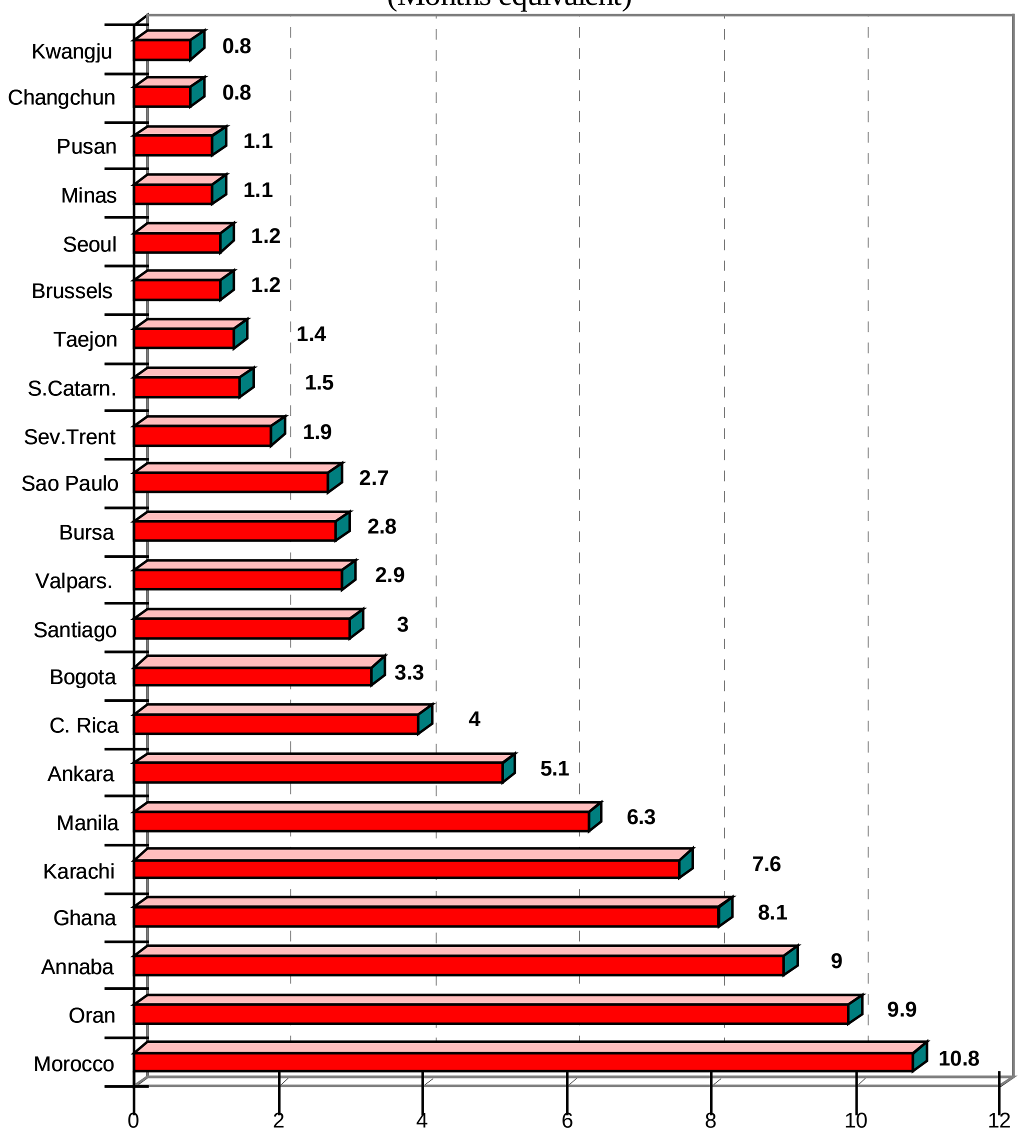
This indicator, expressed in month equivalent of sales, is the ratio between the year-end accounts receivable and operating revenues, multiplied by 12.

Of the 22 utilities with information on accounts receivable, 41% have collection periods of less than 2 months, 20% between 2 and 4 months, and 30% more than 4 months.

When the CP is increasing the company' cash flow can be in jeopardy. This is specially of concern in countries where inflation is high, where no charges are levied against late payment or when these charges do not reflect the financial cost of borrowing money.

Poor collection efficiency is mostly blamed on consumers, and in some cases in particular on public sector agencies. However, the water utility may also be at fault for delayed and faulty billings, inadequate responses to consumer's queries on billings, and a lukewarm effort to collect overdue accounts. A common factor found among the utilities with poor collection efficiency is the lack of a clear policy to promote and enforce prompt payment (like disconnecting the service to consumers with arrears of more than 2 to 3 months).

Accounts Receivable/Collection Period
(Months equivalent)



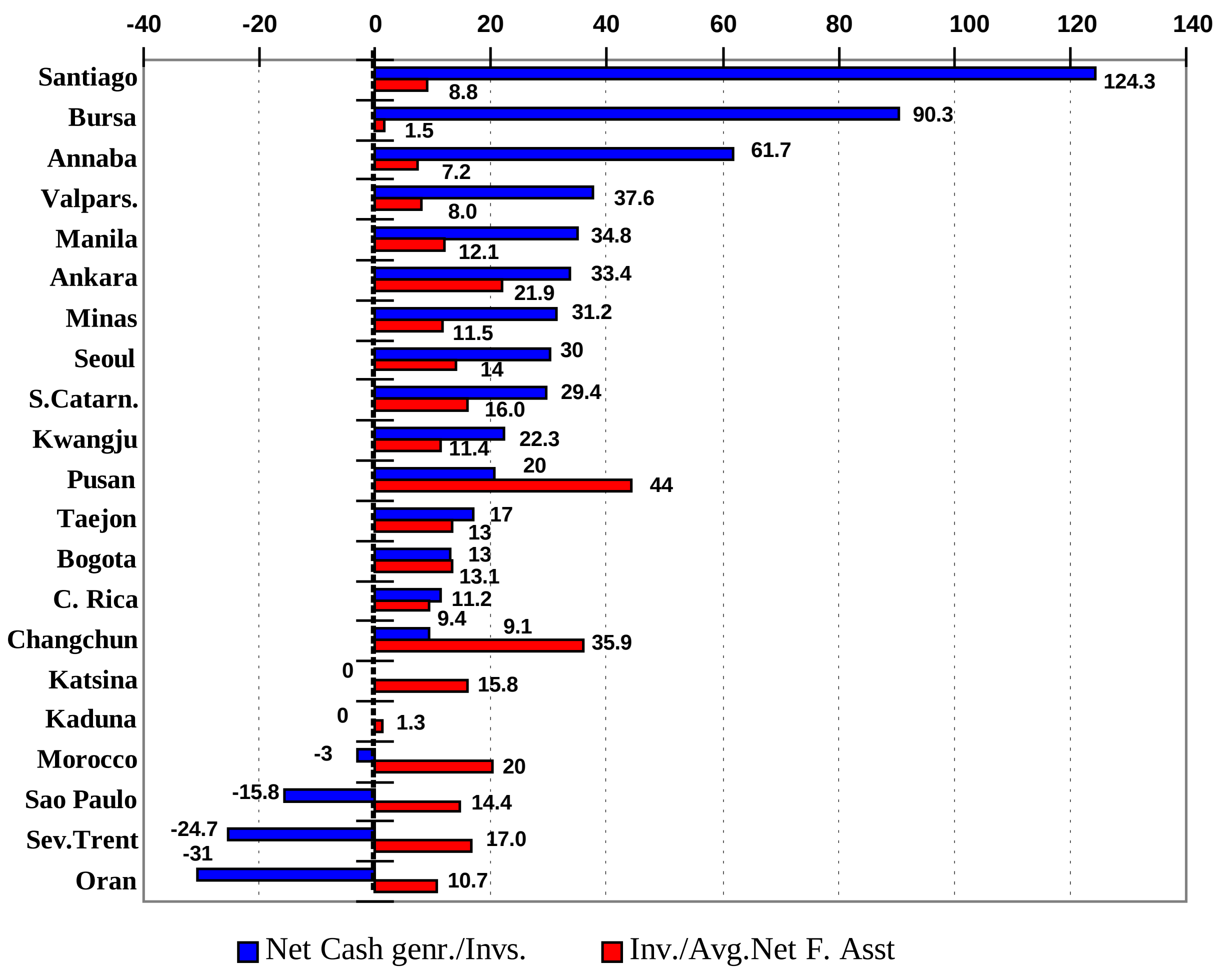
A.4. PERCENTAGE CONTRIBUTION TO INVESTMENT (CTI)

The percentage contribution to investment shows the proportion of capital expenditures financed by the net internal cash generated by the utility. This ratio is often calculated on a yearly basis and therefore depends on the annual cash flow of the utility. As a consequence the CTI ratio, calculated on a yearly basis, can vary widely. Thus, to present a more balanced picture, the CTI has been calculated as the cash contribution over an arbitrary **three year period**.

To provide a sense of the magnitude of investments, this ratio is contrasted with the relative value of new investments to fixed assets over the same period. In general, the data suggest, and not surprisingly, that utilities with relatively large investments have lower CTI ratios.

For the utilities with information available, the overall average contribution to investment rate is 40% and the investment over net fix assets is 13%. Twenty five percent have a negative or 0 CTI, 35% have CTI of less than 30%, 25% between 30 and 50% and 15% CTIs larger than 50%.

Percentage Contribution to Investment

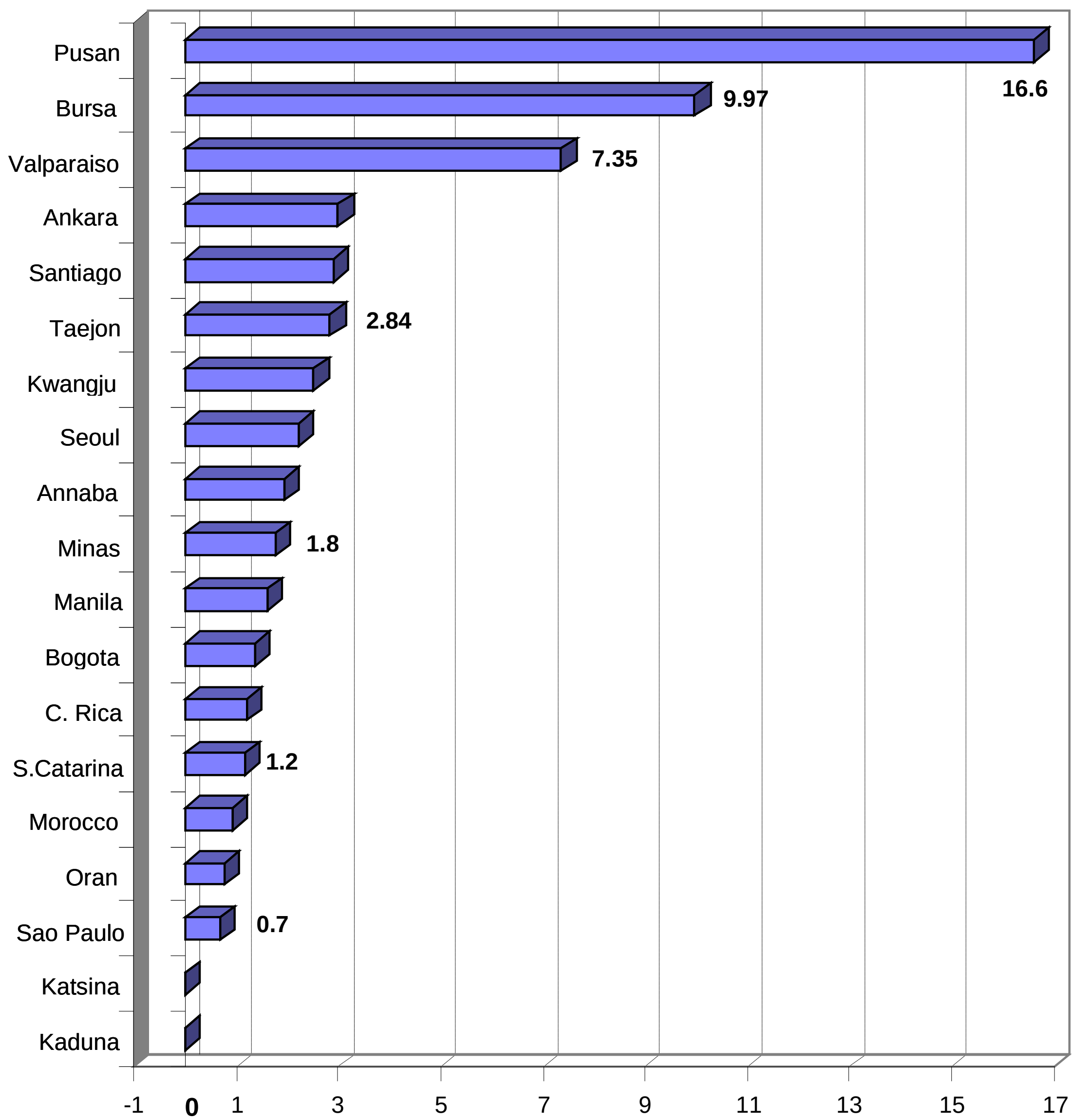


B. LEVERAGE INDICATORS

B.1 DEBT SERVICE COVERAGE RATIO (DSC)

The debt-service-coverage ratio measures the extent to which internal cash generation covers total debt service.. As with the CTI indicator, the DSC has been calculated as the average of the **last 3 years** of information available.

Thirty three percent of the utilities in the sample have a DSC less than 1; that is, their cash generation is not adequate to cover debt service obligations, 28% have a DSC between 1 and 2 and 38% a DSC larger than 2.



The last two utilities in the graph show a negative ratio.

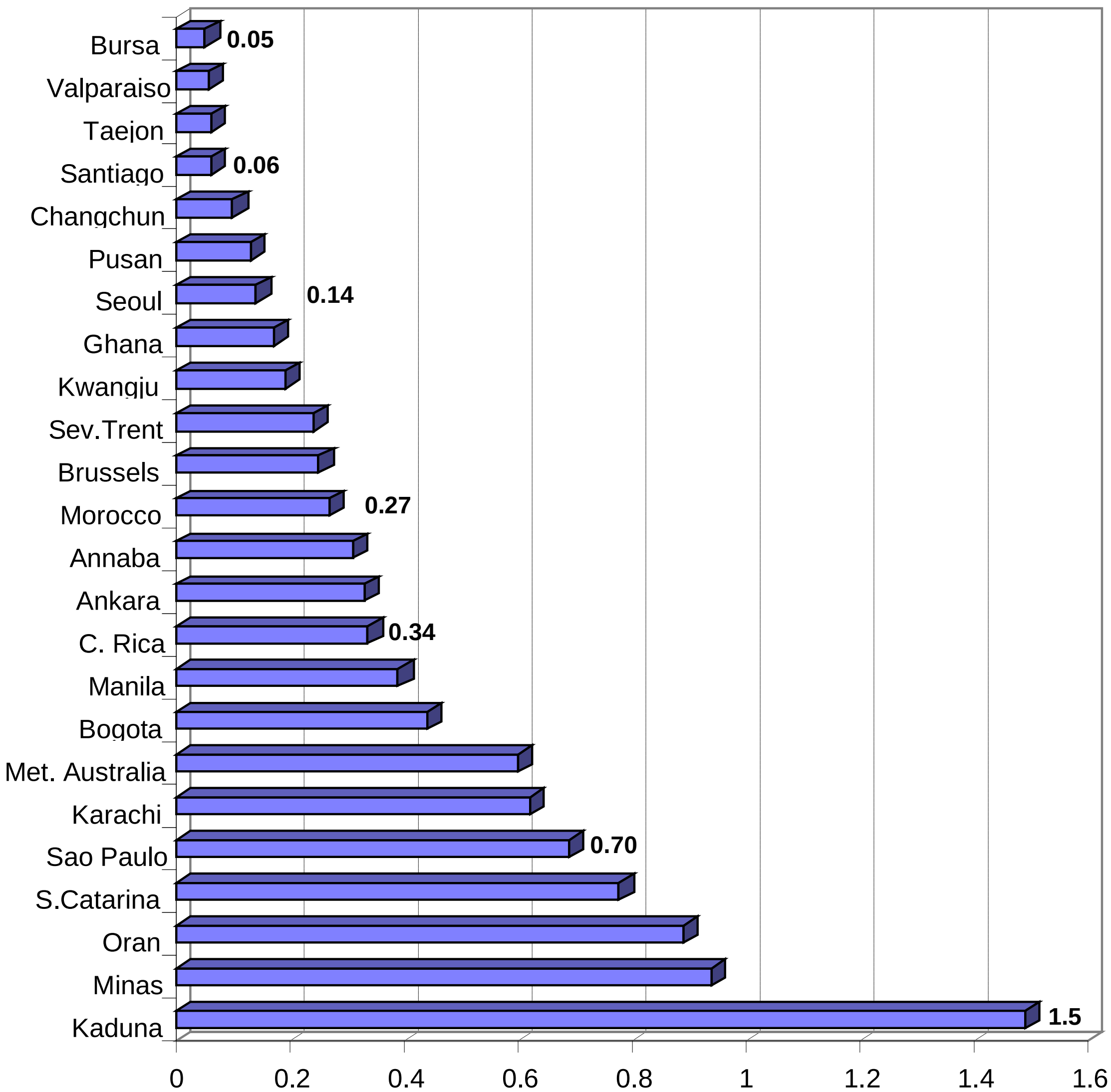
B.2 Debt Equity Ratio (DER)

This ratio is defined as Total Debt/Equity. The average DER for the sample of utilities is 0.40 which is considered quite acceptable; 29% of the utilities show a debt situation that is highly leveraged (over 0.50 and up to 1.50).

Two water utilities in industrialized countries, Severn Trent in England (private) and the water utility of Brussels (public) both report a DER of 0.25.

Not surprisingly, when comparing Graphs 3, 4, and 5 we find that utilities with the highest debt service coverage ratio also have the lowest debt equity ratio.

DER is also affected by the revaluation of fixed assets and therefore caution should be exercised when using this ratio.

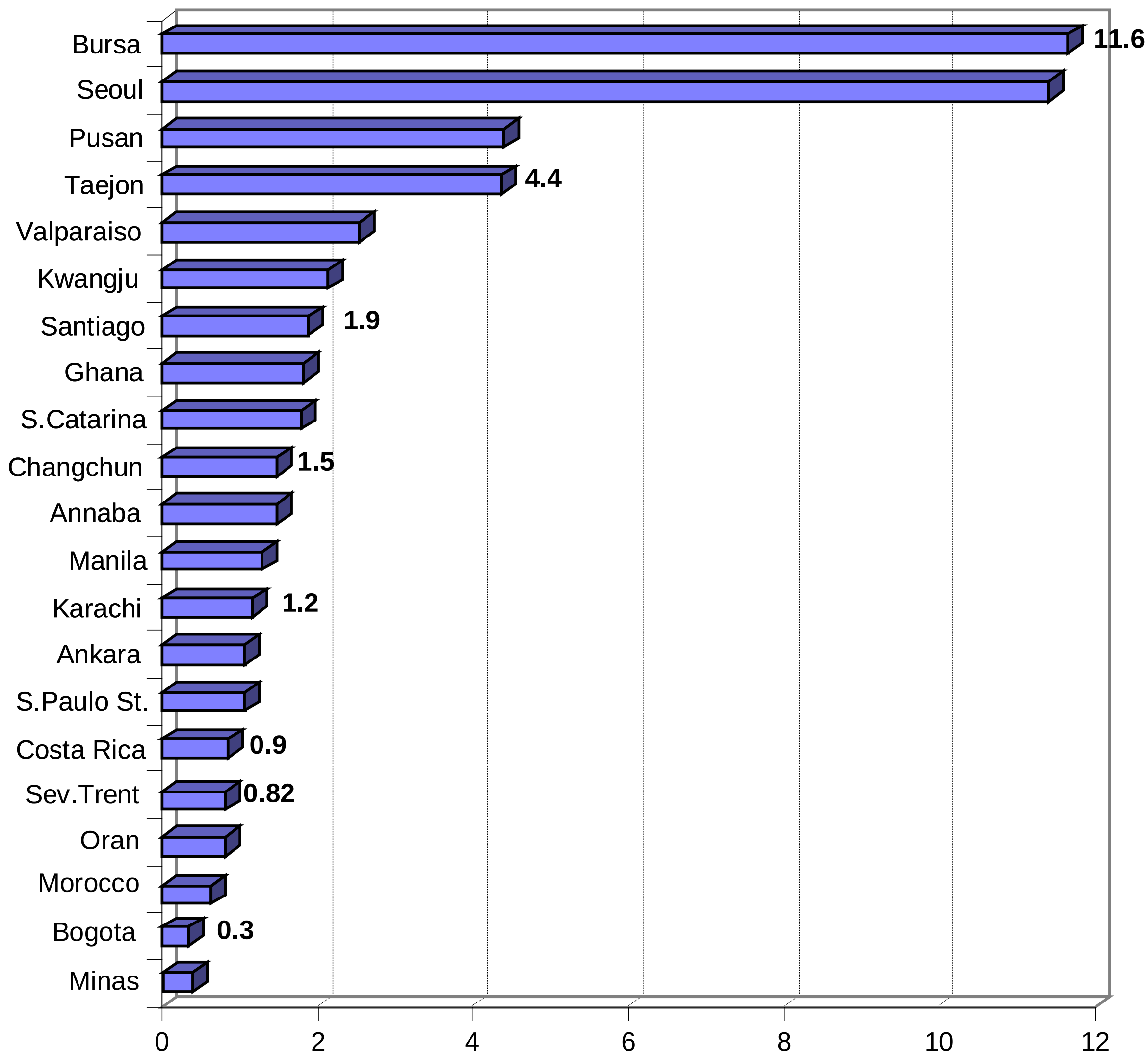


C. LIQUIDITIY INDICATOR

C.1. CURRENT RATIO (CR)

This ratio is computed by dividing current assets by current liabilities. Current assets include cash, accounts receivable and inventories. The CR measures the short-run paying ability of the utility.

From the data we observe that 75% of the utilities have a current ratio of less than one, e.g., most do seem to have short-term liquidity problems. However, this observation should be taken with caution as this ratio does not provide information on utility's capacity to pay and collect its bills promptly. Such is the case of Ghana, for example, which has a CR of almost 2 and a collection period of 8 months.



D. PROFITABILITY INDICATORS

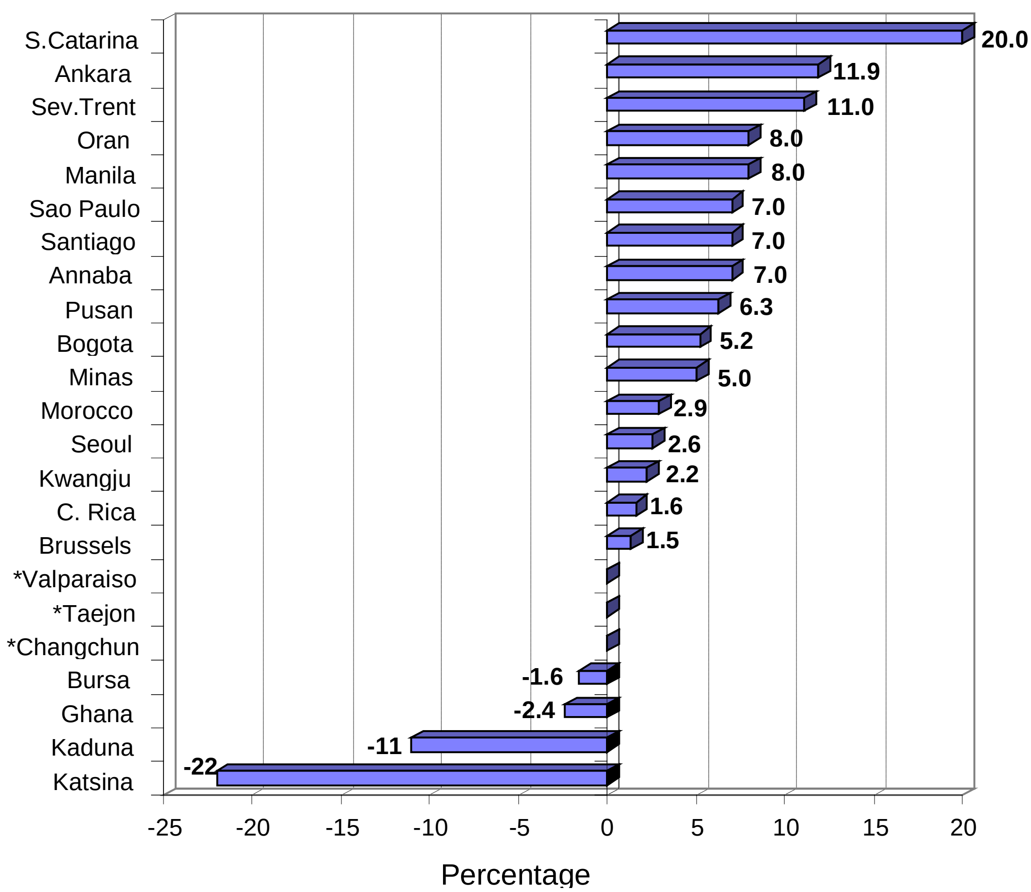
The ratios examined thus far provide some information about the operations of the utility. Profitability ratios on the other hand show the combined effects of liquidity, asset management and debt management on operating results.

D.1. RETURN ON NET FIXED ASSETS (RR)

This indicator measures the productivity of fixed assets in use, expressed as the ratio between net operating income and net fixed assets. The RR has been calculated as the average over a **three year period**.

The median RR of the 18 utilities is 3%; 29% of the utilities report a negative RR, another 29% a RR between 0 and 5%, 27% a RR between 5 and 10% and 13% a RR higher than 10%.

However, we should be cautious when comparing this ratio since it runs into the problem mentioned before related to the revaluation of fixed assets. In addition, it is not uncommon to observe that it would be in the interest of an utility to undervalue its fixed assets in order to meet or show a higher RR target. On the other hand, it is also quite common to find in balance sheets an account "work in progress" which very often includes a large portion of works completed but which are not included in the RR calculation. For instance, EAAB-Bogota reports 17% of its fixed assets as work in progress, while EMOS-Santiago reports 5%.



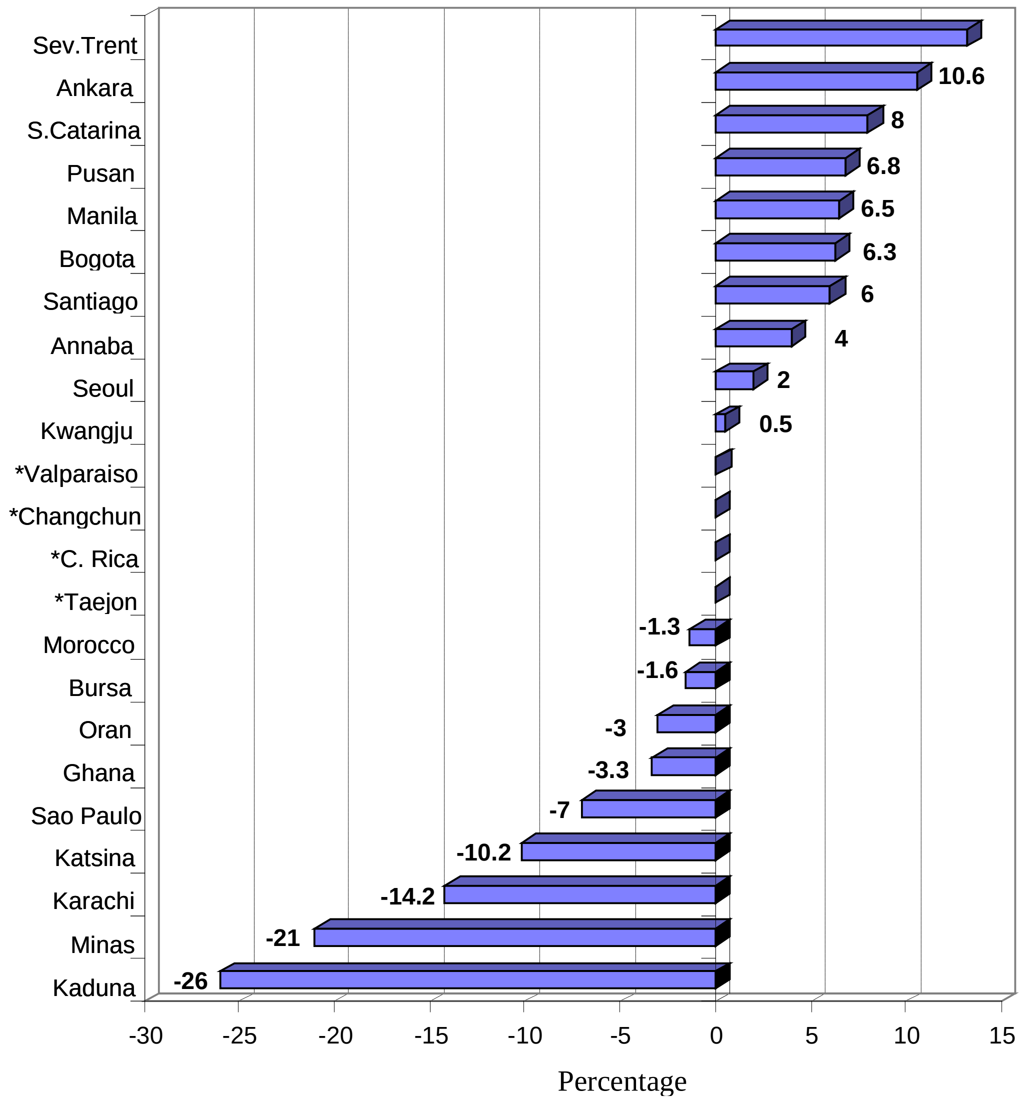
* Slightly negative.

D.2. RETURN ON EQUITY (RE)

Return on equity shows the return to the owners, expressed as the relationship between net income (net income after interest payments) and equity (total assets minus liabilities). As for the RR the RE has been calculated as the **average for three years**. The RE also suffers from the problems associated with the revaluation of fixed assets which would lower the value of equity which in turn would increase the RE.

The median RE is 0%; 58% of the utilities show a negative RE, 8% a RE between 0 and 3% and 25% a RE between 3 and 10%. Only two utilities shows a RE larger than 10%.

The RR and REs behave, in general, in a similar way. However, five utilities (Karachi, Sao Paulo, Minas, Oran and Morocco) show completely opposite results in both ratios. This is explained by its low contribution to investment ratio and thus a high debt to equity ratio.



* Slightly negative.

E. OPERATIONAL RATIOS

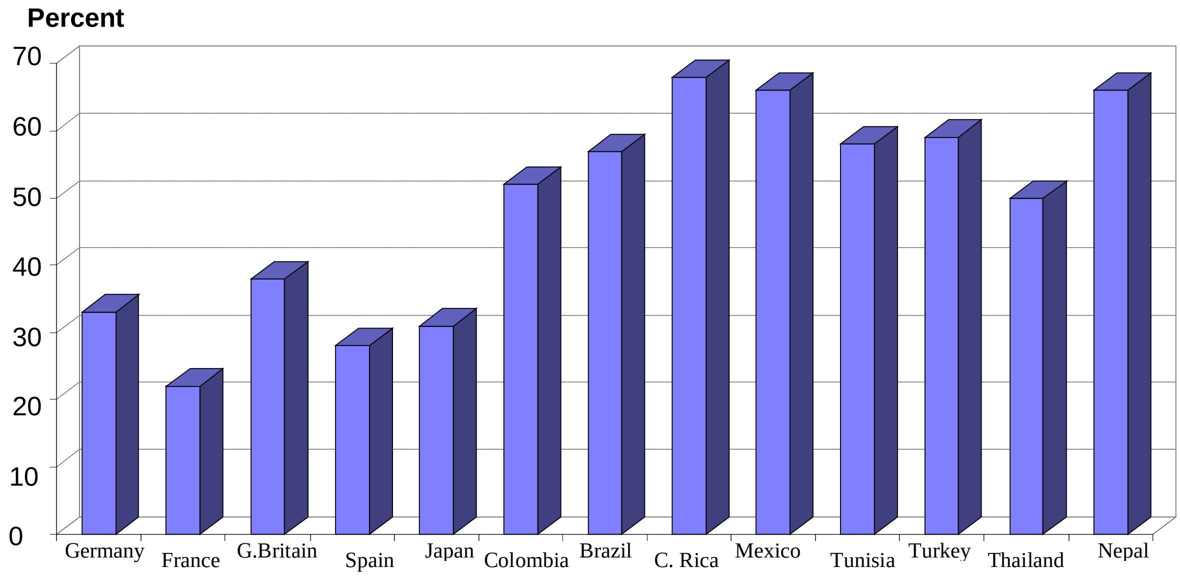
E.1. Personnel

E.1. 1 Personnel Costs

Personnel costs are expressed as a ratio to total operating costs (depreciation and debt service excluded). Depreciation and debt service are excluded due to lack of uniformity in treating revaluation of fixed assets and to facilitate comparison of utilities with and without debt service obligations.

As indicated in Infrastructure note W5 - 12 (Annex 2), staff productivity index (See E.1.2 below) and personnel costs related to operational costs should be examined simultaneously.

Personnel Costs vs. Operating Costs



E.1.2 Staff Productivity Index (SPI)

This ratio is an important measure of the efficiency of a water and/or sewerage utility. It relates the number of staff with the number of connections.

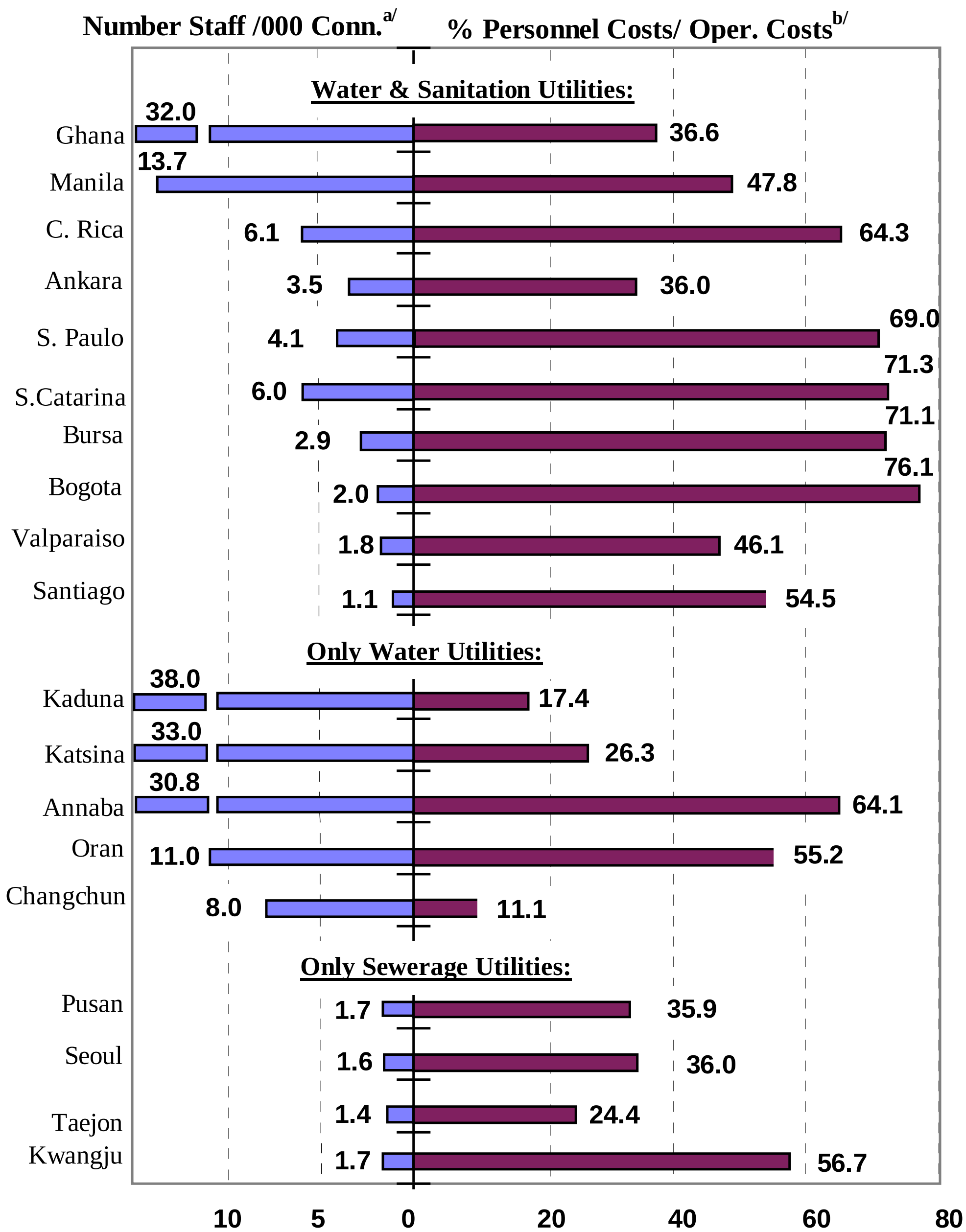
Sixty percent of the utilities with W&S services have a SPI of 4 or less ([w + s] connections), 20% between 4 and 7 and 20% more than 7. The SPI for utilities in some African utilities, that only provide water services is extremely high (over 30 [w] connection). The four sewerage utilities of Korea, on the other hand, have very low SPI's of under 2 ([s] connection).

As a guideline, it would appear that a SPI of less than 4 could be considered adequate but still with room for improvement.

In some cities, particularly in Eastern Europe, residential consumers live in large apartment buildings where consumption in apartments is not individually metered. In similar circumstances, the practice in Brazil is to report simultaneously the number of apartments (*economías*) and the number of connections. In these cases this SPI index may not be particularly meaningful. Alternative indicators, to handle this situation, can be found in Set I, Section F.1.

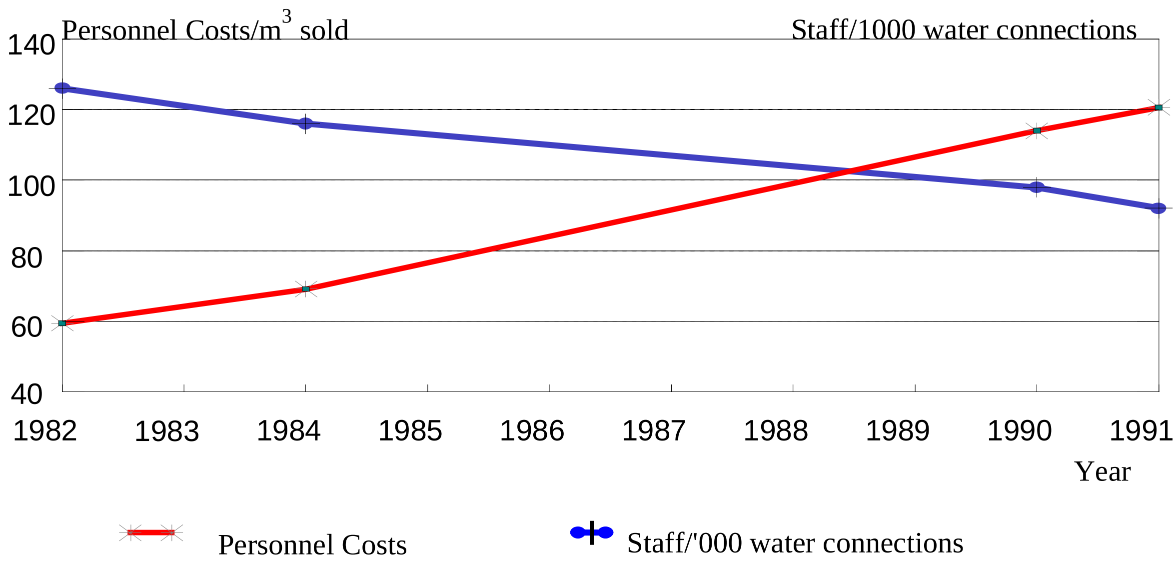
It is also important to remember that a reduction in the SPI ratio cannot necessarily be interpreted as an increase in efficiency. To complete the analysis of staff productivity, as mentioned previously, expenditures on personnel also need to be examined (**personnel costs as a % of operational costs**). There have been cases of utilities with staff/connection ratios decreasing while staff costs, in proportion to operating costs, are increasing as shown in Graph I. In addition, it is also important to examine the staff composition which might show important imbalances or inadequate number of qualified middle-level managers and technical staff.

Not surprisingly, utilities with large personnel costs show a low contribution to investments and a low debt service coverage ratio (Set II A.4 and B.1), such as in Sao Paulo and Costa Rica.



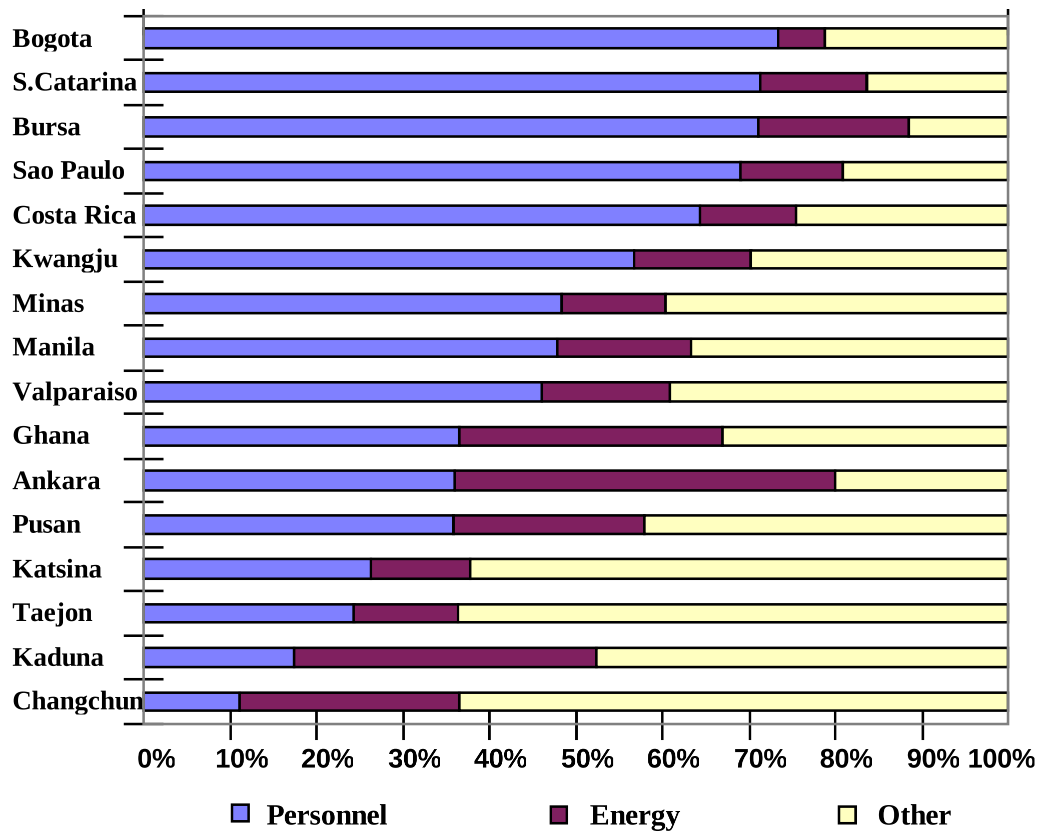
Notes: a/ Includes water and sewerage connections for W&S Utilities
b/ Operational Costs exclude Depreciation and Debt Service.

Graphic I
Number of Staff/'000 Connections vs.
Personnel Costs/m^3 Sold
Bogota (1982-1991)



E.2 Composition of Operational Costs

The two main categories of operating costs are often personnel and fuel/energy consumption. Other operating cost components include chemicals, maintenance and miscellaneous. Depreciation charges are not included.



Range of Operational Costs

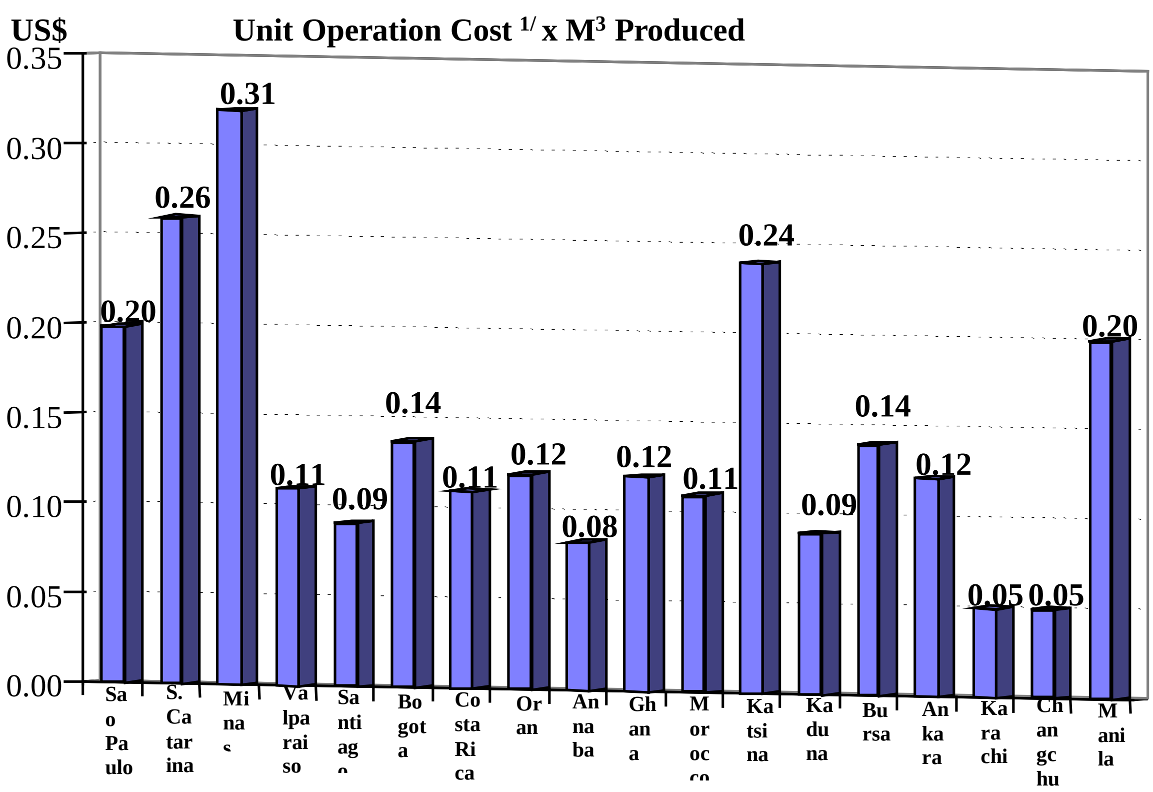
	Low Value	*Average Value*	*High Value*
Personnel	11.1 %	46.0 %	73.4 %
Energy	5.3 %	18.4 %	44.0 %
Other	11.5 %	35.6 %	63.6 %

No information is available for industrialized countries for comparison purposes. Because operating costs are utility specific and given the paucity of data at this time, any further elaboration at this point is not warranted.

E.3. UNIT OPERATIONAL COST (UOC)

Unit operational cost (operational costs[1/] / m^3 produced) varies from US$0.05 per cubic meter in Karachi and Changchun to US$0.31 per cubic meter in Minas Gerais. About 28% of the utilities have an UOC below 10 cents per cubic meter, 44% an UOC between 10 and 20 cents per cubic meter, and 28% an UOC of 20 cents or higher.

Contrary to what could be expected, we do not see evidence, in this sample, that large utilities have lower UOCs. This could be explained, in part, by specific site conditions and by wide variations of domestic costs and price levels in the different countries. We believe, however, that major differences in UOC can be explained by the quality of service provided by the utilities.



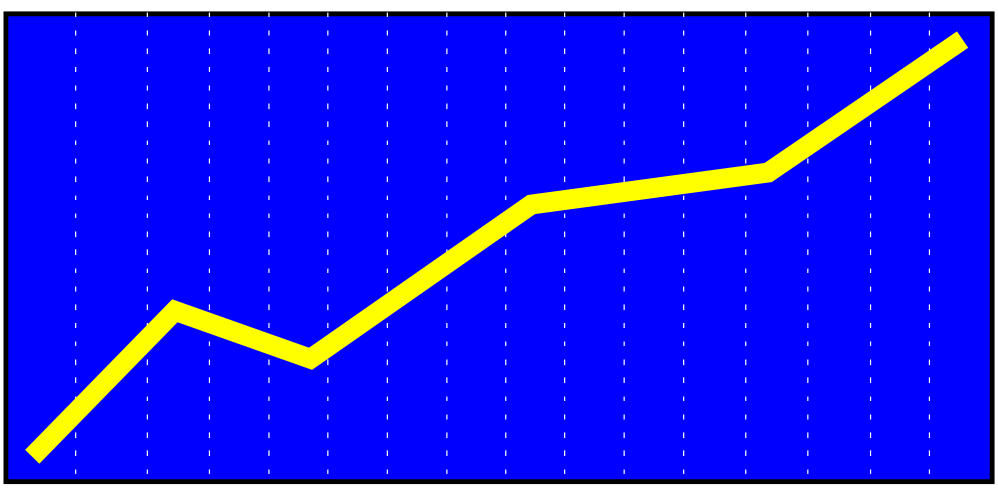
[1/] Excluding depreciation.

INDICATORS
2nd EDITION

WATER & WASTEWATER UTILITIES

SET III

OVERVIEW OF TARIFF RATES AND STRUCTURES



OVERVIEW OF TARIFF RATES AND STRUCTURES

A. 1 BACKGROUND

An overview of water and sewerage tariff rates and structures, from a sample of 9 cities[1] believed to be representative of practices in developing countries, is presented in this section. This overview provides some insights into how rates are structured and offers some recommendations (based on hypotheses that need further testing), into the problems such structures may be causing and pitfalls to avoid. This overview is thus a complement to the set on financial ratios but is not intended to be a thorough discussion of pricing issues.

An understanding of the implications of tariff structures and of the possible distortions that they may be causing is an important step in the design of an strategy and action plan to improve the financial position of a utility based on sound economic principles.

A. 2 TARIFF STRUCTURE

Satisfactory tariff levels must provide adequate funds to meet operations, debt service and capital expansion requirements. Tariffs should also encourage efficiency in the use of resources; and many would argue, on fairness grounds, that the tariff structure should make these services affordable by the poor. Reconciliation of all these objectives remains an elusive task.

All tariff rates, except Singapore and Ankara, reviewed here have two components: a fixed charge and a volumetric charge (related to consumption). The first is often intended to cover the fixed costs of the utility and the second the variable ones. In addition, most tariff rates are progressive, e.g., the volumetric charge increases as consumption increases.

Rate progressivity is often the result of the decision to provide a cross-subsidy from some, presumably wealthy, groups to other groups with a more limited capacity to pay (the poor, schools, hospitals, etc.). More recently, rate progressivity has found its defenders among those interested in promoting water conservation. Whatever the argument, progressivity introduces economic distortions in the use of water, which need to be but are often poorly understood. In addition, low rates often discourage utilities from reaching the poor or reducing UFW.

Most utilities in the sample have also flat charges, independent of consumption, either by design or fiat (when meters are not installed or operative) to deal with non-metered consumption. None of the utilities in this sample fully meters consumption.

In all documented cases here, sewerage charges are a fixed percentage of the water charges. These charges range from a low 18% in San Jose to 100% in Santa Catarina. The

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[1] Ankara, Bogota, Ghana, Manila, San Jose, Santa Catarina, Sao Paulo, Singapore and Seoul.
Sources for the data on water tariffs are Staff Appraisal Reports and from the Asian Development Bank publication "Water Utilities Data Book" (for Singapore, and Seoul).

average lies around 40% to 50%[2] . In some cases, like Ankara, the tariff charged for water also covers sewerage services.

A. 3 DOMESTIC TARIFF

All the utilities in this sample have a progressive tariff structure (normally 3-4 block rates up to about 60 m^3 of consumption per month per connection-m^3/m/c). Rate progressivity applies also to non-residential users.

As shown in Graphs A, B, C and D, we find that:

- there seems to be little consistency in how consumption block intervals are established;
- all utilities offer a subsidized base line consumption, intended to benefit some residential users. This base line is in the range of 5 to 20 m^3/m/c;
- relatively high fixed charges imposed on base line consumption often negate the subsidy intended (Graphs F, G, and H). Fixed-charges are also applied to non-residential users, but most often they are set at higher levels;
- if 20m^3 per month is taken as a reasonable household consumption in developing countries, household payment for this volume ranges from US$2 to US$12 per month. As a way of comparison, households in some European cities pay for this consumption (1991): US$2.60 in Milan, US$5.40 in Rome, US$14.40 in Paris, and US$29.60 in Brussels (Table 3);
- for unmetered connections, the utility often makes an estimate of the monthly consumption based on past consumption patterns or other criteria and charges a corresponding, de facto, fixed charge.

[2] It should be noted that the outcome is that incremental costs of sewerage, which are 1.5 to 3 times those of water, are even less well covered by user charges than water supply costs.

Table 3

Comparison of annual water charges in industrialized countries for a family of four in a house and consuming 200 m^3/year [137 liters/capita/day] (prices in 1991 US dollars)

Country/City	Charge US$/$m^3$
Austria	
• Linz	0.64
• Salzburg	0.99
• Vienna	1.07
Belgium	
• Antwerp	0.68
• Brussels	1.48
• Liege	0.93
Denmark	
• Aarhus	0.72
• Copenhagen	0.60
• Odense	0.65
Finland	
• Helsinki	0.94
• Tampere	1.01
France	
• Banlieue/Paris	1.46
• Lyon	1.52
• Marseille	1.20
• Nice	1.51
• Paris	0.72
Germany	
• Berlin	1.00
• Dusseldorf	1.56
• Frankfurt	1.66
• Gelsenwasser	1.95
• Hamburg	1.59
• Munich	1.05
• Stuttgart	1.79
Hungary	
• Budapest	0.21
• Miskolc	0.72
• Pecs	0.86
Italy	
• Bologna	0.49
• Milan	0.13
• Naples	0.62
• Rome	0.27
• Turin	0.25
Japan	
• Nagoya	0.41
• Osaka	0.25
• Sapporo	0.57
• Tokyo	0.45
• Yokohama	0.41
Luxembourg	
• Luxembourg	1.34
Netherlands	
• Amsterdam	0.94 a/
• The Hague	1.17
• Utrecht	0.57
Spain	
• Madrid	0.84
• Barcelona	0.90
• Seville	0.51
• Alicante	0.46
• Murcia	0.98
Switzerland	
• Berne	0.63
• Geneva	2.12
• Zurich	1.63
United Kingdom b/	
• Bristol	1.23
• Cardiff	1.72
• London	0.88
• Manchester	1.29
• Newcastle Upon Tyne	1.37
Low Value (Milan)	US$ 0.13 /m^3
Average	US$ 0.96 /m^3
High Value (Geneva)	US$ 2.12 /m^3

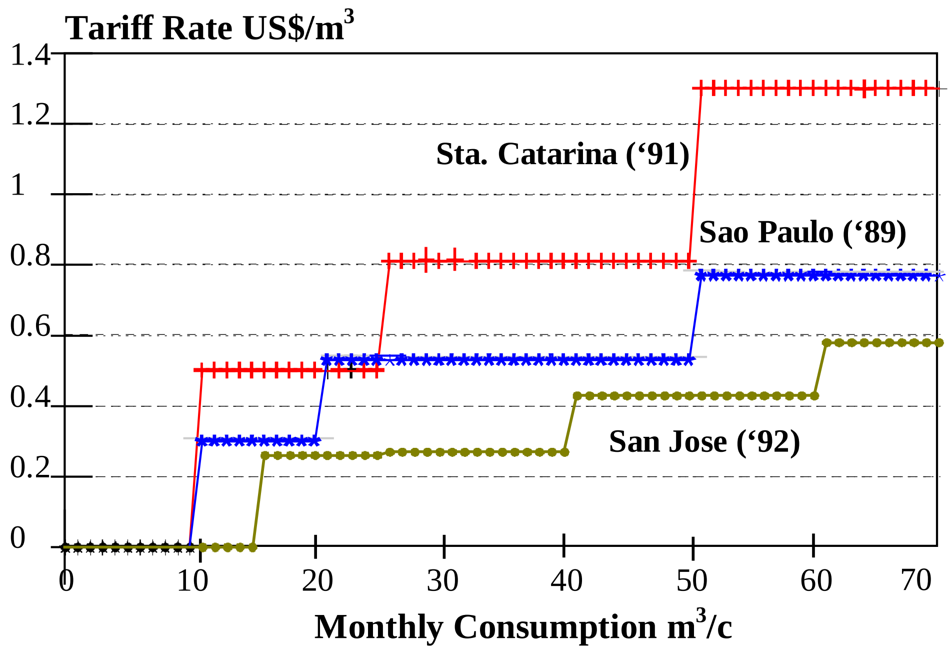
Notes: a/ Average b/ Metered Consumption

A. 4 AVERAGE CHARGES AND AVERAGE INCREMENTAL COST

Information on rate structure, average charges (AR) paid by consumers and average incremental cost (AIC) for water services provided by the utilities of Ankara, Sao Paulo and Manila, is presented in graphs E, F and G. It is worth noting, in these graphs, that all these utilities are subsidizing a large segment of domestic users (financial subsidy: AR less average charge paid by consumer; economic subsidy: AIC less average paid by consumer). Although not shown, small commercial and industrial consumers are also often subsidized.

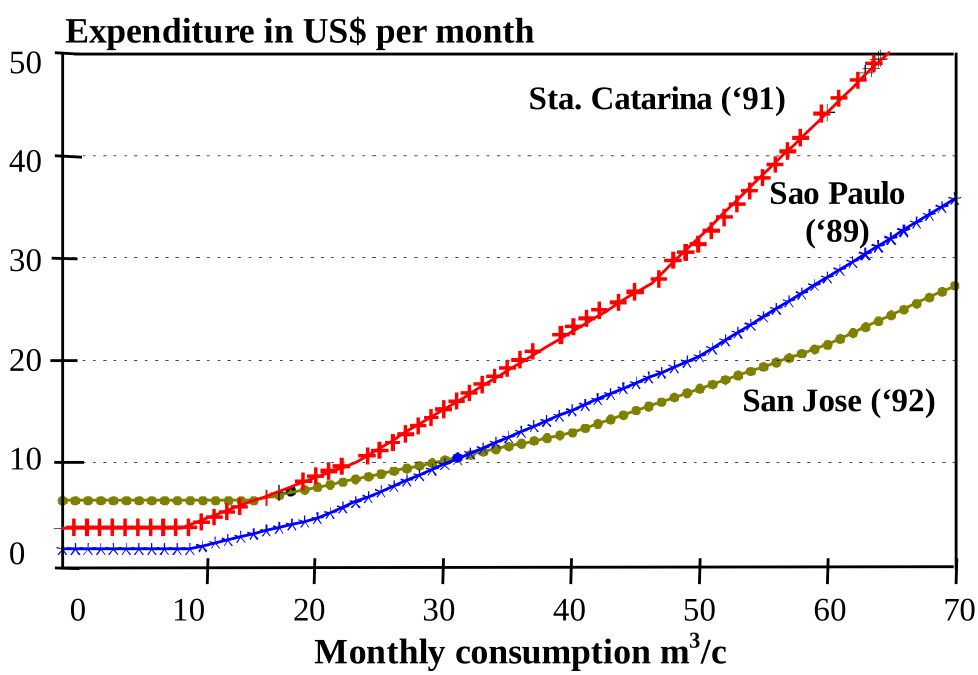
A. 1

Domestic Water Tariff Structure

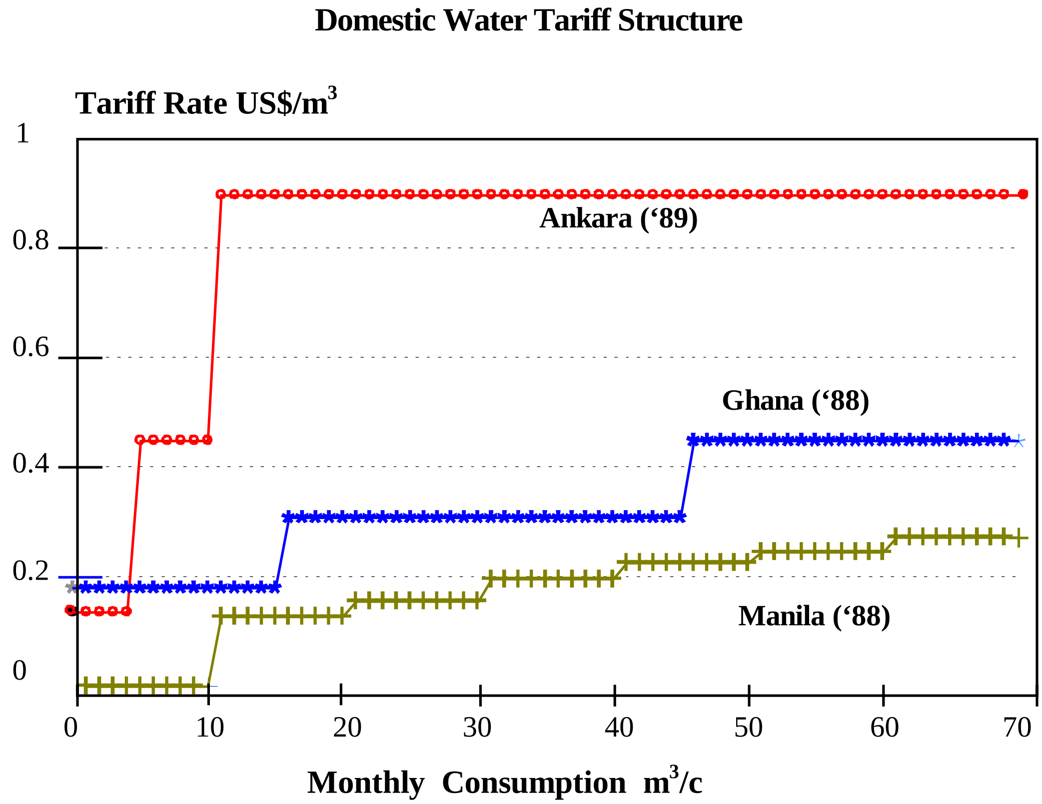


A. 2

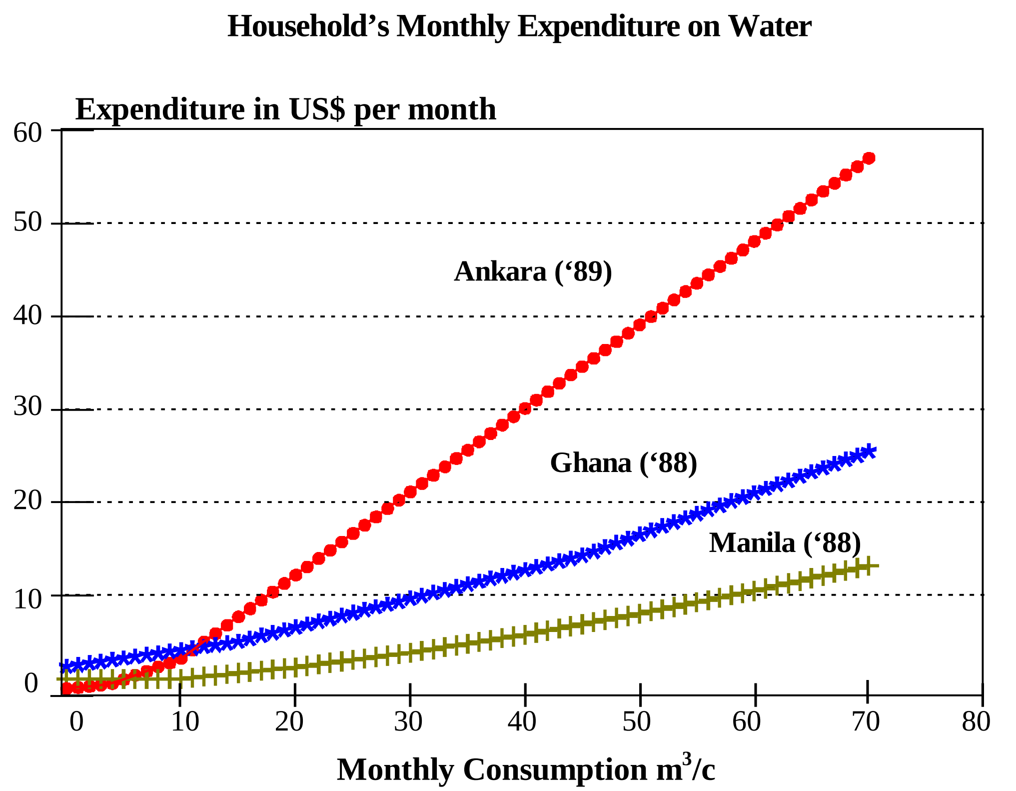
Household's Monthly Expenditure on Water



B. 1

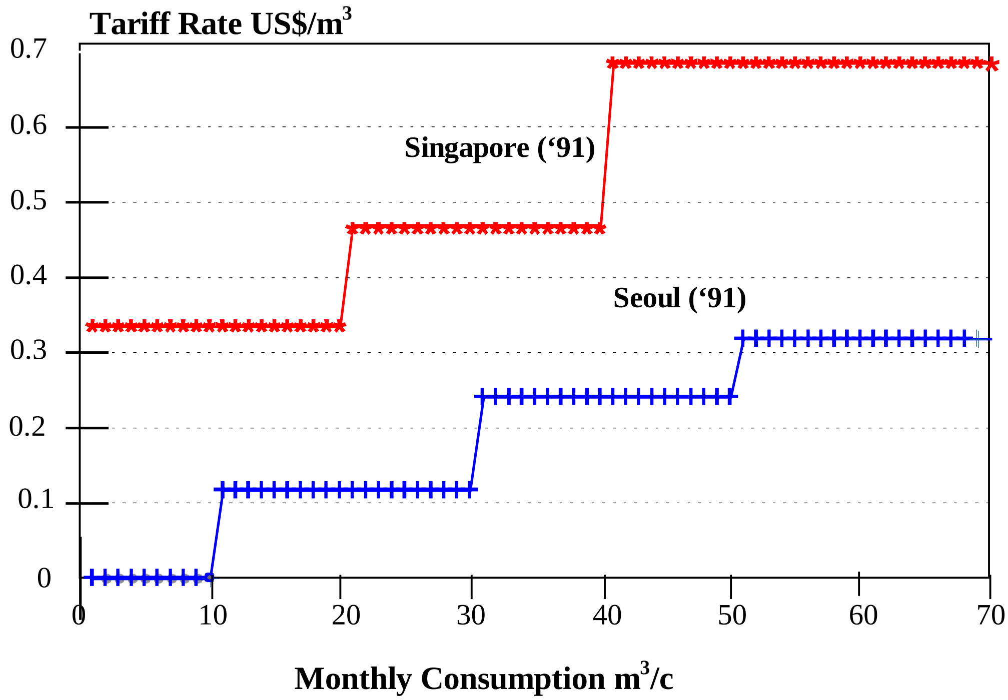

Domestic Water Tariff Structure
Tariff Rate US$/m3
1
0.8
0.6
0.4
0.2
0
Ankara ('89)
Ghana ('88)
Manila ('88)
0
10
20
30
40
50
60
70
Monthly Consumption m3/c

B. 2


Household's Monthly Expenditure on Water
Expenditure in US$ per month
60
50
40
30
20
10
0
Ankara ('89)
Ghana ('88)
Manila ('88)
0
10
20
30
40
50
60
70
80
Monthly Consumption m3/c

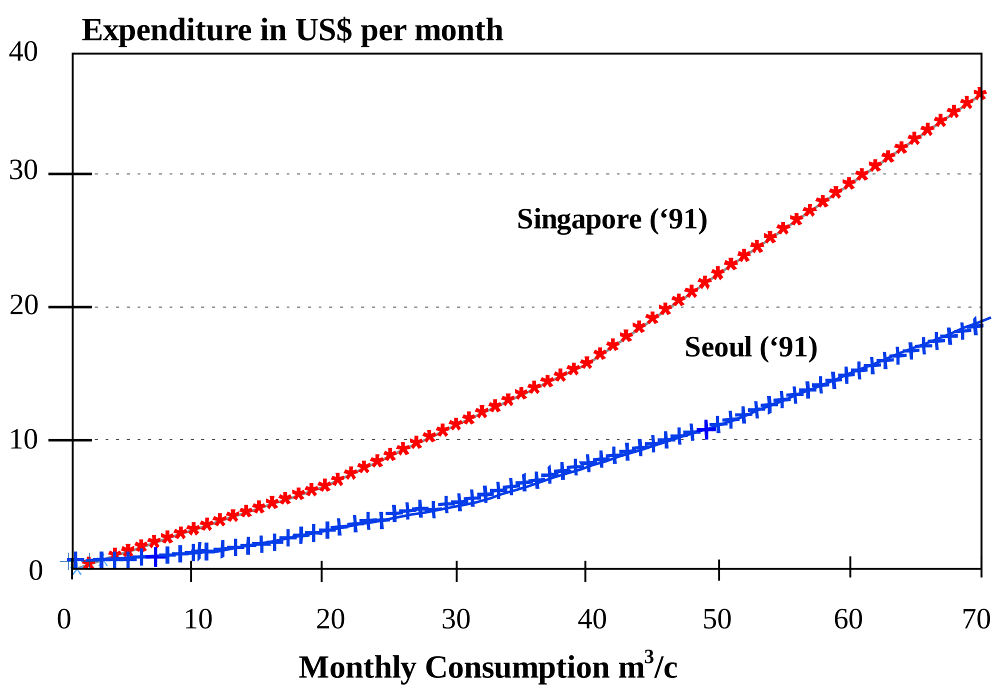
C. 1

Domestic Water Tariff Structure



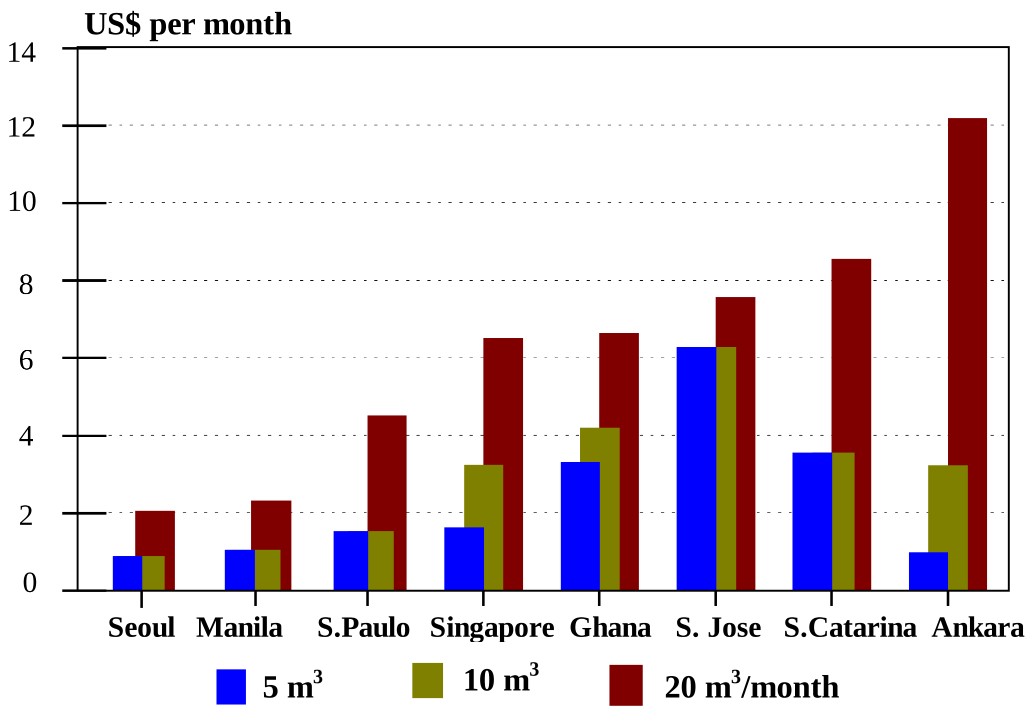
C. 2

Household's Monthly Expenditure on Water



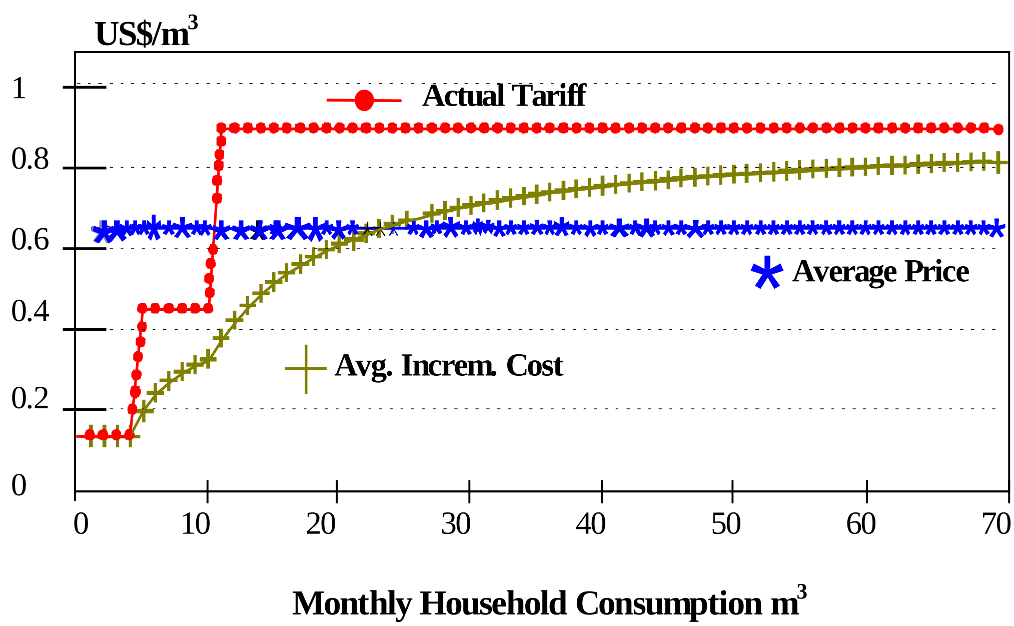
D.

Household Payment for Water Consumption



E.

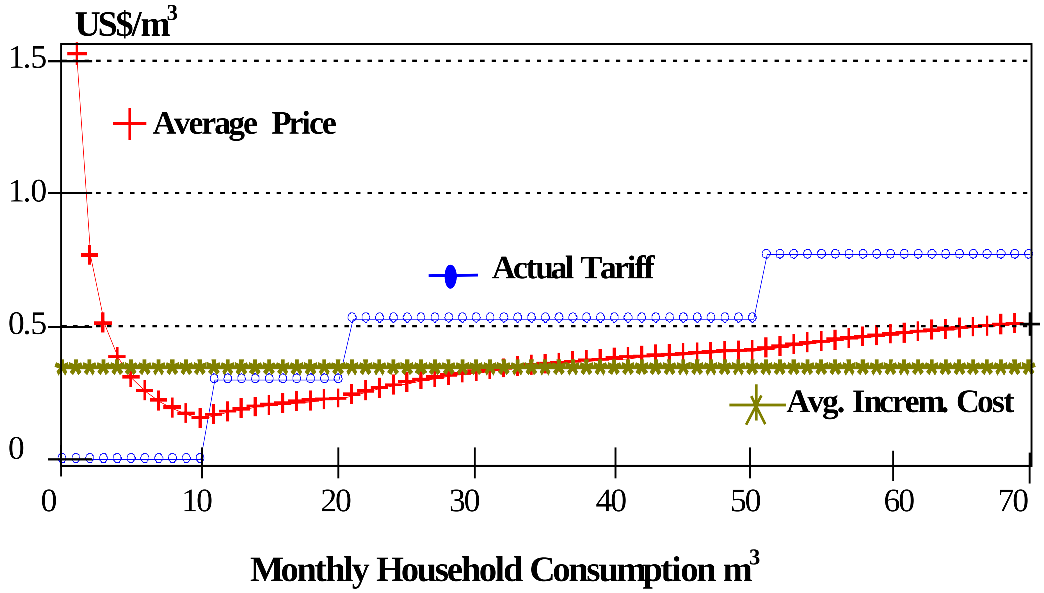
Ankara's Tariff Structure
and Average Incremental Cost (1989)



Source: Staff Appraisal Report November 1989.

I.

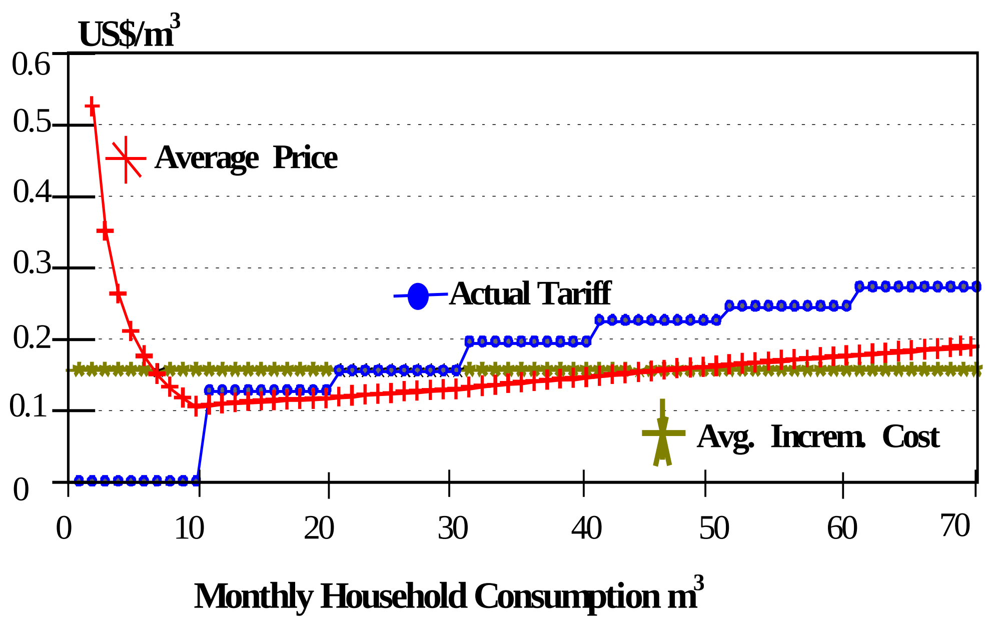
Sao Paulo's Tariff Structure and Average Incremental Cost (1989)



Source: Staff Appraisal Report May 1989.

G.

Manila's Tariff Structure and Average Incremental Cost (1988)



Source: Staff Appraisal Report August 1989.

A. 5 RATE DISCRIMINATION BY CONSUMER GROUP

Tariff structures, in this sample of utilities, are often designed in such way that industrial, commercial, domestic and other users are subject to different rates for the same consumption (rate discrimination).

This practice seems to be rooted in the belief that industrial and other users, presumably wealthy ones, should subsidize all or some of the domestic consumers and on occasion special groups such as schools, churches and the public sector. This cross subsidy element is often substantial as shown in the following table:

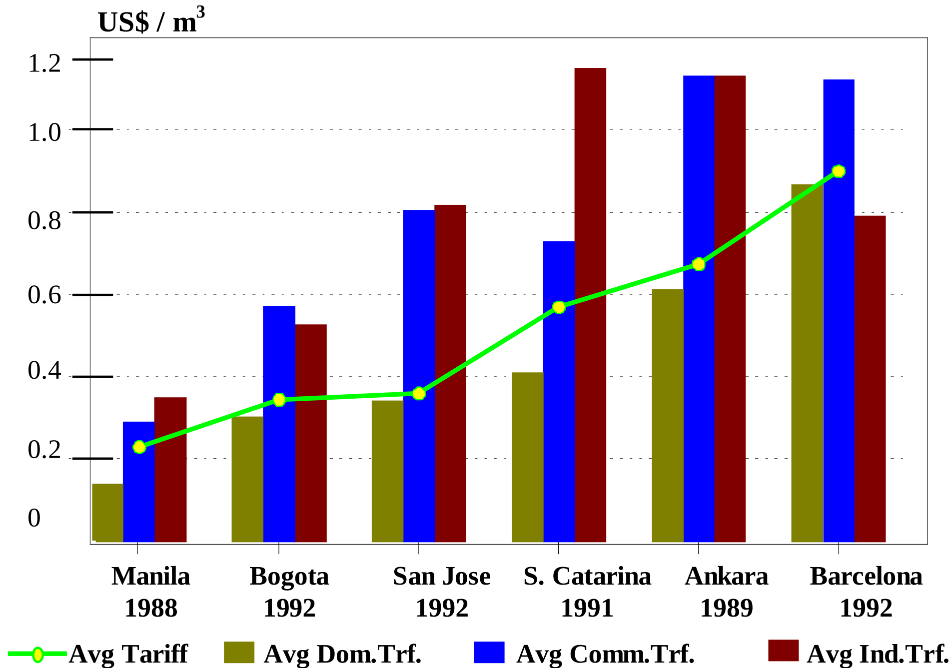
Rate Discrimination
Ratio of Average User Rate to Average Rate

User	***Utility***				
	San Jose ***a/***	*Sta. Catarina*	*Bogota*	*Bursa*	*Minsk*
Domestic	0.76	0.75	0.86 **b/**	0.86	0.05
Commercial	1.79	2.51	1.63	1.32	---
Industrial	1.82	2.85	1.51	1.32	3.84 **c/**, 2.03 **d/**
Pub. Sector	0.76	4.11	1.06	1.32	2.63
Other	0.76	---	0.69	0.34	---
Average Rate	1.00	1.00	1.00	1.00	1.00

a/. San Jose industrial rates differentiate on the basis of water being part of the final product (e.g., soda water and beer).
b/. Average of 6 categories for domestic consumers. The corresponding ratio within each category varies from about 0.32 to 2.71 and the relative fixed charge from 1 to 100.
c/. Drinking water
d/. Non-treated water

No explicit rationale for price discrimination or progressivity in rate structure was provided in any of the utilities' reports. The implicit rationale seems to be "charge whatever it is thought the market can bear", without analysis of the consequences on the price discrimination on the behavior of different consumer groups, and of the distortions created.

H. **Price Discrimination**
Average Tariff Among Consumer Groups



A. 6 Water Billings, Consumption and Users.

Consumption patterns in all users groups are often accentuated by discriminatory pricing practices as a result of cross-subsidies. The following table presents information for San Jose, Manila and Bogota. These differences in consumption and billings must be fully understood when analyzing the impact of tariff reforms and programs to correct large tariff distortions[3].

Water Consumption and Billing
(Percentages)

Type of User	*San Jose*			*Manila*			*Bogota*		
	%U	*%Q*	*%$*	*%U*	*%Q*	*%$*	*%U*	*%Q*	*%$*
Domestic	91	71	55	90	61	42	95	76	69
Commercial	6	8	13	9	32	47	5	8	14
Industrial	2	15	27	1	7	11	0.5	6	11
Public Sector	1	6	5	---	---	---	9.3	5	6
Other	---	---	---	---	---	---	0.0	4	0.3
Total	100	100	100	100	100	100	100	100	100

Totals may not add because of rounding. U = number of users; Q = total consumption; $ = total billing.

[3] Suggested reading:
a) Nieswiandomy, Michael L. "Estimating Urban Residential Water Demand: Effects of Price Structure, Conservation and Education." Water Resources Research, Vol. 28, March 1992.
b) K. L. Kollar and P. MacAuley. "Water Requirements for Industrial Development." Journal AWWA, January 1980.

A. 7 Conclusions and Hypotheses to be tested:

Based on this limited sample, some preliminary conclusions and hypotheses can be drawn, that need further testing:

Issue	Conclusion/Hypothesis
1. Tariff Structure	a) to reach the same level of revenues, for a given consumption volume, it is preferable, on efficiency grounds, to opt for relatively higher volumetric charges and relatively lower fixed charges. Volumetric charges require metering; b) water and sewerage rates should be separated. Otherwise some users are charged for one service that they do not receive often (sewerage) and end up subsidizing those who receive both; c) cumbersome classification of users, based on notional ideas of capacity to pay, are difficult and expensive to maintain up to date and are prone to abuses and corruption; d) consumption estimates based on a proxy such as area of construction, imputed or actual property values or size of industry are prone to substantial errors that are best corrected by metering consumption.
2. Fixed Charges	High **fixed charges** can have two undesirable effects: a) they do not promote water conservation; and b) they can be regressive e.g., they often penalize consumers that use less water and, in particular, low income groups.
3. Price Discrimination	**Price discrimination** can also have undesirable effects: a) industry, in particular, may look for alternative sources thus reducing the commercial base of the utility; b) perceptions of unduly high price discrimination can lead to fraud; and c) low charges remove incentives for utilities to provide services in low income areas. They also remove incentives to reduce UFW.

PERSONNEL COSTS AS AN INDICATOR FOR W&S UTILITY PERFORMANCE IN DEVELOPING COUNTRIES[1]

Karin Kemper, Guillermo Yepes and Mike Garn

Personnel costs in many Water & Sanitation utilities in developing countries constitute a larger cost factor than usually recognized, draining resources from maintenance and other necessary operating expenses and imposing costs on consumers.

Although most developing countries have invested considerable amounts of money in W&S, new investments are still essential in the sector due to rapid population growth, large unmet needs, and a sizeable backlog of postponed maintenance expenditures. However, internal generation of funds by W&S utilities has been disappointingly low and consequently the pressure on national and local governments to provide funds for investments, and often for operations, is large. It is becoming obvious that needed levels of investment cannot be sustained over the long run if business continues as usual.

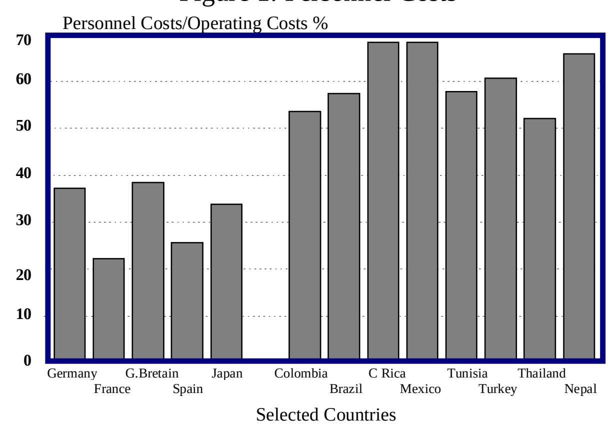
Personnel costs are not usually expected to play a predominant role in W&S utilities since other operating costs, e.g. for energy, chemicals, and maintenance, weigh heavily. (Operating costs, as treated here, do not include depreciation or interest payments). There is evidence, however, that personnel costs in a number of developing countries are disproportionately high in comparison to other operating costs and should receive closer attention when assessing company performance.

If the ratio of personnel costs to other operating costs is too high, the sustainability of previous investments may be undercut. The need for external funds increases, draining more resources than necessary from other sectors, and consumers may have to be charged higher prices if maintenance and other necessary operating expenses are to be met. Thus, although there is a substantial need to expand W&S services in developing countries, the inefficient allocation of resources within the companies may not even permit maintenance of current levels of service, let alone allow investments from internally generated funds.

RATIO OF PERSONNEL COSTS TO OPERATING COSTS

When the financial statements of sector companies in developing countries are examined, it becomes clear that: (a) the impact of personnel costs on the cost structure in many companies is very high, and (b) the ratio of personnel costs to operating costs varies widely, even from company to company in the same country.
The ratio of personnel costs to operating costs (PC/OC) for selected W&S utilities in Great Britain, France, Germany, Japan and Spain and selected developing countries is presented in Figure 1. In spite of the relatively high unit labor costs in the group of industrialized countries, PC/OC ratios are, on average, under 40 percent. Yet, as illustrated, some utilities in developing countries have PC/OC ratios in excess of 60 percent. The average for Brazil and Colombia, for example, is around 55 percent, considerably higher than the average for the industrialized countries (Figure 1).

Figure 1: Personnel Costs



[1] Published in Infrastructure Notes, January 1994 - Transportation, Water and Urban Development Department, World Bank, W & S No. WS 12.

The personnel cost figures for the industrialized countries usually include pension costs. However, in many of the developing countries, reported personnel costs do not include all costs. In some documents cases, W&S companies provide additional fringe benefits to their staff such as free water and sanitation services, subsidized housing and housing loans, educational benefits for family members, etc.. These costs are not always identified in the financial statements or easily quantified. It is reasonable then, to assume that the personnel costs and related ratios presented here for developing countries are underestimated.

RELATIVE PRICES

One explanation for the larger share of personnel costs in developing countries compared to industrialized countries might be that labor in the former is relatively cheaper and therefore substituted for capital. This would increase, the relative share of personnel costs in these utilities' accounts. However, this would not explain wide intracountry differences. There exist substantial differences between companies within countries. For instance in Ecuador, personnel costs in two companies constitute only 39 percent of total operating costs, which corresponds well to the average observed in industrialized countries while two other companies exhibit personnel costs over 60 percent. Similar differences can be observed in Colombia and Brazil. Thus even if it seems reasonable to expect that utilities in developing countries will use somewhat more labor than those in industrialized countries this would only explain parts of the picture.

ECONOMIES OF SCALE

Another explanation for the large differences between companies might be their size. Due to economies of scale, larger companies could be expected to have lower personnel costs per unit of service ($\$m^3$ sold). One study (Yepes, 1990) observed economies of scale in a Brazilian sample, and also data from the US (1970, 1976) indicate that there are economies of scale. However, the Colombian sample illustrates that economies of scale cannot in all cases be counted on. Economies of scale are observable when measured as staff/1000 water connections ratio, but when measured against personnel cost/m^3 sold, these economies do not exist.

WHAT DOES THE "NUMBER OF STAFF PER 1000 CONNECTIONS" TELL US?

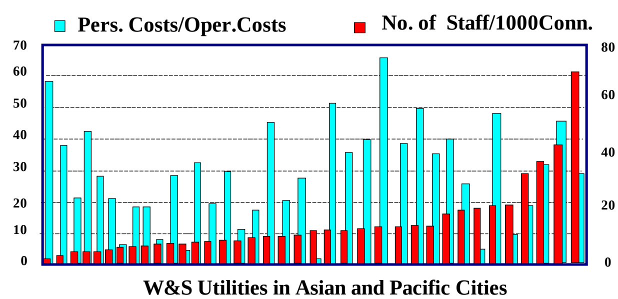
Number of staff per 1000 water connections or 1000 water & sewerage connections are frequently used as indicators of company performance. When related to personnel costs, the picture would be presumed to be fairly straightforward, i.e. companies with high personnel costs would be assumed to have a higher staff/connection ratio. Thus, the problem would be mechanistic, and if personnel costs were perceived as too high, the solution would be to reduce staff numbers.

The staff/connection indicators alone, however, do not give a satisfactory picture of the situation. An analysis of a Colombian sample of 16 W&S utilities shows that in 75 percent of the cases the staff/connection indicator was improving (decreasing) or stationary while the ratio of personnel costs to operating costs was increasing. In one Colombian company, the staff/connection ratio for the last 10 years has been declining steadily and has reached levels very few companies in the region can emulate. However, personnel costs (in real terms) and their impact on the cost of water delivered have been increasing at an alarming rate to the point that the company is now near insolvency. As a result the company has also reduced allocations for maintenance, and investment plans are in abeyance.

This is not an isolated case. Average salary levels and their impact on the cost per m^3 delivered are growing very fast, in real terms, in many W&S companies in developing countries. In a sample of Bank-financed projects implemented between 1965 and 1987, the ratio of salaries to the cost of water sold grew in real terms (over a 6 to 10 years period) at unsustainable rates.

Figure 2 illustrates that the staff/1000 connections indicator does not tell the whole story. As can be seen from the sample of 32 Asian and Pacific cities, there is no direct connection between staff/1000 connections and the ratio of personnel costs to operating costs. For example, in Singapore the staff/1000 connections ratio is a favourable 2.4, but personnel costs constitute 49 percent of operating costs. And in Bombay, there are 61 staff per 1000 connections, but personnel costs amount to only 32 percent of operating costs.

Figure 2: Asian and Pacific Cities



The examples above give an indication that the frequently used staff/1000 connections ratio in itself may be misleading and that an improvement in that ratio cannot necessarily be interpreted as an increase in efficiency. Personnel costs in these cases appear not to

be automatically linked to staff numbers or economies of scale, so that it must be assumed that other factors play a role.
A recent survey carried out by the Union Africaine Des Distributeurs D'Eau in West Africa among its members suggests that inadequate information on personnel costs is an additional problem in W&S utilities. While most of the companies were able to provide all kinds of data relating to turnover, energy consumption, number of personnel etc., only three of the 14 responding companies provided data on personnel costs.

A LOOK AT STAFFING STRUCTURES

The data lead to the assumption that in many W&S utilities average salaries and wages are higher than one would expect. But this need not be the case for the overall workforce. There is evidence from some studies that salaries of lower-level workers in public utilities are substantially higher than the average in the private sector, while wages at management level are lower. The latter seems to be especially true for smaller utilities, which consequently have difficulties in attracting qualified managers. Bank reports mention these problems concerning the W&S sectors in countries as different as Turkey and Nigeria.

Furthermore, the report on the W&S sector in Turkey points out that the combined effect of a reduction of UFW by 20 percent and an increase in productivity of personnel by 20 percent in urban areas on savings and revenues would add about US$180 million a year to the cash generation potential of local agencies. That would imply that a significant part of the cash generation effort recommended at the local level could be achieved without a major effect on existing tariff levels. Similar calculations for Costa Rica and Colombia also point to potential savings. It is thus evident that the opportunity cost of high personnel expenditures is significant.

CONCLUSIONS AND POLICY IMPLICATIONS

To summarize, personnel costs constitute a sizeable part of overall operating costs in many companies in a wide variety of developing countries. This need not be the case since countries with generally higher wages and salaries, such as Britain, Spain and Japan, manage to keep personnel costs at a relatively low level. Excessive personnel costs drain funds from other necessary expenditures for e.g. maintenance and investments for expansion. This Note thus implies that when analysing W&S utilities' performance, personnel costs ought to be taken into account because their weight might have serious implications for a company's financial sustainability; routinely used technical indicators, such as staff/1000 connections might be misleading because their relation to financial performance is not clear; and a combination of indicators and a determination of the trade-offs between their implications are necessary if company performance is to be adequately analysed. To complement the picture, the expenditure on personnel also needs to be examined. Personnel costs can, for example, be related to other operating costs and to the cost of water sold.

In this Note, only technical explanations for high personnel costs, such as relative prices and economies of scale, are examined. As could be seen, although these certainly provide answers in some cases, they do not tell the whole story. Complementary explanations are provided by institutional economics. This evolving field of economic theory uses, inter alia, public choice theory, as well as concepts such as the Soft Budget Constraint, and principal-agent relations for the analysis and explanation of company and sector performance, incentive structures and stakeholders' behavior.

Concerning the performance of the utilities discussed in this Note, explanations for high personnel costs may for example be that the various actors (managers, employees, politicians, etc.) are subject to incentive structures that lead to over/underpayments of certain employees, to demands for higher than appropriate salaries and to overstaffing. This is indicated in sector reports for some countries. For future analyses, it would thus be of interest to look at incentive structures in the W&S sector by employing the analytical framework of institutional economics. This would give additional guidance in policy formulation for specific settings.

TO LEARN MORE:

Ostrom, Elinor, Larry Schroeder, and Susan Wynne. 1993. *"Institutional Incentives and Sustainable Development."* Boulder: Westview Press.

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