Economics of Metering Rural Water Supply Systems — A Case Study

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In the beginning of year 1982 the Uttar Pradesh Jal Nigam had undertaken study of water consumption and other parameters in three selected rural water supply systems and it is still continuing. Prior to undertaking the study the water supply in all these villages was intermittent, but was made continuous to make the study meaningful. Out of three, in two systems all connections were provided with water meters. In the third, metering was not done so as to compare the consumption and other factors.

In this paper the author presents the effect on consumption of water through household connections on metering, based on the recorded consumption figures for a period of 4 years. The average consumption of water in metered connections was about 50 litres *per capita* per day which is well within the accepted norms and about 40 per cent of that in unmetered ones. The question of metering has all along been controversial. Based on the actual data of study, available and adopted norms and some assumptions made in working out the cost for metering, it is revealed that supply through metered connections is economical than in unmetered systems. Obviously the situation in urban areas will be more alarming when metering is not practised.

1. INTRODUCTION

Safe, adequate and reliable water supply at a minimum cost is the prime objective of any system. Only continuous supply can ensure safety by way of keeping adequate pressures in the distribution system to avoid contamination from outside and making water available round the clock, to upgrade its hygienic quality and safeguarding against the risk of fire. It is also well established that unless all connections are provided with meters, the system cannot practically be run on continuous basis at reasonable/accepted norms of water supply. If an unmetered system is required to be run on continuous basis, the consumption *per capita* becomes excessive and goes beyond resources. The rural water supply systems are no exception to this.

Almost all rural pipe water supply systems in India have intermittent supply, period ranging from half-an-hour to 8 hours per day. This has been mentioned in the evaluation report on rural water supply schemes by the National Environmental Engineering Research Institute, Nagpur, published in the year 1980-81.

In order to ascertain actual consumption, fluctuations in demand during different periods, socio-economic conditions etc. and then to frame realistic water tariff, the Uttar Pradesh Jal Nigam, has selected some small urban and rural water supply systems in Bundelkhand area of the province. The selected area is a fair representation of typical water scarcity, hot climate and general socio-economic conditions in the country. The studies in the area

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were started in the year 1980-81 by a special unit named as 'Tariff Unit Jhansi'.

2. LOCATION & SALIENT FEATURES OF VILLAGES SELECTED

The study was conducted in following villages/group of villages which form part of the bigger three groups of villages in Bundelkhand area of Uttar Pradesh.

(i) *Bijauli (Distt. Jhansi)* is one of the 14 villages of Jhansi-Babina group of villages, getting water from Matatila dam commissioned in the year 1967. The present population of the village is about 2440, located at a distance of about 10 Kms. from Jhansi town and well connected by road and railway from Jhansi to Babina.

(ii) 5 villages viz. *Khadesra Kala, Pawa, Nata, Kurmai and Hanota* (Distt. Lalitpur) are part of Talbehat groups of 8 villages which also get water supply from Matatila dam with separate treatment works. These are located about 50 to 55 Kms. from Jhansi on way to Lalitpur. The present population of these villages is about 3620.

(iii) *Bahadurpur and Bachhrawani* (Distt. Lalitpur) are villages of Mahrauni and Madaura group of 36 villages which get water from Jamni dam. The water supply was commissioned in the year 1971. The present population of these two villages is about 1375, and are located in an interior area which is about 170 Kms. from Jhansi and 70 Kms. from Lalitpur, having about 8 Kms. of dry weather road.

The maintenance of water supply in all the groups of villages is being done by the Jhansi Division, Jal Sansthan which is an autonomous local body entrusted with the task.

3. METHODOLOGY

Before the study was started water was being supplied through unmetered connections and the period of supply varied from 4 to 6 hours per day. In order to study the effect of metering all connections in the selected villages of Jhansi-Babina and Talbehat groups were first provided with water meters and then bulk meters were also installed to measure the total supply. The two villages of Mahrauni and Madaura group were selected for studying the effect of unmetered supply. Door to door survey was also carried out to know the number of persons benefited by each connection, their socio-economic conditions, etc. by the staff of the Tariff Unit, Jhansi.

The objectives of the study included:

(a) Consumption of water through connections and standposts.

(b) Variations in hourly, daily, monthly and seasonal demands.

(c) Unaccounted for water through wastage, leakage, pilferage and to suggest ways and means to reduce it.

(d) Performance of water meters and their maintenance/repair cost.

(e) Effects of other sources of water on the number of private connections.

(f) Consumption rate of water by different income groups.

Initially, for one year hourly consumptions at all the three groups were recorded. Later, hourly recording was discontinued in case of Bijauli and Mahrauni Madaura groups. The monthly readings of all meters provided on private connections and daily consumption of all bulk meters are being taken by the Jal Nigam staff and results tabulated to assess actual consumption and wastage of water.

TABLE 1: DETAILS OF WATER CONSUMPTION

Sl. No.	Name of Group / Category / Year	Talbehat METERED				Bijauli METERED				Bahadurpur & Bachharaon UNMETERED			
		1982	1983	1984	1985	1982	1983	1984	1985	1982	1983	1984	1985
1.	2.	3.	4.	5.	6.	7	8.	9.	10.	11.	12.	13.	14.
1.	No. of villages studies	5	5	5	5	1	1	1	1	2	2	2	2
2.	Total population	3405	3475	3546	3618	2298	2343	2391	2440	1295	1321	1348	1375
3.	No. of connections	66	68	74	76	65	72	77	83	31	31	31	31
4.	Population actually served	506	521	560	575	597	648	680	718	396	396	396	396
5.	Hours of supply	24	24	24	24	24	24	24	24	24	24	24	24
6.	Average water supply per day (KLS) ...	47.2	43.5	46.7	56.5	33.6	38.4	46.3	60.3	102.2	93.1	68.5	80
7.	Average water actually consumed per day (KLS)	28.3	26.1	28.0	33.9	25.1	29.2	34.7	45.2	61.3	55.9	41.1	48
8.	Average water actually consumed per *capita*/per day (lpcd)	56	50	50	59	42	45	51	63	154	141	103	121
9.	Average consumption *per capita*/per day over a period of 4 years (lpcd) ...		54				50				130		

In order to know the performance, cost of repairs, frequency of break-downs, etc. of water meters, 36 water meters of 7 manufacturers are under observation since January, 1982. To have more representative idea of the cost of repairs of water meters in service for a longer period, the statistics of repairs carried out at other workshops have also been considered.

4. FINDINGS

1. The quantities of water consumed in metered and unmetered supplies have been tabulated in Table I. In case of metered supply the *per capita* consumption ranged from 42 to 63 and in unmetered from 103 to 154 litres per day. Thus in unmetered supply where additional precautions were taken to stop leakages and consumers persuaded to avoid wastage, the rate of consumption was about 250 per cent higher than that in metered supplies. This is because of the fact that in case of unmetered supply the consumer pays only fixed charges irrespective of the water actually consumed.

2. The studies confirm that in rural areas water can easily be supplied on continuous basis at lesser *per capita* rate than normally designed rate of 70 to 90 lpcd when metering is resorted.

3. In metered supplies the number of house connections increased by about 21 per cent in a period of 4 years while in unmetered supplies there has been no increase. Though exact reasons for this abnormal phenomenon could not be known, however it is partly explained by the fact that average number of persons served, per connection in this category is 13 as against 7 in metered supply.

4. The average chance of breakage/repairs of water meters during four years period was observed as about 22% (Table II) in a year.

TABLE II: STATEMENT SHOWING THE FREQUENCY OF BREAK-DOWN OF WATER METERS

Sl. No.	Year	No. of meters	No. of break down	Percentage of breakdown (%age)
1.	1982	36	NIL	Zero
2.	1983	36	9	25
3.	1984	36	15	41.6
4.	1985	36	8	22.2
	TOTAL	144	32	22.2

5. Against the cost of metering as Rs. 6.45 per connection per month (Annexure A) the cost of extra water supplied in unmetered connection works out to Rs. 14.25 (Annexure B). This clearly shows that metering is much cheaper besides having the advantages of not making unnecessary investment in capital works and forcing the consumers to conserve the commodity which is getting scarce day by day in view of the increased needs.

5. SUMMARY & CONCLUSIONS

The studies undertaken by the Jal Nigam are of pioneering nature and have established, contrary to belief and trend, that rural water supply systems can easily and economically supply water on continuous basis within reasonable and accepted *per capita* rate of water, provided all connections are metered and charged according to the actual quantity of water consumed.

Metering has further advantages of charging the consumers on equitable basis, provides information about wastage of water, indicates trend in consumption of water thereby helping in future planning, provides basic data for framing the water tariff, ensures, supply to all beneficiaries at reasonable pressure and finally becomes a handy tool for conservation of water, particularly in scarcity.

The Jal Nigam is continuing the study of the selected areas, for collecting data on long term basis.

ANNEXURE — A

COST OF WATER METERING

The cost of metering includes the following components:

1. Repayment annuity of the cost of water meter and its installation including safety box.
2. Annual repair charges.
3. Reading and billing.

The average costs of the above components are as below:

Annuity:

(a) Cost of water meter		Rs. 150.00
(b) Fittings & fixing		Rs. 20.00
(c) Safety box		Rs. 30.00
	Total	Rs. 200.00

Taking average life of water meter as 10 years and loan to be repaid in 10 years with an annual rate of interest of 9.5%

Annuity on Rs. 200 = 200 × 0.15927

Rs. 31.85

which is equal to about Rs. 2.65 to be paid monthly.

Annual repairs

(a) Taking out and refitting

Assuming that one plumber can attend 4 such meters per day

$$\text{Average cost} = \frac{25}{4} = \text{Rs. } 6.25$$

(b) Transportation charges from consumers to workshop & back Rs. 10.00

(c) Repairs on materials & labours Rs. 20.00

Total = 6.25 + 10.00 + 20.00 = Rs. 36.25

Presuming that on an average a meter needs repair/servicing once in two years, the monthly cost of repair will be:

$$\frac{36.25}{2} \times \frac{1}{12} = \text{Rs. } 1.51$$

Add 20% overhead charges, net = 1.51 × 1.20

= 1.81

Say Rs. 1.80

Reading & Billing

The calculations are based on experience that a meter reader-cum-billing clerk can complete about 15 meters per day. The working days are taken as

20 in a month and billing is done on bi-monthly basis. The monthly cost works out:

Salary of person	=	Rs. 800.00
Supervisory charges @ 20%	=	Rs. 160.00
Travelling & other expenses (L.S.)	=	Rs. 240.00
Total		Rs. 1200.00

Monthly cost of billing per meter $= \frac{1200}{15 \times 20 \times 2} = \text{Rs. } 2.00$

Total cost of metering per month (i) + (ii) + (iii)
= 2.65 + 1.80 + 2.00 = Rs. 6.45

ANNEXURE — B

COST OF EXTRA WATER CONSUMED IN UNMETERED SUPPLY

The extra cost of water consumed consists of components of capital works and production cost of water.

(A) *Capital Cost*

The study reveals that the actual consumption is 54 lpcd, in metered connection while that is 130 lpcd in an unmetered connection.

Taking average capital cost of production.

(i) for 70 lpcd = Rs. 300/capital.

(ii) for 130 lpcd = Rs. 450/capita.

Extra capital cost of production in an unmetered supply over a metered supply per connection for a family of 7 persons.

$= 150 \times 7 = \text{Rs. } 1050$

Loan to be repaid in 30 years in equal yearly instalments annual rate of interest @ 9½%. (The life of the works is taken as 30 years).

Annuity per connection = 0.10806 × 1050 = Rs. 113.45 per year
= Rs. 9.45 per month.

(B) *Cost of Water*

Quantity of extra water per connection/month

$= (130 - 54) \times 30 \times 7$
$= 15960$ litres.

Assuming average cost of production is Rs. 0.30 per 1000 litres, the cost of extra quantity of water per connection per month.

$\frac{15960}{1000} \times 0.30 = \text{Rs. } 4.78$

Total cost per month per connection = A + B
= 9.45 + 4.78
= Rs. 14.23
Say Rs. 14.25