USER FINANCING AND COLLECTIVE ACTION RELEVANCE FOR SUSTAINABLE RURAL WATER SUPPLY IN INDIA

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Working Paper No. 274

March 1997

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ABSTRACT

Financial resource needed for sustainable rural drinking water is estimated from expenditure data for all states in India. The estimates show that user financing becomes essential for sustainability of the system. Since user financing affects weaker sections adversely, a subsidy from consumers above poverty line to those below is incorporated in the tariff design along the Faulhaberian principles. The rate so arrived at, indicates that public subsidy is still needed for some states with high cost of provision due to their hydro-geological and topographical conditions and/or cost inefficiency. Analysis of institutions based on cooperative action among users suggests that they have several advantages over the other polar alternatives, state ownership and privatisation, in providing potable water. Participatory management inherent in such institutions also enables the government to change its role from provider to facilitator.

JEL Classification : R48

Key words : sustainability, user financing, cross subsidy, stand alone cost, replacement cost, operations & maintenance cost, tariff rate, institutions.

Dedicated to our Professor, Dr. T. N. Krishnan,

for initiating this area of research.

Introduction

User financing, contribution by users in cash or in kind individually or as a group to the capital and/or recurring cost, in the provision of basic services has been suggested as a source of raising resources to meet the increasing shortfall in the budgetary transfers to the sector in the developing countries[1]. Several other reasons are also given for such a policy change. Most important among them are: (a) efficiency; (b) equity; and (c) sustainability. The increase in efficiency, it is argued, comes from both sides of supply and demand. User fee imposed for a hitherto free good restricts over-exploitation of the resources and thereby enhances demand side efficiency. Supply side efficiency is attributed to the probable quality and quantity improvements arising out of accountability on the part of the providers. Equity argument is centered around increased availability of services with better quality at a subsidised rate for users belonging to the group exempted from cost recovery. Sustainability is attributed to better maintenance and timely replacement/augmentation of existing systems using resources generated from user charges. International evidence on the validity of these hypotheses is very weak at least for basic services especially water supply

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[1] Basic services include health, education, drinking water, nutrition, etc..

and sanitation[2]. The case of rural water supply is even weaker mainly due to the dearth of theoretical and empirical research on these aspects. This paper makes an effort to link the urgent need for user financing with sustainability of rural water supply in India[3]. In order to achieve this, one should also evaluate the appropriate institutional arrangements other than the present state provision, the relevance of which is also examined.

The outline of the paper is as follows. Section 1 defines sustainable development and estimates its financial burden on states and households for rural drinking water supply. Section 2 designs a tariff rate with cross-subsidy between users above and below poverty line. A methodology is also developed to estimate rates separately for piped water supply and hand pumps in order to avoid overcharging the users of hand pumps. Section 3 reviews alternative institutions for making the sector financially viable and sustainable. The last section provides the summary and conclusions.

I

1.1 Sustainable development

The concept of sustainability in economic development has been discussed and debated in the context of inter-generational equity. But its relevance to water resources development, especially for drinking water, is increasingly gathering momentum throughout the world. An influential work in this context is by Serageldin on water supply, sanitation

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[2] See Reddy (1996), for an excellent survey.

[3] The issue has been emphatically argued from a global perspective by Serageldin (1994, 1995).

and environmental sustainability published in the series on Direction of Development by the World Bank[4]. The main focus of this study was on financing challenges facing the sector globally for achieving sustainable and environmentally sensitive use of water resources. This challenge, he argues, has two important components: (i) Providing water supply and sanitation to the millions of families yet to be served with the facility; and (ii) Maintaining the quality and quantity of the services already provided. The financial burden of the first task is easy to assess while that of the second is cumbersome, unless a measurable version of sustainability incorporating quality is identified. Since quality in the context of environmental sustainability is an intractable problem from the empirical point of view, it is not considered for the present analysis.

Sustainability literally means 'keep going or maintain'. Several definitions have been given in the literature by development economists. Among them, the Hicks-Page-Hartwick-Solow (HPHS) version seems to be more appropriate for measurement. More specifically, sustainable development occurs if real consumption remains constant through time while keeping capital stock intact[5]. Capital stock remains intact only if it is replaced when its life expires. For this purpose, a replacement value need to be collected regularly. Even if capital is replaced, the real consumption may go down unless additional finances are raised for operation and maintenance of the system. This explicitly establishes the relationship between physical and financial sustainability as discussed by Serageldin in the context of 'new agenda' facing the sector. Now let us examine this linkage empirically to measure its burden on households and/or the government.

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[4] See Serageldin (1994).

[5] Pearce and Atkinson (1995), p.167 for a survey of definitions.

The HPHS definition includes three forms of capital stock: (a) human capital; (b) natural capital; and (c) man-made capital. Measurement of human capital presents 'immense difficulties' in general and water supply in particular since it deals with the stock of knowledge and skills developed through generations[6]. Natural capital here refers to the value of renewable resources. In the present context it is the value of ground and surface water existing at a given point of time. Moreover such values are influenced by hydrology, topography and climatic variations of the region. Since water in the above forms is not treated as an economic good in most of the developing countries, valuation of the resource becomes very difficult if not impossible. Even if one could evaluate it, such estimates are subject to a wide margin of error. Hence, we have not made any attempt to value this form of capital as well. As a result, capital stock is restricted to 'man-made capital' including expenses on operation & maintenance (hereafter O & M) of the system. In other words, it is the sum of the value of reproducible capital and expenses on O & M. The estimation of these components is discussed below.

1.2 Estimation of capital stock and replacement cost

Estimation of capital stock is a controversial issue both in theory and in practice. The issues are very familiar; therefore we do not enter into a discussion[7]. Quite often, perpetual inventory method is used for the estimation of capital stock. This requires calculation of capital stock in a benchmark year and investment in the subsequent years. This again needs book value and age structure of capital in the benchmark year. In

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[6] See ibid p. 168.

[7] An excellent survey of the literature is given in Goldar (1986) and Hashim & Dadi (1973).

the present context, it consists of assets created for piped water and hand pump. The measurement of capital stock in a piped system, unlike hand pumps, varies substantially due to variations in intake system, raw water conveyance, treatment plant and distribution networks resulting from hydro-geological conditions. Neither the values of these assets nor their age structure are available systematically and/or on a comparable basis for the sector. Only aggregate expenditures, that too from 1977 onwards, are available for the above estimation. In principle, the capital expenditure on piped water supply can be obtained as a residual from the aggregate if time series data on hand pumps are known. Unfortunately, this information is available only for selected years and hence even the residual method cannot be applied. As a result of severe restrictions on data, the following methodology is used for obtaining the capital stock of the aggregate sector.

1.3 Aggregate sector

Gross capital stock in any year is equal to the cumulative investment in previous years adjusted for price change plus current capital addition. But, for its calculation, only annual expenditures since 1977/98 are available from Rajiv Gandhi National Drinking Water Mission (hereafter Mission)[8]. The Mission provides them on two different heads: (i) Accelerated Rural Water Supply Programme (ARWSP); and (ii) Minimum Needs Programme[9] (MNP). According to the Mission, only a portion is spent on reproducible capital. More specifically, about 90% of ARWSP and 60% of MNP expenditures contribute to the capital

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[8] The mission, an agency constituted by the Government of India, is responsible for the provision of public drinking water in rural India.

[9] ARWS are programmes with 100% grant-in-aid from Government of India to provide drinking water at the rate of 40 litres per capita per day. MNP refers to the states' own resources of borrowed funds.

formation in the sector[10]. Using these proportions, the total capital expenditure is estimated for each year. The annual expenditure is then adjusted for price change with appropriate price index[11]. The cumulated expenditure in constant prices is taken as capital stock. In order to estimate the annual recovery for replacement, we need life of the system. This is taken as 15 years as suggested by the Mission. Hence capital expenditures starting from 1980/1981 alone are considered and the period of analysis is restricted to 1980/81 - 1994/95. During this period, replacement cost in year t' (R_t) is calculated using the following formula:

$$R_t = \sum_{i=0}^{14} A_{t-i} \qquad \text{....... (1),}$$

$$t = 1980/81,.., \quad 1994/95.$$

where $A_{t-i} = I_{t-i}/15$, I_{t-i} is the capital expenditure in year t-i. In an inflationary world, annuity does not remain uniform throughout the life of the system. For instance, the annuity in 1994/95 arising from 1980/81 expenditure is lower in value due to inflation during the fourteen years. Therefore annuity from different years of capital expenditure needs to be adjusted for inflation to keep it uniform. Hence total replacement in year 1994/95 is the sum of inflation adjusted annuities arising from 1980/81 onwards. Since there exists severe dearth of time series data on O & M, it is taken as 6% of the cumulated capital expenditure as suggested by the Mission[12]. The results are reported in Table 1.

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[10] The remaining is accounted either as operational expenses or as establishment charges.

[11] For construction of price index, see Pushpangadan and Murugan (1995).

[12] This is the standard ratio used by the Mission for allocation of funds for O & M.

Table 1. Cost estimate for sustainability in rural water supply, 1994/95.

State/Union Territories	Replacement cost (Rs. crores)	Capital cost (Rs. crores) [1]	O & M cost (Rs. crores)	Per capita capital cost (Rupees) [2]
Andhra Pradesh	58.73	557.91	33.47	145.03
Arunachal Pradesh	7.16	71.33	4.28	1153.78
Assam	39.97	361.64	21.70	272.30
Bihar	53.69	478.47	28.71	68.84
Goa. Daman & Diu	3.09	30.36	1.82	546.94
Gujarat	47.07	444.06	26.64	190.57
Haryana	31.58	271.24	16.27	817.05
Himachal Pradesh	35.10	313.56	18.81	846.93
Jammu & Kashmir	47.15	414.83	24.89	926.25
Karnataka	52.86	486.86	29.21	190.38
Kerala	42.81	384.28	23.06	456.76
Madhya Pradesh	74.15	645.68	38.74	152.53
Maharashtra	121.58	1058.81	63.53	239.13
Manipur	10.79	89.58	5.37	1179.68
Meghalaya	11.85	104.07	6.24	911.96
Mizoram	4.83	44.31	2.66	2003.84
Nagaland	8.51	65.62	3.94	1338.99
Orissa	33.74	306.20	18.37	160.21

Table I. (Contd....)

Punjab	18.66	170.51	10.23	192.44
Rajasthan	85.35	789.66	47.38	305.06
Sikkim	7.05	63.40	3.80	2260.91
Tamilnadu	56.83	524.49	31.47	235.69
Tripura	9.03	81.18	4.87	510.29
Utter Pradesh	116.18	1024.33	61.46	132.06
West Bengal	36.21	323.22	19.39	93.41
UTs [3]	10.93	50.65	3.04	1752.93
All India	1019.42	9156.23	549.37	190.35

Note: [1] Cumulative capital expenditure from 1980/81.
[2] Capital cost ÷ population covered.
[3] Includes Andaman & Nicobar islands, Chandigargh, Dadra and Nagar Haveli, Delhi, Lakshadweep and Pondicherry.

Source: *Government of India [1996].*

The table shows that financial resources needed for keeping capital stock constant at the aggregate, come to the tune of Rs. 1019 crores. In the same year, O&M need for the sector is Rs. 549 crores. The capital expenditure per person for provision of drinking water at the national level is Rs. 190.4 which varies from as low as Rs. 68.8 in Bihar and as high as Rs. 2260.9 in Sikkim. It is to be noted that the per capita cost is lowest among the states which predominantly exploit ground water. Hilly regions like Sikkim, Mizoram, Nagaland, Manipur and Arunachal Pradesh have the highest per capita investment which could be attributed to different technology or inefficiency in production. Analysis of the factors affecting inter-state variations in capital cost cannot be undertaken at the moment due to non-availability of information. The estimates reported here have a bias due to the assumption of uniform life for both the systems, piped system and hand pump as demonstrated by the numerical example given in appendix B.

Table B1 in appendix B shows that the assumption of uniform life makes the recoverable amount lower during the first ten years and higher during the remaining five years of the system. It is also observed that the hand pump sector is charged even after the expiry of its life. If the rate of recovery is same for both systems during the fifteen years, hand pump sector subsidises the piped sector when the expenditure in a year is more than fifty percent on the piped sector and vice versa if the expenditure is more than fifty percent on the hand pump sector.

As a result, any rate based on the above estimates in Table 1 is likely to have a bias depending on the composition of the systems. Therefore we have to estimate the rate for one of the systems independently so that the other can be deducted from the aggregate. For this purpose, hand pump sector is selected mainly due to the availability of cross-section data. This is attempted in the next section.

1.4 Hand pump sector

Latest state-wise data on hand pumps (hps) are available for the period 1993-1995. The age composition of the pumps is unknown; hence no adjustment has been made for hand pumps which have already crossed their life span. Out of a total number of 18.8 lakh hand pumps in 1993/95, only ninety percent (16.9 lakhs) are working. This would mean that the rate of source becoming defunct is about 10% per annum due to various reasons. For arriving at the rate structure needed for a sustainable hand pump sector, information on life of the system, population covered per hand pump, capital cost and expenses on O & M are required. The Mission suggests that the life be taken as ten years; coverage approximately 250 persons per hand pump; average cost of a hand pump about Rs. 15000; and expenses on O & M about 6% of the capital cost, i.e., Rs. 900. Using this information, the financial resource needed for sustainability of the system is estimated for 1993/95, and the results are given in Table 2.

Table 2. Cost estimate for sustainability in hand pump sector, 1993-95.

State/Union Territories	Number of working hps	Replacement cost (Rs. lakhs) [1]	O & M cost (Rs. lakhs) [2]
Andhra Pradesh	186493	2797.40	1678.44
Arunachal Pradesh	20	0.30	0.18
Assam	100050	1500.75	900.45
Bihar	606584	9098.76	5459.26
Goa, Daman & Diu	597	8.96	5.37
Gujarat	54644	819.66	491.80
Haryana	55	0.82	0.49
Himachal Pradesh	4069	61.03	36.62
Jammu & Kashmir	330	4.95	2.97
Karnataka	134016	2010.24	1206.15
Kerala	3635	54.52	32.71
Madhya Pradesh	248265	3723.97	2234.38
Maharashtra	104066	1560.99	936.60
Manipur	1558	23.37	14.02
Meghalaya	684	10.26	6.16

Mizoram	537	8.06	4.84
Nagaland	23	0.34	0.21
Orissa	134822	2022.33	1213.40
Punjab	323	4.85	2.91
Rajasthan	113270	1699.06	1019.43
Sikkim [3]	--	–	–
Tamilnadu	132778	1991.67	1195.00
Tripura	6018	90.28	54.17
Utter Pradesh	374056	5610.84	3366.51
West Bengal	120450	1806.75	1084.05
UTs [4]	1898	28.46	17.08
All India	1694042	25410.62	15246.37

Note: [1] Replacement cost = Total number of working hps x 1500.
[2] O & M cost = Total number of working hps x 900.
[3] No hand pumps.
[4] Includes Andaman & Nicobar islands, Chandigargh, Dadra and Nagar Haveli, Delhi, Lakshadweep and Pondicherry.

Source: *1. Government of India [1996].*
2. Appendix A.

Table 2 suggests that the hand pump sector itself warrants Rs. 254.1 crores for replacement and Rs. 152.5 crores for O & M at the national level. Obviously the inter-state variation is explained by the predominance of hand pumps in the respective states. Let us examine the financial implications of the above two tables for sustainability.

1.5 Implications for financing sustainability

From Table 1, the financial resource needed for keeping capital stock constant at the aggregate is about Rs. 1019 crores in 1994/95. This is about 64% of Rs. 1957 crores, the total expenditure on ARWSP and MNP for 1994/95. Similarly, the O & M comes to about 34% of the above budget in the sector for the same year. If the priority is sustainability of the system, the expenditure for the year 1994/95 is just adequate to meet replacement and O & M, leaving very little for additional coverage and/or quality improvement. But actual expenditures of the states reveal the other way around: it goes mainly to additional coverage leaving very little for maintenance and/or replacement. A recent sample study in Kerala shows that repair and maintenance as percentage of total direct cost has decreased from 11.3 percent in 1987/88 to 2.8 percent in 1990/91. This shows low priority in the allocation of funds for maintenance of the system resulting in cost escalation and shortening the life of the system. Probably this could be the reason for very high failure rates of systems. There exists some evidence to support this hypothesis. For example, All India data collected during the period 1993-95 by the Mission indicates that only 90 percent of hand pumps are in working condition. Similar estimates for piped water supply are not available for India but exist for the state of Kerala. A recent study indicates that the failure rate ("Unsatisfactory Schemes") in Kerala is about 25% for schemes commissioned after the formation of the State Water Authority[13] in 1984.

This brings us to the conclusion that rural water supply is unsustainable even if narrowly defined. Hence sustainability of the system with increase in coverage and quality services becomes extremely

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[13] See Price Waterhouse (1994), Vol. 2, p. 28 for these estimates.

difficult unless additional resources are generated either from within the sector or from budgetary transfers. The latter is very unlikely, considering the competing demands from other sectors, leaving user financing as the only option. This brings us to the importance of user financing which is currently endorsed for the sector globally[14]. The discussions so far, indicate only the financial burden of sustainability on the states but not on the users. This aspect is examined in the next section.

II

2.1 User financing

No evidence exists in India on the impact of user financing on rural water supply, although there are a few studies on willingness to pay[15]. These studies are only reflections of the necessity of but not the ability to pay for this basic good. However cross-country evidence of user fees in the provision of health services indicates that it reduces the rate of utilisation among poorer and socially weaker sections[16]. Since water is essential for existence, one would expect the following effect. Due to price inelasticity, increase in price results in the reduction of consumption of other basic goods. If not, they substitute unprotected sources for drinking. Both reduce the welfare of the poorer households. Since there exists hardly any evidence on the likely impact of the user rates on poorer households, they should be excluded, at least in the beginning, from such tariff on welfare as well as on equity grounds. Furthermore, charging the poorer sections for basic goods like water is not a politically feasible proposition. This problem can be circumvented

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[14] See World Development Report (1994) and Serageldin (1995).

[15] See Reddy (1995) and Singh et.al. (1993)

[16] See Reddy (1996) for details.

if a tariff rate based on subsidy to the poorer users is devised. The design of such a rate structure is discussed below.

2.2 Cross-subsidised user rates

The poorer users can be subsidised either from a general taxation or from a cross-subsidy among the affordable users or a combination of both. The welfare implication of such a taxation or cross-subsidy in drinking water is hardly explored in the literature. Intuitively one would expect the latter to increase welfare in general, since the cost is in return for a better service for everyone. One method of devising such a rate is the Faulhaberian tradition[17]. These rates are discussed and estimated below. Interestingly enough, the example used by Faulhaber for defining cross-subsidy is also from drinking water, a simplified version of which is presented below for our purpose.

Suppose there are 'n' groups of consumers to be served in a rural location, say, a village. They can be served from a single system or from 'n' separate systems or 'm' sub-systems. Since the sub-system serves more than one group of consumers, 'm' should be less than 'n'. Let $C(q)$ be the cost of provision of a single system which provides water supply for all the groups; $C(q_i)$ be the cost of the 'i'th separate system where $i=1...n$; and $C(q_j)$ is the cost of providing the 'j'th sub-group, $j= 1...m$. The stability of joint and separate supply depends on the following condition:

$$C(q) \leq \sum_{i=1}^{n} C(q_i)$$

$$\leq \sum_{j=1}^{m} C(q_j)$$

[17] See Faulhaber (1975).

In other words the single system of provision is stable only if the cost of joint production is less than the stand-alone cost[18]. This condition clearly indicates that cross-subsidy for poor cannot exceed the stand-alone cost. If it exceeds the stand-alone cost then the groups will defect and cross-subsidy would be ineffective[19].

In such a situation, the option is to have a subsidy which makes the rate less than the stand-alone cost. Now let us estimate this rate for the rural system which obviously needs data on cost of extracting, transporting, storing, treating and distributing water for both joint and separate production. Since this information is not available, the rates are based on replacement, operation and maintenance costs given in table 1 & 2. In the present case a simple form of cross-subsidy is illustrated where the cost of supply to the poor is completely subsidised by the affordable class. Since the purpose is to differentiate between the poorer and affordable class among the rural community, poverty line has been used as a criterion. This requires state-wise rural poverty estimates. Unfortunately this information is not available for 1994/95, the year for which the cross-subsidy is to be designed. Therefore, poverty indicators based on Head Count Ratios were projected for the year 1994/95 from the estimates[20] of 1977/78 and 1987/88. These ratios were applied for the calculation of tariff with cross-subsidy for the aggregate sector[21]. The rates for the piped sector is taken as the difference between the aggregate and the hand pump. It is to be noted that there is no scope for cross-subsidy to the hand pump sector as it is being used mainly by the poorer households. The results are given in Table 3.

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[18] Stand-alone cost is the cost incurred by a group of consumers to get the service from a single system mostly by private arrangement.

[19] See Faulhaber (1975), p. 968 for a game-theoretic interpretation of this problem.

[20] See Tendulkar, et. al. (1993), for the tables.

[21] The projected poverty ratios in 1994/95 may be different from the actual. To that extent the rates given are biased.

Table 5. Monthly tariff for sustainability, 1994/95. (Rupees / household)

State / Union Territories	Aggregate sector				Hand pump sector		Piped sector			
	Replacement cost		O & M cost		Replacement cost	O&M cost	Replacement cost		O & M cost	
	Without subsidy	With subsidy	Without subsidy	With subsidy			Without subsidy	With subsidy	Without subsidy	With subsidy
Andhra Pradesh	5.98	7.98	3.41	4.55	2.35	1.41	3.63	5.63	2 .00	3.14
Arunachal Pradesh	49.17	83.29	29.41	49.82	2.55	1.53	46.62	80.74	27.88	48.29
Assam	15.02	32.96	8.16	17.89	2.99	1.80	12.03	29.96	6.36	16.10
Bihar	3.94	11.30	2.11	6.04	3.06	1.84	0.88	8.24	0.27	4.20
Goa,Daman & Diu	22.60	38.29	13.34	22.60	2.44	1.46	20.16	35.85	11.88	21.14
Gujarat	9.51	14.26	5.38	8.36	2.82	1.69	6.68	11.94	3.69	6.66
Haryana	51.33	62.53	26.45	32.22	3.24	1.94	48.09	59.30	24.51	30.28
Himachal Pradesh	42.54	55.31	22.80	29.65	2.69	1.62	39.85	52.62	21.19	28.03
Jammu & Kashmir	48.66	76.07	25.68	40.16	2.77	1.66	45.88	73.30	24.02	38.49
Karnataka	9.68	15.64	5.35	8.64	2.81	1.69	6.87	12.83	3.66	6.95
Kerala	22.53	35 .00	12.14	18.85	2.66	1.59	19.87	32.34	10.54	17.26
Madhya Pradesh	8.20	14.87	4.29	7.77	2.81	1.69	5.39	12.06	2.60	6.08

Maharashtra	12.32	26.46	6.44	13.83	2.69	1.61	9.63	23.77	4.82	12.21
Manipur	70.99	120.26	35.37	59.92	3.00	1.80	67.99	117.27	33.57	58.12
Meghalaya	47.25	80.05	24.91	42.20	2.73	1.64	44.52	77.32	23.27	40.56
Mizoram	108.35	183.55	59.59	100.96	2.97	1.78	105.38	180.58	57.81	99.17
Nagaland	84.04	142.37	38.90	65.89	2.90	1.74	81.14	139.47	37.15	64.15
Orissa	7.81	20.43	4.25	11.13	2.65	1.59	5.15	17.78	2.66	9.54
Punjab	10.64	13.00	5.83	7.13	3.03	1.82	7.61	9.97	4.01	5.31
Rajasthan	16.47	26.11	9.14	14.50	3.00	1.80	13.47	23.12	7.34	12.70
Sikkim	110.62	187.39	59.68	101.10	2.64	1.58	107.98	184.75	58.09	99.51
Tamilnadu	9.29	17.02	5.14	9.43	2.18	1.31	7.11	14.84	3.83	8.12
Tripura	25.16	42.63	13.57	22.99	2.66	1.60	22.50	39.97	11.97	21.39
Utter Pradesh	7.69	14.27	4.07	7.55	3.08	1.85	4.61	11.19	2.22	5.70
West Bengal	4.84	9.64	2.59	5.17	2.78	1.67	2.06	6.87	0.93	3.50
UTs [1]	86.01	145.71	25.65	43.45	2.58	1.55	83.43	143.13	24.10	41.90
All India	9.79	16.59	5.28	8.94	2.77	1.66	7.02	13.82	3.61	7.28

Note: [1] Includes Andaman & Nicobar islands, Chandigargh, Dadra and Nagar Haveli, Delhi, Lakshadweep and Pondicherry.

Source: *Government of India [1996].*
Pushpangadan and Murugan [1995].

At the all India level, the monthly rate per household is Rs. 7 for replacement and Rs. 3.61 for O & M. in the piped sector without subsidy. This would mean that if Rs. 11 were collected from the users, the system is sustainable. In a cross-subsidised rate it becomes Rs. 21 per household which varies substantially among states. For example, financial burden is very high among the hilly regions which necessitates budgetary transfer and/or introduction of cost minimizing technology.

Hitherto, household connections are not envisaged for rural schemes, since they are mainly financed through government grants. If metered house connections are permitted, affordable class can be cross-subsided using multiple tariff. In such a situation, the rate will go up due to extra cost arising out of extension and augmentation of existing systems and their related activities. Sometimes, this can result in a tariff higher than stand-alone cost causing defection of affordable class of consumers by making their own arrangements. Government assistance by way of subsidy, equivalent to the difference between stand-alone cost and the tariff, becomes essential in this context for making the system viable and sustainable. The other option is to cross-subsidise consumers spatially, say, rural and urban or by type of users such as industrial and commercial. The above discussion is based on the assumption that water is not transferable from one class of consumers to the other. If this is not the case, a resale market emerges for water making the coalition a very unstable and unsustainable one. One way of overcoming the problem is to devise new institutions to manage the resource without these problems. The next section is an attempt in this direction.

III

Institutional innovations in management.

Drinking water in rural India is mainly provided as a public good. The other options of privatisation and collective action have not been explored in India by and large. Let us examine the implication of these options. Privatisation of rural supply by creating exclusive rights has two major undesirable consequences as rightly pointed out by Bardhan in a recent symposium on management of common property resources[22]. The first is on equity aspect, especially in its future provision. The expansion under private ownership unless properly regulated will be mostly directed towards meeting the demands of the affordable class of the community. This obviously creates inequality in its distribution among the different sections. The second problem is the inability of property rights to internalise fully the externalities of the good especially tradeability of the right[23]. The tradeability of the right, as pointed out by Seabright, discourages resource-specific investment and has very little incentive for proper maintenance of the system. Hence, in the long run the tradeability aspect in water supply results in unsustainability and under-investment in the sector. Therefore, private property solution has very limited application in this context leaving collective action as an alternative. Let us examine this as surveyed by Runge, Wade and Bardhan among others[24].

The institution based on collective action can succeed if it satisfies certain conditions as suggested by Wade[25]. According to Wade, cooperation has a higher chance of success if the resource and its beneficiaries are clearly identifiable and small in size. The public taps and its users obviously satisfy this condition since Government of India norm stipulates that a public tap is meant for every 250 persons. Moreover

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[22] See Bardhan (1993).

[23] See Bardhan (1993) and Seabright (1993).

[24] Runge (1981), Wade (1988) and Bardhan(1993).

[25] See Wade (1988), chapter 11.

higher is the success rate of collective model, if there is overlapping of resources and users. This condition is also valid for drinking water since public taps are generally provided in the midst of a cluster of households. This overlapping works as a deterrent for free riding beneficiaries. For instance, users with lower tariff may sell water to a higher tariff group and make a profit which can undermine the effectiveness of cross-subsidised rates. As a result, revenue from such systems will be inadequate even to meet operational expenses thereby driving it to a premature collapse. Under state management, the guilty is unlikely to be punished due to administrative and other coordination problems arising out of distant bureaucracy. Whereas in a cooperative setup, such resale market is very unlikely to operate since policing the system can be effectively done by the users themselves. The question of tradeability of rights is simply not relevant. In addition to these, it is interesting to note that the new institution can find solutions to some of the major problems facing the sector.

It is a fact that the sector is facing financial crunch due to inadequate budgetary provision. Under the new arrangement, adequate resource can be mobilised from the users who need house connections. This also paves the way for finding a solution to the management of O & M of newly commissioned systems which reduces substantial financial burden on the state. Another advantage is that the role of the state under the new institution changes from provider to that of facilitator. Incidentally, cooperatives can now borrow from financial institutions guaranteed by state or local self-governments and make periodic repayments by collecting appropriate tariff from users. This option makes the sector financially viable as well. Above all, implementation becomes easy since it is a collective decision of beneficiaries.

An important criterion for the selection of an institution is the relative transaction cost. It is argued that this cost is likely to be the least for cooperatives[26]. However there exists no data either to accept or reject the hypothesis. The novelty of this financial model is that the project can raise enough finance for its completion by combining grant, equity and debt. Hence a major component of cost escalation, time overrun, arising from inadequate funds is completely eliminated.

There is no universal model which can be applied in all situations. It varies from region to region and according to cultural practices. Hence our task is to design such institutions through social experiments. This is the challenge facing the sector. Hence the need of the hour is to undertake such social experiments to reach the promised land of health for all where quality water and clean environment are assured even for the poorest.

IV

Summary and conclusions

The study makes use of a rigorous definition of sustainability in the context of economic development to quantify its financial implication on states and households. Estimates based on expenditure data indicate that if the present rate of budget allocation is followed, the amount is only enough to meet expenses on replacement of old systems and operation & maintenance. This points to the fact that additional coverage and/or quality improvement cannot be undertaken unless user financing is introduced urgently. Since user rates in basic goods like drinking water are likely to have a larger effect on the welfare of the poorer households, tariffs are designed with subsidy for such households. Poverty measure has been used for identifying poor and affordable classes, in the absence of any other suitable criterion, for estimation of

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[26] See Runge (1981), Bardhan (1993)

cross-subsidy among beneficiaries. At the national level, the monthly cross-subsidised rate per household is about Rs. 21 for full cost recovery in the piped sector with substantial variation among states ranging from Rs. 8.70 to Rs. 284.25. These high-cost states, unless supported with budgetary transfers, would become unsustainable if escalations in cost are solely due to hydro-geological reasons. However, budgetary support can be reduced considerably if technological innovations are introduced. Analysis of institutions based on cooperative action indicates that they have several advantages over state provision or privatisation. This institution also makes the sector financially viable and changes the role of government from provider to facilitator. The study clearly brings out the need for systematic collection and publication of data on all aspects of water supply for future research. Technological innovation and synthesis among various techniques are prerequisites for cost effectiveness and sustainability, and should be given utmost priority. For this purpose, research and development effort should be strengthened and redirected.

[This is a revised version of the paper presented in the National Seminar On Water Supply and Sanitation at Centre for Development Studies, Thiruvananthapuram held in June, 1996 and in the 22 WEDC conference, New Delhi held in September, 1996. It also draws heavily from a memorandum submitted on cost recovery to the sub-group on Rural Water Supply and Sanitation constituted for the formulation of strategies during the Ninth Five Year Plan by Ministry of Rural Areas and Employment, Government of India, New Delhi. The seminars at the National Institute for Public Finance & Policy, New Delhi and the Centre for Water Resources Development and Management, Calicut have enriched the analysis in several ways. The authors would like to thank Henk van Norden, U. Sankar and M. Sengupta for valuable comments and discussions on the earlier versions of the study. The empirical

analysis would not have been possible without the untiring support of P K Sivanandan and Jagadish Chander, Rajiv Gandhi National Drinking Water Mission, Ministry of Rural Areas and Employment, Government of India. We also thank Sam Jose and M Rajesh for their excellent research assistance. Of course, the limitations are purely ours.]

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APPENDIX A

i)	Total expenditure for installing a hand pump	Rs. 15000
ii)	Life of hand pump	10 years
iii)	Annual amount for replacement (15000/10)	Rs. 1500
iv)	Annual amount for operation and maintenance (6% of item i)	Rs. 900
v)	Annual amount for sustainability (iii+iv)	Rs. 2400
vi)	Number of users per hand pump	250
vii)	Annual per capita rate for sustainability	Rs. 9.6
viii)	Annual per capita rate for O & M	Rs. 3.6

APPENDIX B

For understanding the impact of the assumption of uniform versus non-uniform life span for water supply systems, piped vs hand pump, a numerical example is used. Let the total capital expenditure in a year be Rs. 100. Consider two cases. In case 1, let more than 50 % of the expenditure be on piped sector; and in case 2, let it be on hand pumps. For convenience, we assume that the expenditure is in the ratio of 3:1 and 1:3 for cases 1 and 2 respectively. Let the life of the piped system be 15 years and that of the hand pump be 10 years. If the proportion of expenditure is unknown, we assume uniform life span for the system and calculate the rate of recovery and the distribution of amounts for the aggregate system. The same rates were calculated for the two cases where the proportions are known. The results are given below.

Table B1. Effect of uniform and non-uniform life on replacement.

	Life of the system (years)	Total capital expenditure	Rate per annum	Total replacement cost recovered during		
				first 10 years	last 5 years	Total
Case 1:						
Piped sector	15	75	5	50	25	75
Hand pump sector	10	25	2.5	25	-	25
Total		100		75	25	100
Case 2:						
Piped Sector	15	25	1.7	16.5	8.5	25
Hand pump Sector	10	75	7.5	75	-	75
Total		100		91.5	8.5	100
Aggregate	15	100	6.7	67	33	100

The Table shows that total recoverable expenditure in the first case is Rs. 75 and in the second case Rs. 92.5 during the first ten years (life of the hand pump). Under the uniform assumption, it is only Rs. 67 during the same period. Hence, the assumption of uniform life makes the recoverable amount lower during the first ten years and higher during the remaining five years of the system. It is also observed that the hand pump sector is charged even after the expiry of its life. If the rate of recovery is same for both systems during the 15 years, the hand pump sector subsidises the piped sector in the first case and vice versa in the second case.