

2 0 2 . 7

8 8 P R

Reprint from

Aqua Fennica 18, 1 • 1988

02  
1

Tapio Katko

PRICING OF WATER SERVICES IN FINLAND AND  
SOME OTHER DEVELOPED COUNTRIES

202.7-88PR-5214

LIBRARY, INTERNATIONAL REFERENCE  
CENTRE FOR COMMUNITY WATER SUPPLY  
AND SANITATION (IRC)

P.O. Box 53190, 2509 AD The Hague

Tel. (070) 814911 ext. 141/142

RN: 15N 5214

LO: 202.7. 88 PR

## PRICING OF WATER SERVICES IN FINLAND AND SOME OTHER DEVELOPED COUNTRIES

Tapio Katko

Katko, T. 1988. Pricing of water services in Finland and some other developed countries. *Aqua Fennica* 18,1: 61—74.

In developed countries water pricing seems to have some controlling effect on water consumption. The income structure of water and sewage works in Finnish cities *relies extensively on volume-based charges whereas the structure of rural municipal works is more versatile*. For the last decade consumption charges have remained the same whereas effluent treatment charges have grown in real terms. The difference between the maximum and minimum volume-based charges in Finland is about 20-fold for water and about 10-fold for sewage. Unlike other public services such as electricity and district heating the services of water supply and particularly the sewage works in Finland are underpriced. Some comparisons on water pricing in OECD-countries are presented. The paper is a preliminary step in the analysis of water pricing experiences in the developed countries and their implications for the developing world.

Index words: water pricing, water charges, sewage charges, tariff structures, Finland.

Tapio Katko, Tampere University of Technology (TUT), Institute of Water and Environmental Engineering, P.B. 527, SF — 33101 Tampere

### INTRODUCTION

Pricing of water services consists of the different types of charges for water and sewage. In developed countries these services are mostly public and to a large extent they are paid for by direct consumer charges. However, unlike in the case of other public utility services such as electricity, water charges do not cover the costs fully. Thus they have to be covered partly by other means such as taxation. Besides considering price levels also price structures should receive more attention. In the developing world inadequate cost-recovery is the most severe constraint in the water supply and sanitation sector as shown by the author's earlier work (Katko 1986). Recently in the United States an expert team considered inadequate rates the most problematic issue in the

water supply industry (AWWA 1984).

The objective of this paper is to point out the most important issues in water pricing in developed countries, particularly in Finland and find possible implications for water pricing in the developing world. This work is part of more extensive research on the role of cost-recovery for sustainable water supply and sanitation in developing countries financed by the Finnish International Development Agency (FINNIDA).

The paper is based on interviews of some Finnish and international experts as well as on a rather thorough literature survey concentrating particularly on Finland. The paper also includes several examples on managing water and sewage charges in the OECD -countries.

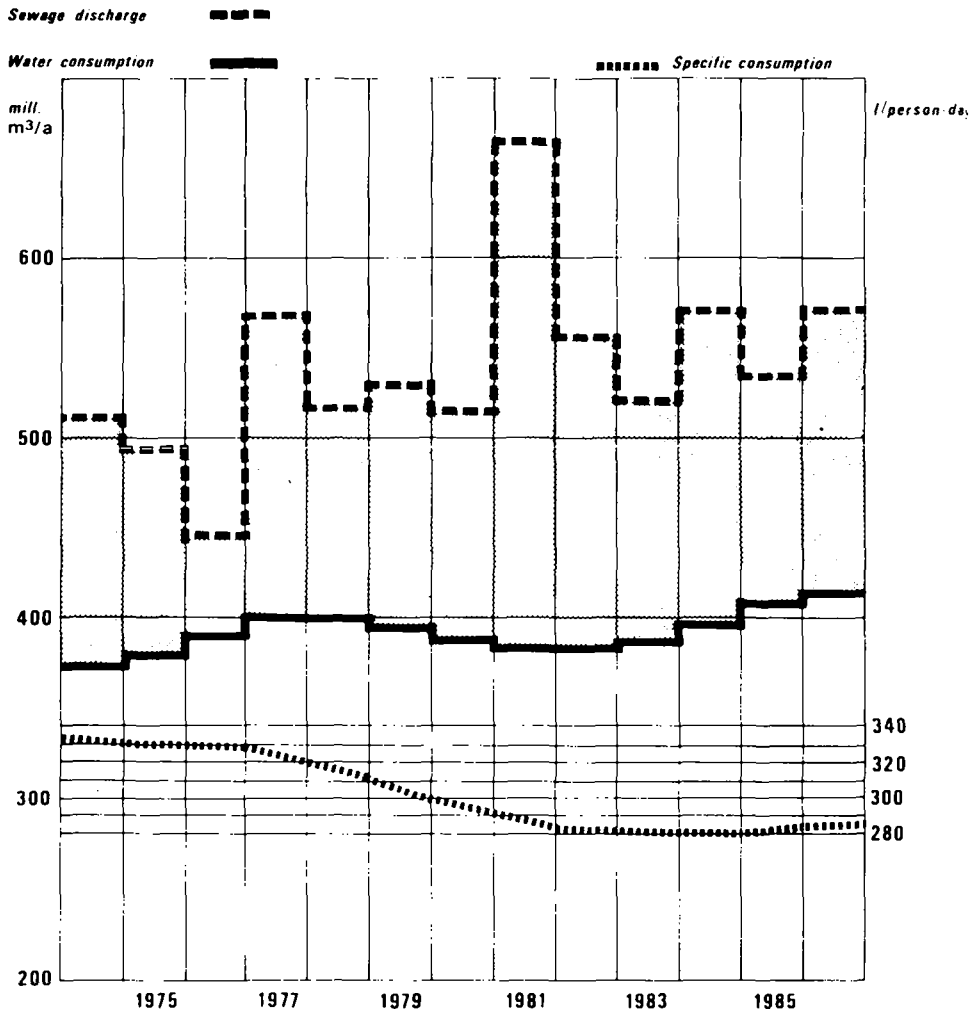


Fig. 1. Average water consumption by public water supply plants, specific consumption and sewage discharge from public sewer systems in Finland in 1974—1986 (National Board of Waters and Environment 1987).

## WATER AND WASTEWATER CHARGES AND THEIR STRUCTURE

### *Water consumption trends in Finland*

In Finland the investments in public waterworks and sewage works were at their highest in the mid-1970s whereafter they have decreased in real terms. In 1974 specific water consumption reached its highest level of 333 l/c · d so far. By 1984 consumption decreased to 279 l/c · d (National Board of ... 1987). Thereafter specific consumption has slightly increased (Fig. 1).

The decrease of specific water consumption has been the result of energy conservation activities, introduction of sewage charges in 1974, improved water use devices, recirculation of water in industry, leakage control, changes in consumer attitudes towards water saving etc.

### *Effect of water price on consumption*

According to OECD (1987) the price elasticity coefficient of water demand  $n$  is defined as

$$n = \frac{\text{per cent change in quantity}}{\text{per cent change in price}}$$

The surveys in the United States and the United Kingdom in the 1970s indicated a typical coefficient value of  $-0.4$ . OECD (1987) reported values from  $-0.005$  to  $-0.30$  in the OECD-countries in the 1980s. Thus according to the latter option a doubling of price would reduce consumption by 0.5–30 per cent. Higher values have occurred during summer season.

Carver and Boland (1980) noticed a short-run price elasticity of less than  $-0.1$ . The long-run elasticity coefficient was from  $-0.2$  to  $-0.4$  as commonly reported. Gundermann (1986) pointed out that price has a bigger effect on industrial water consumption.

The introduction of sewage charges in Finland in 1974 had obviously quite a strong effect particularly on industrial water consumption. This led to water recirculation and a great reduction in water consumption especially in those industrial plants connected to the municipal networks.

#### Water metering

OECD (1987) reported that water metering has a considerable effect on water use. There is tremendous variation in the practice of domestic metering in the member countries. In Britain metering is least relevant. In France metering of individual households by volume is possibly most common. In Finland, Japan and Switzerland metering is comprehensive.

In Finland, e.g. Rosengrén (1981) has studied water consumption in different types of residential buildings in the city of Turku. In municipal rental flats the consumption was 210–250 l/c · d. In row houses with metering of individual households the figures were 140–155 l/c · d.

In Helsinki, Finland, Erkiö (1983) noticed a reduction in water consumption from 300 l/c · d to 160 l/c · d due to renovation of a block of flats. During the renovation hot water meters were installed for individual flats. Flats were charged for consumed hot water starting a year later. Consumption decreased 5 per cent during the first year of charging for hot water.

#### The structure of water and sewage charges

In January 1986 there existed altogether 789 water supply works (a minimum of 200 subscribers) in

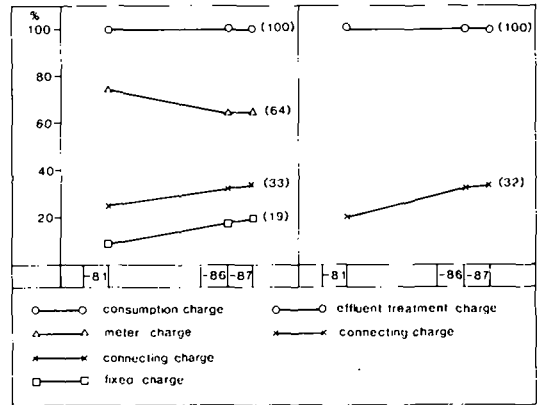


Fig. 2. The structure of water supply charges and sewage charges in Finnish cities in 1981, 1986 and 1987 (Liimatainen 1981, 1988; compiled by the author).

Finland. Of these 140 works were operating in cities and 641 in rural municipalities (National Board of Waters 1986).

Water charges can include consumption, connecting, fixed, meter, fire fighting, unit and other charge components. Fig. 2 shows the structure of water charges and sewage charges in Finnish cities in 1981, 1986 and 1987. The amount of connecting and fixed charges collected by water works was remarkably low. The sewage charge law does not include any fixed component at all and connecting charges have been fairly rare. There is, however, a growing trend towards fixed and connecting charges in water works as well as connecting charges in sewage works.

The income structure of waterworks and sewage works in Finland in 1984 is shown in Fig. 3. The volume-based water consumption and effluent treatment charges dominated strongly in cities. About 20 per cent of the income of the rural municipal works came from connecting charges.

In January 1986 33 per cent of the water works in cities and 77 per cent of the rural municipal water works had connecting charges for one-family houses. The connecting charge varied from 50 to 8230 FIM (National Board of Waters 1986b). It has to be noted that about one third of the "municipal water works" are stock companies. In 1978 practically all of these companies had a connecting charge and 63 per cent a fixed charge (KUVENE 1978b). Thus the rural municipal waterworks and particularly stock companies have a more varied income structure than the works in cities.

Table 1. A sample of water supply rate schedules in Belgium, Canada and USA (OECD 1987).

Rate schedule	USA (All sectors, 1982)	Belgium (All sectors, 1983?)	Canada (Residential sector, 1983)
Fixed charge	—	5	62
Uniform volume charge	2	—	—
Fixed charge + volume charge	7	19	—
Minimum charge + volume charge	26	—	—
Fixed charge + decreasing block	4	—	—
Minimum charge + decreasing block	56	69	34
Fixed charge + increasing block	3	—	—
Minimum charge + increasing block	1	7	4
Fixed charge + seasonal rate	1	—	—
	100%	100%	100%
No. of utilities in sample	(90)	(80)	(205)

Source: Lippiatt and Weber (1982) and Canadian and Belgian submission to OECD.

OECD (1987) pointed out that so far, in most of the member countries, the water industry has been preoccupied with price rate levels. Until recently it has been little concerned with price/rate structures. Table 1 shows a summary of different types of water rate schedules and a sample of these in three countries.

Fixed charges alone lead easily to wastage of water. Volume charges can be uniform or they can

be decreasing or increasing (so-called blocks). Often the charge has two components, a fixed or minimum charge to which is added one type of block. Decreasing block is the most common type in Table 1. Larger water users, particularly industries have lower peak factors than smaller users and therefore the decreasing block has been favoured. However, this structure encourages inefficient resource allocation and should not be recommended (OECD 1987). Still in 1973 about 60 per cent of the waterworks in Finnish cities applied the decreasing block to large consumers. In 1988 this block is used only by 7 per cent of the respective works (Limatainen 1988).

It is obvious that tariff structures with increasing blocks should be recommended. According to OECD (1987) these types of tariffs have been taken into use particularly in Japan. In developing countries the increasing block seems to have an income redistribution objective (United Nations 1980).

Seasonal charging systems have become more common in the United States. In Europe there is some experience of seasonal tariffs in France and the Netherlands, usually in resort areas (OECD 1987). Lobb (1975) has proposed that daily and hourly peak factors could be taken into account. These types of tariffs have for long been used by electricity plants and gas works. However, the development of water metering is not as advanced as metering in the other fields.

Miller (1984) has reported on the use of separate rates for "old" and "new" water in the contracts with suburban wholesale purveyors. This was introduced particularly to meet the demand

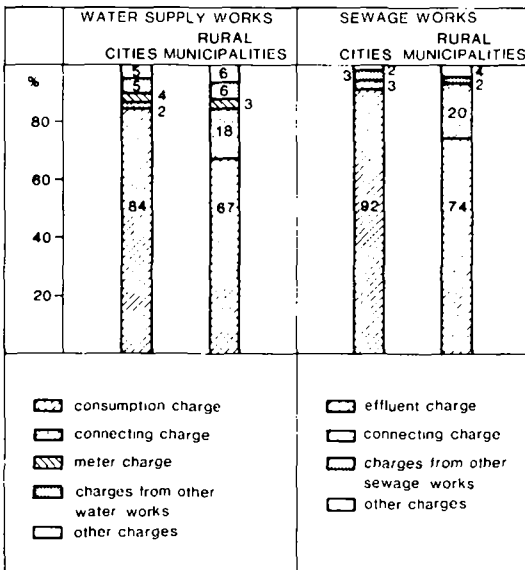


Fig. 3. Income structure of water supply works and sewage works in cities and rural municipalities in Finland in 1984 (National Board of Waters 1985; compiled by the author).

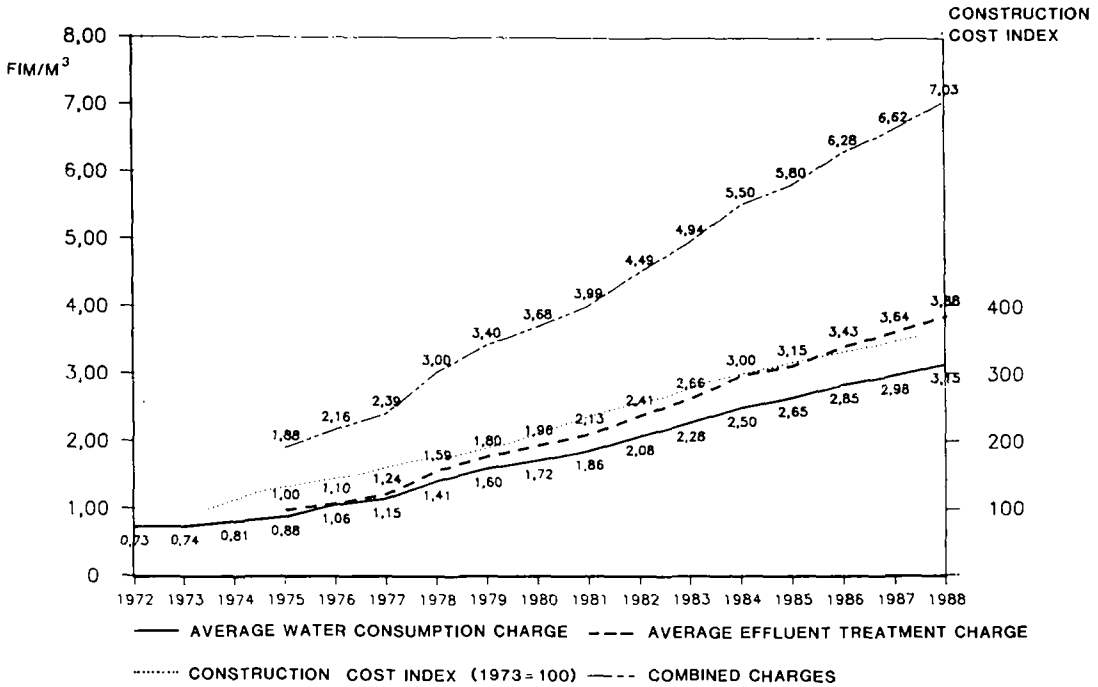


Fig. 4. Trends of water consumption charges and effluent treatment charges in Finnish cities in 1972–1988 compared to the construction cost index (Liimatainen 1988).

created by suburban growth. Mann (1987) pointed out that seasonal rates should be complemented by spatially differentiated or zonal rates for water service (increase in the charge with distance). He continued that uniform rates over time and space involve inefficiencies. Schlenger (1986) suggested a model with 25 per cent spatial price difference for a metropolitan water utility in North Carolina, USA.

Based on Turvey's (1969) concept, Hanke (1981) has developed a method for using marginal cost in water pricing. Gibbs (1978) noticed in his studies in Florida that the average price model significantly overestimated the response of consumption to price and income charges. Mann (1987) pointed out that marginal cost pricing includes conceptual and application problems. Average cost analyses should be supplemented by marginal cost analysis. Mann concluded that the selection of costing methods and pricing forms involves numerous judgements. So far in OECD-countries marginal cost pricing has been used to a very limited extent (OECD 1987).

## Trends in water prices in Finland and other OECD-countries

### *Water and sewage charges in Finland in the 1970s and the 1980s*

Fig. 4 shows the development of average water consumption charges and effluent treatment charges in Finnish cities in 1972–1988. The water consumption charges have closely followed the rise in the construction cost index. The effluent treatment charges have shown an increasing trend in real terms. This can be partly explained by the evident underpricing of effluent treatment when introduced in 1974 and partly by ever stricter treatment requirements.

Fig. 5 shows an indicative comparison of the trends in water consumption charges and effluent treatment charges in cities and rural municipalities. Due to the more versatile price structure of rural municipal water and sewage works these two components are only indicative of the development of the total water and sewage price. The figure shows similar patterns in charges by cities and rural municipalities: the water consumption charges have remained at the same level in real terms whereas the effluent treatment charges show an increasing

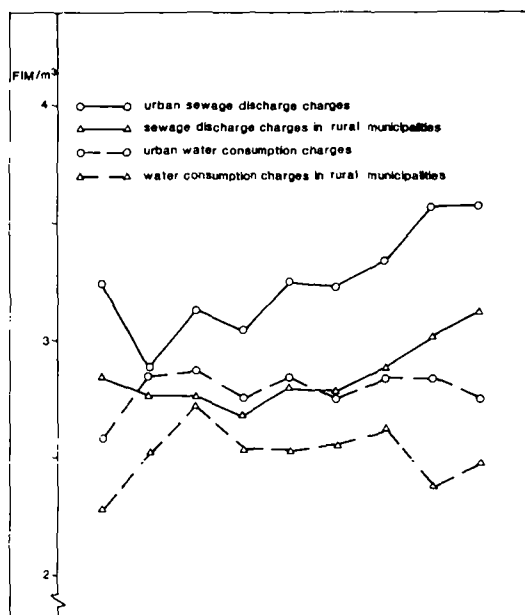


Fig. 5. Trends in average water consumption charges and effluent treatment charges in Finnish cities and rural municipalities in 1978–1986 in 1986 prices according to cost of living index (ETLA 1987, National Board of Waters 1979–1986, National Board of Waters and Environment 1987; compiled by the author).

Table 3. The trends in connecting charges of the sewage works in Finnish towns and rural municipalities in 1986 prices adjusted by the cost of living index (ETLA 1986, National Board of Waters 1979, 1981–1986, National Board of Waters and Environment 1987; compiled by the author).

Year	Sewer connecting charges	
	Towns FIM/m <sup>2</sup> *	Municipalities FIM/m <sup>2</sup>
1979	4.35**	5.13
1980	6.70	4.63
1981	6.21	4.65
1982	5.67	4.41
1983	4.02	4.01
1984	4.22	4.00
1985	4.37	4.17
1986	4.14	4.18

\* 1 US \$ = 5.1 FIM (1986)

\*\* charges at the end of the year

trend.

Table 2 shows the remarkable variation in water consumption charges and effluent treatment charges between different cities and rural municipalities. The difference between the highest and lowest water consumption charge is about 20-fold and that between the highest and lowest effluent treatment charge about 10-fold.

Table 3 shows the trend in sewer connecting charges in Finnish cities and rural municipalities in 1978–1986. The charges in cities have been slightly higher than those in rural municipalities. In real terms the charges have decreased. The variation between the minimum and maximum

values was about 10-fold in 1986 but it used to be up to 25-fold around 1980. The variations both in effluent treatment and sewer connecting charges can be explained by the differences in water resource and pollution control conditions as well as those in local tariff policies.

Fig. 6 shows the average water price/m<sup>3</sup> for a medium size one-family house and the average effluent treatment charge/m<sup>3</sup> in Finland 1.1.1987. The economies-of-scale seem to apply to works serving a population over 20 000. In Sweden a similar phenomenon occurs with water and sewage works serving over 25 000 people (Association of Swedish... 1987).

Table 2. The variation in water consumption charges and effluent treatment charges in Finnish cities and rural municipalities 1.1.1987 (National Board of Waters and Environment 1987).

Charge	Minimum value		Maximum value		Average value	
	Cities	Rural Municipalities	Cities	Rural Municipalities	Cities	Rural Municipalities
	FIM/m <sup>3</sup> *	FIM/m <sup>3</sup>	FIM/m <sup>3</sup>	FIM/m <sup>3</sup>	FIM/m <sup>3</sup>	FIM/m <sup>3</sup>
Water consumption	0.78	0.30	4.25	8.13	2.77	2.48
Effluent treatment	1.00	0.50	8.21	8.00	2.97	2.68

\* 1 US \$ = 5.1 FIM (1986)



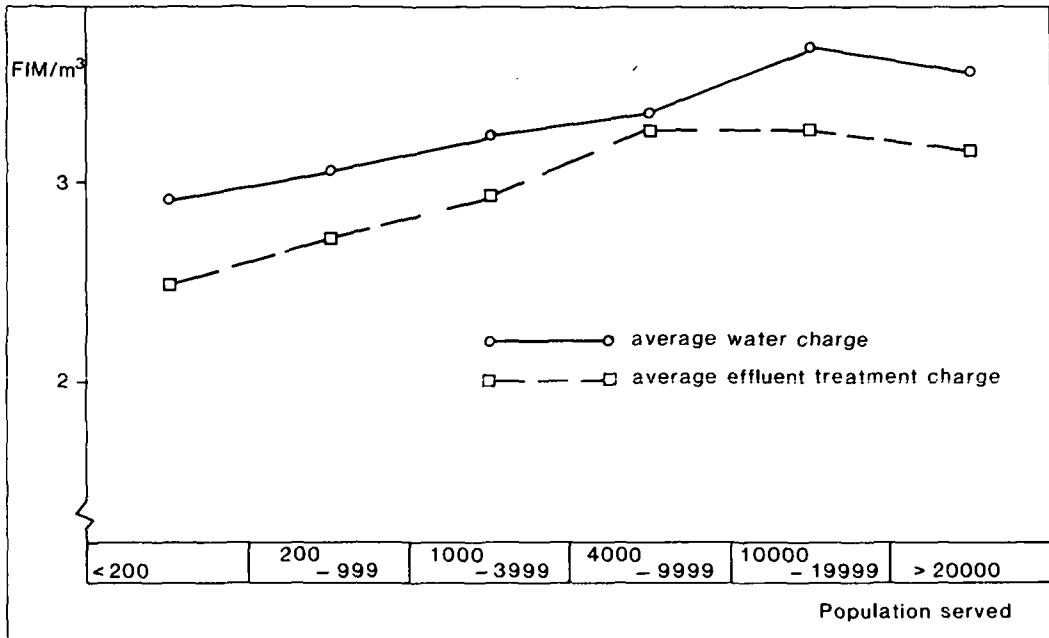


Fig. 6. Average water charges (including water consumption, meter, fixed and connecting charges for a medium size one-family house) and effluent treatment charges in Finland 1.1.1987. The economies-of-scale seem to apply to works serving more than 20 000 people (National Board of Waters and Environment 1987; compiled by the author).

In Finland people are used to buying spring water in plastic bags available in shops particularly in areas supplied with less tasty water. The retail price of this water which is generally believed to be of very good quality is about 2–3 FIM/l. Naturally the amount bought is fairly small. However, this indicates that people are willing to pay more for better quality water than they do at the moment. One bucket of water (10 l) supplied by a public works in Finland costs on the average only 0.06 FIM or  $6 \cdot 10^{-3}$  FIM/l which indicates the low price of water.

#### International comparison of water prices

In Finland the average water price including consumption, meter and fixed charges but excluding connecting charges was 2.90 FIM/m<sup>3</sup> at the end of 1986. In Sweden the roughly respective average water price was 4.95 FIM/m<sup>3</sup>.

International comparison of water prices in selected countries in 1986–1987 (Fig. 7) shows that Australia and the Federal Republic of Germany had the highest prices. The next highest

prices were in Sweden, the United Kingdom and the United States. In Canada and Finland the price was roughly two thirds of that in the above mentioned three countries. This survey made by National Utility Services (1987) is based on a limited sample of larger cities in the ten countries. Therefore, the comparison is only indicative.

In developing countries people often pay 20 to 30 times more for vended water (transported and sold) than publicly supplied water would cost if it were available (WHO 1987).

#### Cost calculation methods

In Finland a committee for the development of municipal accounting systems called "KULAUS" made a recommendation for public works including water supply and sewage. The recommendation is summarized in Table 4. The economic life of a water and sewage network is 30 years and declining depreciation is 10 per cent. The economic life of the water and sewage treatment machinery and equipment is 15 years with declining depreciation

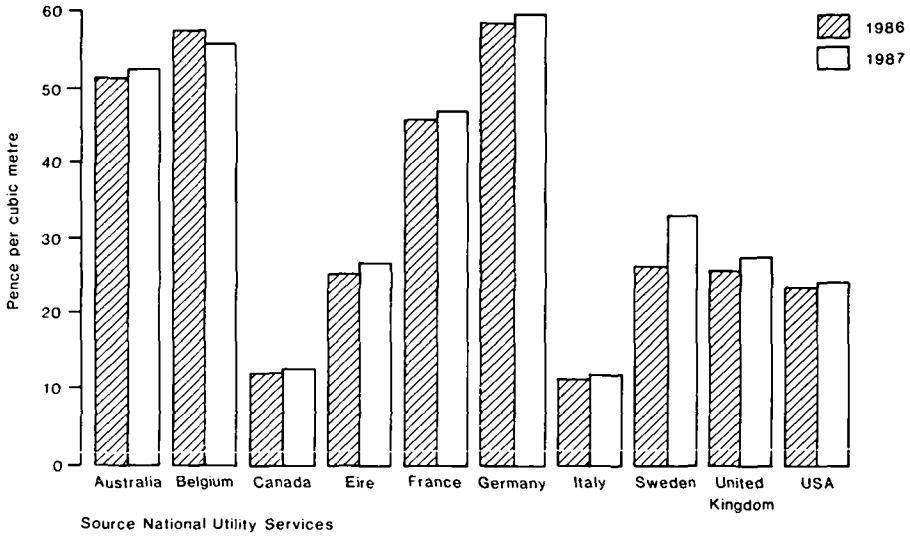


Fig. 7. International comparison of water prices in selected developed countries from July 1986 to July 1987 based on a sample of larger cities in the countries. The prices mainly include only consumption charges (National Utility Services 1987).

Table 4. The recommendations on depreciation and economic life by the municipal accounting system "KULAUS" for water supply and sewage works (KULAUS 1974).

Component	Economic life years	Declining depreciation percentage	Straight line depreciation percentage
Water supply network	30	10	3.5
Sewage network	30	10	3.5
Equipment and machinery of water and wastewater treatment plants	15	10	6.5

at 18 per cent. The value of the capital assets is adjusted every 1—3 years due to inflation. Originally the annual interest rate of 6 per cent for investment calculation was recommended but later it was lowered to 3 per cent (Association of Finnish Cities 1982).

#### Underpricing of water services

Fig. 8 presents a sample of under- and overpricing of public services (electricity, district heating,

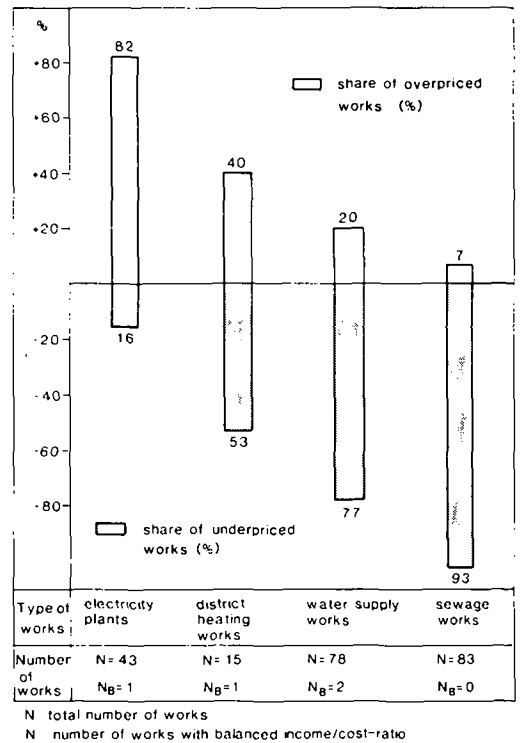


Fig. 8. A sample of under- and overpricing of municipal services in Finnish cities in 1982. Water supply and particularly sewerage services were underpriced (Association of Finnish Cities 1984; compiled by the author).

water supply, sewerage) in Finland in 1982. The figures are based on the recommended accounting method "KULAUS". According to this method the vast majority of electricity plants and close to half of the district heating plants made a profit. About 80 per cent of the waterworks and over 90 per cent of the sewage works underpriced their services. The result indicates the common difficulty of achieving full cost-recovery for water services. This is, however, highly dependent on the calculation method used. If the depreciation method applied, e.g. to stock companies were utilized, the result would be more positive (Kalliomäki 1988).

According to Lindblad (1987) the rate of cost-recovery in Swedish water and sewage works has been 70–80 per cent during the last decade. In Finland and probably in most of the developed countries, the underpricing of water is caused by municipal political decision-making. In the developing world this constraint is often much more severe due to the policy of supplying water free of charge at least to some consumers. In Finland district heating plants are mostly owned and managed by municipalities. However, they typically recover their costs fully.

The economy of water supply and sewage works can also be studied by cash flow calculations. Annual fluctuations can be quite big e.g. due to investments. Kalliomäki (1988) noticed that cash flow calculations give a more favourable result than other cost calculation methods except for the years of highest investments. Particularly in the case of developing countries van der Mandele (1987) pointed out that liquidity should be held as the basic criterion for determining appropriate rates.

## Costs and income of water supply and sewage works

### *Fixed and variable costs*

Gundermann (1986) has estimated the proportion of fixed and variable costs in water supply in the Federal Republic of Germany (Fig. 9). In water intake the share of variable costs, i.e. the costs depending on consumption was under 10 per cent. In water treatment the share of these costs is about 15 per cent but in water distribution only 1–2 per cent. Thus the vast majority of the costs are fixed i.e., they do not depend on the amount of water consumed. According to Kiuru (1987) the share of

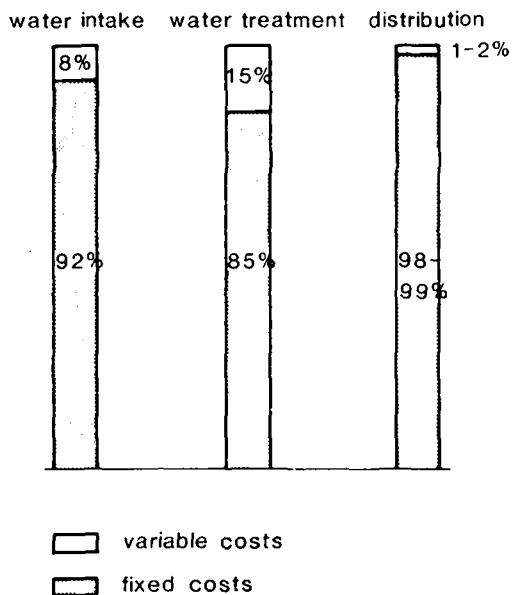


Fig. 9. Relative proportions of fixed and variable costs in water intake, water treatment and water distribution in the Federal Republic of Germany (Gundermann 1986; modified by the author).

fixed costs in water supply in Finland is 70–90 per cent. In Sweden Lindblad (1987) has estimated the respective average of 80 per cent.

### *Investment, running and use costs of water*

Table 5 shows a hypothetical calculation of the annual costs of water supply, sewerage and water use in an typical municipality of 20 000 inhabitants in Finland. Three-fourths of the total costs are created in the buildings themselves when taking into account the pipelines, equipment and devices in the buildings as well as the use of water. The latest component is mainly caused by the work (15 FIM/h) (Peltokangas 1988).

According to Korhonen (1988) in Finland investment costs' share of the total (excluding the costs of water use) is 50–60 per cent in water supply works and about 70 per cent in sewage works. However, there is wide variation in these figures under different conditions. For example, in Japan the share of investment costs is on the average much lower than in Finland. This can be partly explained by the higher population density in Japan.

Table 5. Distribution of the annual costs caused by water supply, sewerage and use of water in a hypothetical, typical municipality in Finland 1.1.1986. The population is 20 000 and the water consumption is 300 l/c-d. The economic life of the buildings is 30 years and that of machinery and equipment 10 years. Interest rate is 6 per cent (Pelto-kangas 1988).

Component	Annual cost	
	FIM/c-a	%
1. Water intake (surface water)	90	2
2. Water supply network	305	9
3. Elevated reservoir	20	1
4. Sewers	310	10
5. Sewage pumping station	5	1
6. Wastewater treatment plant (simultaneous precipitation) (1+2+3)*	100 (830)	3 (26)
7. Pipelines in buildings	90	2
8. Water use devices	230	7
9. Operational costs related to water use (washing powder, energy, work) (7+8+9)	2190 (2420)	75 (84)
<b>Total</b>	<b>3250</b>	<b>100</b>

\* the share of public water supply and sewerage (note by the author)

#### Consideration of the cost and income structures

The varying share of the volume-based consumption charge in the income structure of water supply works in Finland has increased on the average (Fig. 10). The figure includes both the works of cities and rural municipalities. This trend exists in spite of the increasing relative amount of connecting and fixed charges (Fig. 2). Before 1974 specific water consumption was increased continuously and the present income structure was justified. Kiuru (1987) suggested that the income structure should be developed by increasing the share of non-volume based charges. This would mean increasing the relative share and level of fixed charges for water supply works. For sewage works fixed charges would demand changes in legislation. According to KUVENE (1982) the reliance on water consumption and effluent treatment charges are appropriate if the investment level or the supply area of the water works is stable.

In Sweden the non-volume based charges by water works were, on the average 11 per cent of the total in the early 1970s but in 1987 they were 26 per cent. IWSA (1982) reported respective shares of 30–40 per cent in Switzerland and 50 per cent in Italy. The Association of Finnish Cities (1982) and Lindblad (1987) have suggested that the share

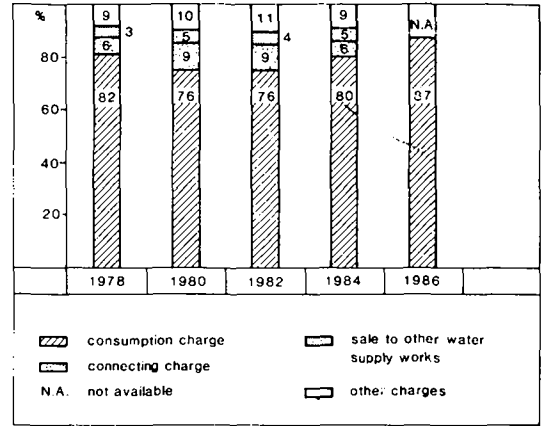


Fig. 10. Trends in the income structure of Finnish water supply works in 1978–1986. The figure includes both the works of cities and rural municipalities (National Board of Waters 1979, 1981, 1983, 1985; National Board of Waters and Environment 1987; compiled by the author).

of fixed charges should not exceed one-third of the total. Gundermann (1986) has suggested a respective increase of fixed charges for the water works in the Federal Republic of Germany.

The more complete the water supply and sewage networks and the wider area they cover, the less important the connecting charges. In Finland the water supply and sewage systems are mainly built already and the emphasis is now shifting more to renovation. Therefore the non-volume based charges could be based, e.g. on the quantity and quality of apartments and number of occupants per apartment. Rental charges could be combined with annual fixed charges.

#### Subsidies or full cost-recovery?

In Finland the Government has supported water supply and sewerage via low-interest loans and partial grants. The Government support is seen as important for developing large areal systems as well as for schemes in sparsely populated rural areas. In areal systems it has been typical that the long-distance water and sewage transfer mains have been partially financed by grants. This is deemed justified for controlling the need to raise water prices as well as for supporting water pollution control programmes. However, there is no direct subvention of less profitable works by more prosperous ones. Neither are there any regional or national charges

but each public water and sewage works has its own tariff system and rate.

In the OECD-countries subsidies have varied greatly being, surprisingly, generally higher in Australia, Japan and North America. Waste water service subsidies are, in general, higher than in water supply. The highest subsidies exist for irrigation projects. The general trend is to decrease subsidisation (OECD 1987).

In the European countries ECE (1986) noticed that as the water supply and sanitation sector develops further, it tends to become self-supporting. In Finland this situation is close because support in the form of low interest loans is only a few per cent of the total investments (Liimatainen 1988). ECE (1986) recommended that in countries with a rather incomplete infrastructure, governments should continuously support the sector.

Piippo (1984) discussed the role of taxation in the sector. In Finland the private households consume 50—60 per cent of water supply, sewerage, electricity and district heating services. If these services are paid for by local tax revenues the share of costs to be covered by private households rises up to 90 per cent. The sharing of costs based on pricing water for private, industrial and institutional users would be much more appropriate.

The World Bank has pointed out that subsidies do not often benefit the original target group. According to OECD (1987) the Australian and Canadian views were highly critical of subsidies because of their inefficiency. WHO (1987) concluded that the typical policy in developing countries of supplying water free of charge means in practice that service cannot be extended to others.

### How to increase water charges?

In developed countries such as Finland there is a trend toward regional and national management of local water supply and sewerage systems. Hanke (1981 b) noted that in that kind of situation inter-system equalization policies are developed. It means that all customers in a certain customer class pay the same price per unit volume regardless of their location. Hanke's view is that equalization discriminates against systems that control their costs and favour those that do not. According to National Utility Services (1987) there are plans in the United Kingdom to do away with general rates which have involved equalization within regional water authorities.

The author's view is that in most cases consumer prices based on full cost-recovery are the

most efficient and also the most equitable alternative. There still exist several instances where partial subsidization can be considered beneficial.

The author agrees with Daily et al (1988) who have found that people are willing to pay a fair price for something they value. Daily et al introduced a public education campaign to promote the acceptance of rate increases. There were three distinct groups: direct consumers, elected officials and the media. Each group had its own unique requirement for information. With this approach a 45 per cent increase in rates was achieved without public opposition. Particularly in the developing world it is often difficult to raise or even introduce water prices. Politicians often tend to use water services as a means to get votes. Thus the need for public education in those conditions is even higher.

About thirty years ago Murdoch Jr. (1956) did a historic review of water pricing in the USA. His conclusion was that water has traditionally been too cheap. Low rates and poverty of water works have meant that customers have not been able to get service when wanted. The author's view is that the criticism is still partly true. In developing countries this problem is very serious.

## DISCUSSION AND CONCLUSIONS

### Water pricing in developed countries

The following conclusions can be drawn on water and sewage charges in Finland and some other developed countries:

- (i) Water and sewage charges have some effect on water consumption patterns and wastage.
- (ii) Water metering for individual houses is getting more popular. In this respect Finland is quite advanced.
- (iii) In 1977—1986 the water charges in Finland stayed practically the same whereas sewage charges increased in real terms.
- (iv) In Finland the maximum water consumption charge is about 20 times the minimum charge. The respective variation in sewage works is about 10-fold.
- (v) Volume-based water prices in Finland are lower than in most other OECD-countries.
- (vi) Three-fourths of the total costs of water are created in the buildings themselves when taking into account the pipelines, equipment and devices in the buildings as well as the use of water. From this viewpoint water is a very cheap commodity in Finnish conditions.

- (vii) Water supply and particularly sewerage services have been underpriced in Finland, whereas electricity and district heating have been overpriced. Cost-recovery is, however, highly dependant on the calculation method (interest and depreciation).
- (viii) In Finland and a number of other OECD-countries about 80 per cent of the total costs are fixed, i.e. independent of water consumption. Increasing the share of fixed charges in Finland should be considered although the local conditions should be decisive.
- (ix) In areas with scarce resources, a tariff structure of increasing blocks should be considered to avoid water wastage and to secure efficiency.

In Finland water and sewage charges will be fairly low also in the future due to the general availability of water resources. It is, however, evident that consumers would be willing to pay more for better quality water.

### Implications for the developing world

In the developing countries it has been common to try to supply water free of charge for some categories of users. Laugeri (1987) noted that the problem is generally no longer whether to charge but of deciding to what extent the costs should be covered. Everyone should pay their share but not necessarily the same amount, in the same form or at the same time.

The experiences of developed countries cannot naturally be directly transferred to the developing world. In fact Warford & Julius (1979) pointed out that there is much that technologically advanced countries facing the problem of scarce water resources can learn about water pricing in the developing world. The author agrees but also believes that the findings of this study on the experiences in Finland and other developed countries indicate some of the key constraints and possible paths of development such as:

- (x) In general, water is not a free commodity in developed countries and consumers pay at least a part of the costs. Taxation is often less equitable than direct consumer charges.
- (xi) The rate of water charges should be related to the real costs of water production. A national or regional tariff does not take into account the differences in local conditions and is therefore not recommended for me-

tered water. However, when applied to the poorest users in the urban fringe and rural areas regional tariffs can be considered justified.

- (xii) Charges based on consumption decrease wastage of water which is important particularly in areas with scarce water resources.
- (xiii) Seasonal and increasing block tariffs could be considered for the dry season.
- (xiv) Municipal and industrial sewage charges should be taken into use also in developing countries.

### ACKNOWLEDGEMENTS

This paper is part of a research project financed by the Finnish International Development Agency (FINNIDA). The author wishes to thank Prof. Matti Viitasaari and the colleagues from Tampere University of Technology as well as several Finnish experts for their contribution and comments on the paper. Special thanks go to Mr. L. Laugeri from WHO, Geneva and Mr. P. Jalkanen from the Association of Finnish Municipalities for reviewing the article.

### TIIVISTELMÄ

Artikkeli käsittelee vesi- ja jätevesimaksujen kehitystä Suomessa ja eräissä muissa kehittyneissä maissa. Tämä osaselvitys liittyy kirjoittajan laajempaan tutkimushankkeeseen, joka tarkastelee kustannusvastaavuuden merkitystä vesihuollon toimivuudelle kehitysmaissa.

Suomen, kuten monen kehittyneen maan, oloissa veden hinnalla voidaan jossain määrin hillitä veden kulutusta. Suomen kaupunkien vesilaitosten tulot perustuvat lähes yksinomaan vedenkulutusmaksuihin ja jäteveden käyttömaksuihin. Kuntien vesi- ja viemärlaitoksilla saadaan noin kolmannes tuloista liittymismaksuilla. Vedenkulutus- ja käyttömaksut ovat Suomessa nykyisin käytännöllisesti katsoen kulutusmääristä riippumattomia.

Viimeisen vuosikymmenen aikana vedenkulutusmaksut ovat pysyneet reaalisesti samalla tasolla. Jäteveden käyttömaksut ovat reaalisesti kasvaneet. Suurimman ja pienimmän vedenkulutusmaksun ero Suomessa on noin 20-kertainen ja jäteveden käyttömaksun ero vastaavasti noin 10-kertainen. Useimmissa tapauksissa vesilaitokset ja erityisesti viemärlaitokset ovat alijäämisiä. Tämä riippuu kuitenkin ratkaisevasti käytetyistä koron ja poiston laskentamenetelmistä. Suomessa vedestä perittävät mak-

sut ovat alhaisempia kuin useimmissa OECD-maissa.

Kehittyneiden maiden kokemukset veden hinnoittelusta eivät sellaisenaan ole siirrettävissä kehitysmaihin, mutta ne antavat kuitenkin pohjan mahdollisille kehityspoluille.

## REFERENCES

- Association of Finnish Cities. 1982. Liikelaitostyöryhmän loppuraportti. (Final report of the committee on municipal enterprises.) Publication C 47. (Original in Finnish).
- Association of Finnish Cities. 1984. Kaupunkien maksupoliittiset tavoitteet. (The financial policy objectives of cities.) Publication C 63. 24 pp. + 12 Appendices. (Original in Finnish).
- Association of Swedish water and sewage works. 1987. Va-taxor 1987. (Water and sewage charges.) Report VAV TX87. 48 pp. (Original in Swedish).
- AWWA (American Water Works Association). 1984. Rates, health research top list of national water problems. *Mainstream*, Nov. 1984. Cited by Grigg, N. S. 1986. *Urban water infrastructure: planning, management and operations*. John Wiley & Sons. 328 p.
- Carver, P.H. & Boland, J.J. 1980. Short- and long-run effects of price on municipal water use. *Water resources review*. 16.4: 609–616.
- Daily, J., McKinley, L. & High, T. 1988. Educating the public about sanitation rate increases. *Journal WPCF*. 60.2: 180–183.
- ECE (Economic Commission for Europe). 1986. Water supply and waste water management in changing economies. Committee on water problems. *ECE/Water/45*. 11 pp.
- Erkiö, E. 1983. Lämpimän käyttöveden huoneistokotaintain laskutus. Kokemuksia perusparannuskohteista. (Experiences on charging for hot water consumption in renovated buildings.) *Energialoudellinen yhdistys*. Raportti 9/1983. 33 pp. + Annexes. (Original in Finnish, Abstract in English).
- ETLA (Elinkeinoelämän valtuuskunta). 1987. Suhdanne. (Economic prospects.) 1987/3. 158 pp. (Original in Finnish).
- Gibbs, K.C. 1978. Price variable in residential water demand models. *Water resources research*. 14.1: 15–18.
- Gundermann, H. 1986. Water tariffs as an instrument to influence demand. 18 pp.
- Hanke, S. 1981 a. On the marginal cost of water supply. *Water/engineering & management*. 128.2: 60–63.
- Hanke, S.H. 1981 b. On water tariff equalization policies. *Water/engineering & management*. 128.8: 33–34.
- IWSA (International Water Supply Association). 1982. Cost structure and charges. General report 4. IWSA conference in Zürich, Switzerland.
- Kalliomäki, M.-L. 1988. (Draft). Kuntien liikelaitostöiminnan ja kiinteistönhoidon tavoitteellinen kehittäminen. (Development of activities of municipal enterprises and building management.) (Original in Finnish).
- Katko, T. 1986. Major constraints in water supply in developing countries. *Aqua Fennica*. 16,2: 231–244.
- Kiuru, H. 1987. Vesi- ja viemärilaitosten taloudenpito. (Financial management of water supply and sewage works.) *Rovaniemi* 10.12.–11.12.1987. Vesihuoltoliitto. 6 pp. (Original in Finnish).
- Korhonen, M. 1988. Personal communication.
- KULAUS (Kunnallisen laskentatoimen uudistamistoimikunta). 1974. Pääomakustannuslaskentasuositus. (Recommendation on investment cost calculation.) Report no. 2174. 47 pp. (Original in Finnish).
- KUVENE (Kunnallisen vesihuollon neuvottelukunta). 1978. Vesi- ja viemärilaitosten kuluttajamaksut ja talous 1976–77. (Consumer charges and economy of water and sewage works in 1976–77.) 86 pp. + 5 Appendices. (Original in Finnish).
- KUVENE (Kunnallisen vesihuollon neuvottelukunta). 1982. Vesi- ja viemärilaitosten taksat ja taksarakenne. (Tariffs and tariff structures of water supply and sewage works.) 32 pp. (Original in Finnish).
- Lauger, L. 1987. Water for all-who pays? *World health forum*. Vol. 8: 453–460.
- Liimatainen, J. 1981. Vesi- ja viemärilaitosten maksuista ja taloudesta. (On the charges and economy of water supply and sewage works.) *Suomen kunnallislehti*. 66.17: 8–9. (Original in Finnish).
- Liimatainen, J. 1988. Personal communication.
- Lindblad, N. 1987. Va-taxor. Trender och problem. (Water and sewage charges. Trends and problems.) In: Svensson, H. (ed.) 1987. *Ekonomi i VA-verksamheten*. (Economics of water supply and sewage works.) Association of Swedish water and sewage works. Report VAV M57. 75 pp. (Original in Swedish).
- Lobb, H.J. 1975. Demand-rate economics. *Journal AWWA*. 67.5:246–250.
- van der Mandele, H.C. 1987. Liquidity maintenance as a basic criterion for the determination of appropriate potable water rates. Background paper. In: WHO. 1987.
- Mann, P.C. 1987. Reform in costing and pricing water. *Journal AWWA*. 79.3: 43–45.
- Miller, J.W. 1984. Old water — new water: setting equitable water rates for suburban customers. *Journal AWWA*. 76.9: 34–41.
- Murdoch Jr., J.H. 1956. 75 years of too cheap water. *Journal AWWA*. 48.8: 925–930.
- National Board of Waters, Finland. 1979–1986. Vesihuoltolaitokset. (Water supply and sewer systems.) Reports no. 163, 180, 195, 214, 223, 240, 249, 261, 279. (Originals in Finnish, partly in English).
- National Board of Waters Finland. 1986 b. Vesi- ja viemärilaitosmaksut. (Water and sewage charges.) 1.1.1986. Vesihallituksen monistesarja no. 441. 38 pp. (Original in Finnish).
- National Board of Waters, Finland. 1986 b. Vesi- ja viemärilaitosmaksut. (Water and sewage charges.) 1.1.1986. Vesihallituksen monistesarja no. 441. 38 pp. (Original in Finnish).
- National Utility Services. 1987. International water price comparison. 12 p.
- OECD, 1987. Pricing of water services. Paris, France. 145 pp.
- Peltokangas, J. 1988. Vesihuollon talous. (Economics of water supply and sanitation.) Tampere University of

- Technology, Construction economics. Publication no. 1988/3. 93 pp. + Appendices. (Original in Finnish).
- Piippo, R. 1984. Maksu- ja taksapolitiikan vaihtoehtojen vaikutukset. (The effects of alternative tariff policies.) Teknisten lautakuntien täydennyskoulutuspäivät. Savonlinna 6.—7.3.1984. 4 pp. (Original in Finnish).
- Rosengrén, R. (Unpublished). 1981. Veden kulutuksen ja asukasluvun kehitys Turussa vuosina 1977—1980. (Trends of water consumption and population growth in the city of Turku in 1977—1980.) Tutkimustiivistelmä. 3 pp. (Original in Finnish).
- Schlenger, D.L. 1986. The application of zonal pricing to a metropolitan water utility. Doctoral dissertation. University of North Carolina at Chapel Hill. 247 p.
- Turvey, R. 1969. Marginal cost. *Economic journal*. June 1969.
- United Nations. 1980. Efficiency and distribution equity in the use and treatment of water: guidelines for pricing and regulations. United Nations. Natural resources/Water series no. 8. ST/ESA/103. 175 pp.
- Warford, J.J. & Julius, D.S. 1979. Water rate policy: lessons from less developed countries. *Journal AW-WA*. 71.4: 199—203.
- WHO. 1987. Cost recovery in community water supply and sanitation. Report of the second informal consultation on institutional development. Geneva, 5.—9. October 1987. WHO/CWS/87.5. 41 pp.

*Received 25 July 1988*

*Accepted 5 August 1988*