Working Paper
333

SOCIAL RETURNS FROM DRINKING WATER, SANITATION AND HYGIENE EDUCATION
A Case Study of Two Coastal Villages in Kerala

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ABSTRACT

Social returns from investing in water supply, sanitation and hygiene education (WATSANGENE) have been estimated from the UNICEF model of water supply, sanitation and hygiene after modifying it using Sen's commodities and capabilities approach. The various characteristics of the commodity, WATSANGENE, affect significantly the functioning levels of people with respect to poverty, health, longevity, education and quality of environment. Among them, education, longevity and quality of environment have not been evaluated because of the high degree of subjectivity in their measurement leading to wide margin of errors. Hence, only two of them - poverty and health- have been taken up for valuation by case study method and by "with" and "without" project approach. For the case study, two villages from the coastal belt of Kerala inhabited mainly by fishing community were selected. The study clearly shows that the social benefits are underestimated if the travel time is valued by shadow wage rate instead of by the value of energy expended. For example, the value of time saved "with the project" is only 35 % of the value of energy expended for fetching drinking water from distant sources. In the case of sanitation, it is only 25 % of the value of energy expended. The averted annual public expenditure per household resulting from the elimination of water borne and sanitation related illness with the project is Rs.682. The private annual expenditure per household for treating illness is Rs.510. The cost of providing water supply, sanitation and hygiene per household is Rs. 12,086. The ratio of benefit (present value of the recurring expenditure) to cost is 3.6 in the case of shadow pricing of travel time and 9 in the case of energy expenditure method. This result supports strongly that capabilities approach should be used for the valuation of benefits from water supply, sanitation and hygiene education. The study shows that provision of WATSANGENE in the coastal belt qualifies even under commercial borrowing.

JEL Classification : H43, I31, I38

Key words : social returns, UNICEF model, capabilities and functionings, shadow pricing, valuation of energy loss.

Introduction

The major share of financial resources needed for the provision of drinking water and sanitation in rural India comes from budget allocations earmarked mainly for the poor. This would mean that the distribution of these basic goods and services is governed by non-market principles. Such commodities are classified as merit goods in the public finance literature[1]. Naturally, such goods are not allocated on the basis of investment criteria such as social rates of return/cost-benefit ratio. However, cost effectiveness is, whether practised or not, usually insisted for its provision. From the investment point of view, the criteria of cost effectiveness alone would not attract funds for the sector. The share of investment in GDP in the sector compared with that of other social sectors in India lends support to such a conjecture. For example, the latest figures show that only about 0.4 per cent of GDP of the developing countries is invested in water supply, sanitation and hygiene education (WATSANGENE) while it is about 4.7 per cent for health and 4.4 per cent for infrastructure[2]. Moreover, the share shows a declining trend in the 90's. For reversing the declining trend in public investment in the sector, there is an urgent need for sensitising policy makers on the social returns from such investments. Higher returns would encourage private initiatives with institutional alternatives for the provision of these basic goods. Therefore, there is an urgent need for developing a methodology

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1 Musgrave (1988); 452-53.

2 See Nigam (1998).

for the estimation of social returns from investing in WATSANGENE. This is the main objective of this paper.

The methodology is based on standard Cost-Benefit Analysis (CBA). CBA is conducted sometimes ex ante and sometimes ex post. In the ex ante analysis, it is meant for ranking projects for the allocation of scarce resources so as to maximise social welfare. The information from the latter method can be used for not repeating the mistakes in future decisions of the same kind. The present study is an ex-ante one. CBA can be conducted in two ways. In the first method, benefits and costs are measured from 'with-' and 'without-' project situations. This is basically a case control analysis. In this approach, we take two homogeneous regions, one with project and other without project. The difference in the value of the impacts between the two regions is taken as the benefits attributed to the project. The crucial assumption is that all the benefits are exclusively from the project. In the second approach, a benchmark survey is undertaken on social-economic aspects of the region ''before" the project and resurveyed "after" the project. The changes that have taken place "after" the project is taken as the estimate of the social benefits. The main limitation of the method is that benefits can be measured only after implementing the project, a delay in the estimation process. In our study, we use elements of both approaches as become clear later in the paper.

Another issue in the valuation of benefits from water supply project is the distinction made on incremental and non-incremental aspect of measuring benefits (output) and costs (inputs)[3] . The distinction is made since the valuation of incremental and non-incremental inputs/outputs differs substantially. The method becomes relevant if the benefits are

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3 See ADB(1998), chapter 6 for details.

estimated from the demand functions of the commodities produced under the project. Let us examine the demand function for the composite commodity, WATSANGENE. Since rural water supply is not usually priced, other methods should be used for the demand estimation. One way of estimating it is by combining willingness to pay and the existing tariff on urban water supply[4] . Applying the same approach to sanitation has the following limitation. It will be extremely difficult to elucidate the marginal worth of sanitation from the rural population since its benefits are not realised immediately unlike drinking water. Further, demand for sanitation depends parametrically on hygiene awareness and other socio-economic variables of the households.

In other words, consumer may judge the worth of drinking water more accurately than that of sanitation. Hence contingent evaluation method may yield the demand function for water supply without much error but not for sanitation. The method is certainly not suitable for hygiene education since it only shifts the demand curve for water supply and sanitation. Hence the demand for water supply and sanitation should be estimated with hygiene as one of the parameters in the specification. To sum up, demand approach for measuring the benefits may be more reliable for water supply, less so for sanitation and very little for hygiene education.

The applicability of willingness to pay method, with all its limitations, is still possible if the benefits are separately measurable. This is further complicated by the existence of economies of scope in the provision of WATSANGENE jointly[5] . This scope effect is especially

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4 See ADB (1998) for the details.

5 See UNICEF (1995) for a schematic presentation of this problem.

very strong in the case of health, one of the impacts from the WATSANGENE[6]. This has been alternatively stated in the literature as an identity as follows[7]:

Health = water supply + sanitation + hygiene education.

Under joint provision, the aggregate demand function of the two goods, water supply and sanitation, and the service, hygiene education, is not properly defined. Hence alternative ways should be devised for the valuation of impacts. We use the 'commodities and capabilities' approach for the analysis[8].

The remainder of the paper is organised as follows. Section 2 provides theoretical background for the analysis. It links the UNICEF model of water and environmental sanitation to Sen's 'commodity-capability' approach for the valuation of benefits. Section 3 develops the methodology for the valuation of major capabilities, poverty and health, arising from reduced travel time and the averted expenditure on water and sanitation related illness. It also provides net present value from the costs and benefits. Final section summarises the paper.

II

2.1 The theoretical background

The first attempt to conceptualise the role of water supply and sanitation in development is by UNICEF with particular emphasis on children's health as shown in figure 1. The model identifies three basic conditions - immediate, underlying and structural - for the development of water and environmental sanitation. The immediate conditions in the diagram provide the impacts of the commodities, i.e. water, environmental

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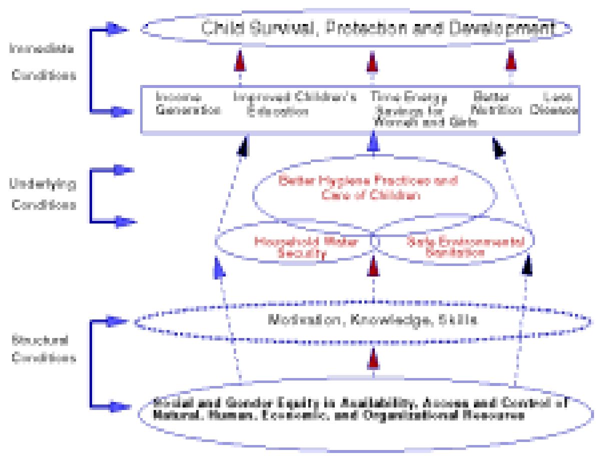
6 See Pushpangadan (1998:p.8) for the statement of this problem within production function analysis.

7 See Cairncross and Cochar (1994).

8 See Sen (1987).

sanitation and hygiene behaviour, on child survival and protection. The nature of the commodities (underlying conditions) depends on the structural conditions prevailing in the economy as shown in the first block of the flow chart.



Source: UNICEF

Figure 1. The UNICEF model of water, sanitation and hygiene behaviour.

For our analysis, the model is reformulated in the following way using the 'commodities-capability' approach[9].

2.2 UNICEF model; commodity-capability view

Possession of commodities, private / public, provides the means to achieve certain ends that a person considers worth living. There are three ways of judging such achievements: (1) by utility; (2) by opulence; and (3) by the quality of life[10]. The choice depends mainly on which

9 See Sen (1987) for the approach.
10 See Kumar (1987); Sen (1992, 1993, 1996, 1998).

perspective of achievement, actual level or the freedom aspects, is being emphasized in the evaluation. While utility approach is more concerned about the actual achievement, opulence and quality of life, the other two, emphasize more on the freedom aspect of achievements[11] . However, the latter two measures do not address quite the same dimension of a freedom according to Sen (1992). While the measure on opulence provides the means to achieve freedom, the quality of life captures the extent of freedom enjoyed by the individuals as reflected in the living that consists of interrelated functionings. In other words, functionings, it is argued, are constitutive of a person's (well) being, an assessment of which implies an assessment of the constituent elements. Our study concentrates on the evaluation of the constituent elements arising from the commodity, WATSANGENE as given in the flow chart in figure 2.

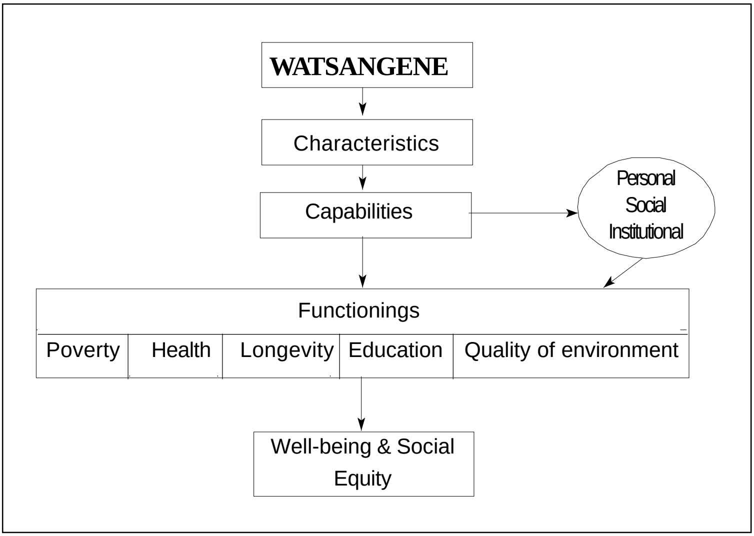


Figure 2. Water supply, sanitation and hygiene education: A capability view

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11 This section draws heavily from Chapter II of Sen, (1992), and Sen (1987)

The approach can be put in a nutshell as follows. The commodities provide certain characteristics that enable the individuals to achieve certain capabilities. The achieved capabilities, i.e. functionings, of the persons from the commodity-characteristics depend on personal as well as social factors. An aggregate index of the functionings, a measure of well-being, determines the relative position of the social group in the social hierarchy. For the aggregate commodity, WATSANGENE, we consider only the capabilities related to – poverty and health - for valuation with the project. The poverty capability is affected in the following way. With the project, the travel time needed per household for fetching water and for sanitation reduces considerably. The income generating capacity of the households with saved time would reduce the poverty levels of the households. It has another interesting gender dimension as well. The poverty gap among the females in poorer households will be reduced as a result of energy saved from the diminished travel distance[12] . However, only one of the estimates can be included in order to avoid double counting. Another significant impact, with the project, would be the lower incidence of water borne and sanitation-related illness. The household has the ability to save the amount that otherwise would have been spent on the treatment of water borne diseases. This would mean, in the long run, households would have better health status leading to lower mortality rates and higher longevity. Better health status would also increase the efficiency of conversion food into various nutrients enabling the households to reduce the poverty gap further. The averted medical expenses have an income effect on the consumption of basic items like food, clothing, shelter, education, etc. If the saved time is that of the girl child, then it could

12 See Pushpangadan et. al. (1996) for explaining lower user rates of public taps in Kerala in terms of distance travelled .

increase the enrolment rates in school or improving the performance at school[13]. Finally, the quality of environment improves substantially due to better hygiene awareness on sanitation and water-handling practices. The improved constituent elements in the well-being such as lower poverty levels, higher longevity, lower illiteracy and so on, would take the social group to higher welfare and social equity. This is the essence of the flow chart given in figure 2 based on commodity-capability approach. Let us examine the evaluation of the two major capabilities, poverty and health, arising from the project.

III

In this section we briefly review the methodology for the case study and for the valuation of selected capabilities.

3.1. Sample Survey and Data Collection

Sample households from two coastal hamlets - Adimalathura in Kottukal Panchayat and Pulluvila in Karumkulam Panchayat, in Thiruvanathapuram district of Kerala State - inhabited mainly by fishing community were selected for the case study. For selecting sample, all the households in the hamlets were listed. From the census of 1892 households, two hundred households have been selected at random using the circular systematic sampling technique. The spatial distribution of the sample is 84 households from Pulluvila, and 116 from Adimalathura, based on the proportions of the households in the population. The survey period was from February 1998 to February 1999. On a careful scrutiny, data from seven households in the sample

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13 The problem is very genuine in the northern part of India, unlike in Kerala, since female literacy rate is very low. However, the quality aspect may still be relevant for Kerala especially in the coastal region where considerable amount of female children's time is spent on fetching drinking water.

were found to be either incomplete or of poor quality. Therefore, only 193 households were considered for the estimation. The issues in the valuation of benefits are taken up next.

3.2. Valuation of time

Earlier studies on user rates of public taps in Kerala found that lower utilisation of public taps are related to the higher travel distance in rural areas[14]. If there is no public source, then one has to travel a long distance for getting the drinking water in the coastal region. With the project, the beneficiaries would be able to save the time that otherwise would have been spent for fetching water and for sanitation purposes. The reduced travel time is the benefit from the project. It can be valued either as the opportunity cost of time saved or as the value of calories saved from reduced travel distance. We use both methods for valuation but consider only one of them for the calculation of net benefits in order to avoid double counting.

There are two steps involved in the valuation process. First step is the estimation of time saved if the project were implemented and the second is the valuation of the saved time. Both issues are taken up in the case of water supply first.

3.2.1 Water supply

Time saved is estimated as the difference between time used for fetching water 'with' and 'without' project. The total time taken for fetching water consists of (1) time taken for travelling from the source to household, (2) queuing time at the source, and (3) time for filling the vessel. The general formula for calculating the total time saved is given in equation (1) (Abelin, 1997).

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14 See Pushpangadan, Murugan and Navaneetham (1996) for the details.

$$T = (2D/1000\ S + q/60 + V/60\ Q_d)(1000/V) \ldots (1)$$

where

T = Travel time for fetching water (hours/m^3)

D = Distance from home to the source (meters)

S = walking speed (km/hour)

q = queuing time (minutes per trip)

V = volume collected (litres/trip)

Q_d = water delivery rate at source (litres/minute)

m^3 = 1000 litres .

The formula needs some modification for our case study. The queuing time is not valid in our case since the entire water supply is met from open well with enough space for drawing the water. This is especially true for Adimalathura. The discharge time is assumed to be the same with and without project. Hence we are concerned only with time saved due to the reduction in the travel distance with project. At present, the open well in Adimalathura is situated about 400 meters away from the seacoast, which is taken as the travel distance for getting drinking water without project. The distance becomes zero if household connections are given with project. But according to Government of India 'norm' for the coverage of drinking water in rural areas, private connections are not permitted. Only public taps are given so that all households would get water within a walking distance of 250 meters at the rate of 40 litres per capita per day. Applying this norm, it can be concluded that the distance saved with project is about 150 meters for every trip. For valuation, total time saved per household with the project and its opportunity cost have to be estimated, the details of which are given below.

Table 1: Opportunity cost of travel time for drinking water

(in Rupees)

The reduction in the travel distance per trip (meters)	= 2(400-250)
*Time saved for fetching water per trip (hrs.)	= . 3/2 = .15
**Water demand per household per day as per norm (liters)	= 6.4 *40=256
***Total number of trips per household per day	= 256/20 =12.8
Travel time saved with project (hrs.)	= 12.8*.15 = 1.92
Queuing time with project	= 0
Discharge time with project	= 0
Total time saved (hrs)	= 1.92
****Female time saved per day per household (hrs.)	= .63 *1.92 = 1.26
*****Opportunity cost of female time per day per household (Rs.)	= 1.26 * 5.5 = 6.66
Value of female time saved per household per year with project (Rs.)	= 6.66*365 = 2431

Source: Primary Survey

Notes:

* Average speed of walking is assumed to be 2km/hr.

**Average household size is 6.4 and 40 litres per capita per day is norm recommended by Government of India in rural areas.

***It is assumed that a person carries, on an average, one bucket and one pot of water per trip. The volume of a bucket is taken as 12 litres and that of a pot is 8 litres. Hence the total volume of water carried per trip is 20 litres.

****The baseline survey shows that about 63 % of the time the water is brought by adult females.

***** The shadow wage rate for the valuation of the female time is taken as the going rate of the domestic help. This is estimated to be Rs. 45 for eight hours per day.

The valuation shows that the opportunity cost of time saved per household with the project, assuming Government of India norm in rural areas, would be two thousand four hundred and thirty one rupees. Let us value the time saved with sanitation project.

3.2.2 Sanitation

Baseline survey shows that the traditional latrine technology is not suitable for coastal belt especially in water logged regions with shallow groundwater table. In addition, coverage of latrine is very low because of the high incidence of poverty in the region. As a result, males go to seashore and females to open space for defecation and other sanitation activities. The resource mapping of Adimalathura shows that the open space is about 100 meters from the drinking water source, i.e., dug well. Energy expended by males for sanitation is not assessed because the distance to seashore is very negligible and we do not have reliable information on the proportion of males using the open space for defecation. Hence, we consider the estimation of energy expenditure by females only and, that too, age ten and above. It is also assumed that they combine fetching water and sanitation. As a result, the distance already included in water supply is excluded in the case of sanitation in order to avoid double counting. This would mean that the travel distance for sanitation is, on an average, only (500-150) meters.

Table 2: Opportunity cost of travel time for sanitation

Distance travelled for sanitation by females per day (meters)	= 2 (250 +100) =700
Average number of females above the age of ten years per household	= 2.4
Total travel distance per day per household (kms)	= .7 *2.4 =1.68
*Travel time per household per day (hrs.)	= 1.68/2 = 0.84
**Travel time of adult females (hrs.)	= . 84 *.63 = 0.53
Value of female time per day (Rs.)	=. 53*5.5 =2.91
Value of female time per household per year (,,)	= 2.91 *365
	= 1062

Source: same as in Table 1.

Notes:

* Average speed of walking in the coastal belt is taken as 2 km/hour.

** It is assumed that only adult female time has opportunity cost. This is estimated to be about 63 % in the study region.

The value of time lost without sanitation coverage is estimated to be one thousand and sixty two rupees per year per household. This impact can be obtained in terms of energy expended for the reduced travel distance. This approach is more appropriate in this community since it practices gender discrimination in its allocation of life saving and sustaining resources as reflected in the unfavourable sex-ratio observed in the community unlike that of Kerala[16]. This alternative valuation is more appropriate since the energy loss affects mainly the females. Let us obtain the value of energy saved with the project.

3.3 Valuation of Energy

3.3.1 Water supply

We have already estimated that average travel time saved per day per household for fetching water is 1.8 hours with project. In addition, it would also save the energy expended for walking to and from the source. The following methodology is used for valuing the energy saved with the project as shown in Table 3.

The valuation shows that saved annual energy expenditure per household for fetching drinking water is six thousand six hundred and eighteen. It may be noted that the two methods of evaluating the travel time give substantially different values of benefits. The finding has implication for the choice of methodology for measuring the benefits in poorer regions. Let us value the same for sanitation.

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15 It is estimated that there are only 970 females per thousand males in this community compared with 1035 per 1000 for Kerala. In other words, 65 females are missing in this community if the Kerala ratio were taken as the standard. See Kurien (1995); Pushpangadan and Murugan (2000) for the details.

Table 3. Value of energy expenditure for water supply

Total travel time saved per day per household		= 1.8.
*Female time	(hrs.)	= 1.4
Male time	(hrs.)	= 0.4
**Energy expenditure of female per day per household	(cal.)	= 1.4*1.37*60
		= 115.1.
Energy expenditure of male per day per household	(cal.)	= 1.63*.4*60
		= 39.1.
Total energy expenditure per day per household	(cal)	=115.1+ 39.1 =154.2 cal.
***Value of energy expended per household per month	(Rs.)	=286.1*154.2*30/2400
		=551.5
Value of energy expended per household per year	(Rs.)	= 12*551.5 = 6618

Source: Same as in Table 2

*The survey shows that about 77 % of the time adult females or female children bring the water.

**The average speed of walking is taken as 4 km/hour. Since walking in sand is almost twice as costly as walking on a hard surface, the speed is taken as 2 km/hour. For the calculation of the energy expended, the average weight of a male is taken as 55 kg and of female as 45 kg. The calculation is based on the discussion with a subject expert, medical doctor, who specialises in sports medicine.

***The conversion of energy expended into money value is based on poverty estimates. The poverty level in the rural area per person per month in Kerala for the year1999 is the inflated value of the estimate for the year 199/93 from Suryanarayana (1997). The per capita income needed for buying 2400 calories worth of food, the poverty line, are 286.1 rupees. This conversion factor is used for the valuation of energy expended.

The valuation by energy expended method estimates the benefit as Rupees Six Thousand Six Hundred and Eighteen.

3.3.2 Sanitation

In the case of sanitation, the energy expenditure is calculated for female adult and female children above age ten only. The details are given in Table 4.

Table 4. Value energy expended for sanitation

Walking distance per person (one way) to open space for defecation (meters)	= 500
Total travel distance of adult females per household per day (Km)	= 500 *2 * 2.4 = 2.4
Travel time per day per household (hrs.)	= 2.4/2 = 1.2
Energy expended for sanitation per day per household (cal.)	=1.37*1.2*60 = 98.6
Value of energy expended per month per household (Rs.)	= 98.6*30*286.1/2400
	= 351.9
Value of energy expended per household per year (Rs.)	= 12*351.9 = 4223

Source: Same as in Table 3

The value of energy expended for sanitation per household per year is rupees four thousand two hundred and twenty three. Next we take up valuation of the impact of health with the project. Our objective is to estimate the public and private expenditure that would be averted "with" project. The methodology used for this purpose is explained below.

3.4 Estimation of health expenditure

Health benefit with the project consists mainly of averted treatment expenditure, both private and public, and the opportunity cost of days lost during sickness (ADB, 1999; Albin, 1997). Illness affects the income of the households in three ways. First is the loss of income of the sick person if he/she is gainfully employed. Second is the bystanders' time lost due to hospitalisation and/or nursing the sick. Third is the income loss due to the decline in the productivity of the sick person until he/she recovers fully. Before proceeding to evaluate the benefits from the survey data, let us consider some of the limitations of data used for estimation.

Information collected from the households shows the prevalence of both long-term and short-term illness. The long-term diseases are mostly confined to the reproductive tract of women mainly caused by, according to public health professionals, the lack of hygiene awareness and inadequate provision of water supply and sanitation facilities. The cost of the long-term illness is very difficult to calculate unless it reaches an infectious stage requiring medical treatment. But this information is simply not available from the households and excluded from the treatment costs. As a result, only the expenditure on short-term illness is considered; that too, for water and sanitation related diseases. This is obviously an underestimate, the extent of which is difficult to assess. The health expenditure has two components: public and private. The former refers to the expenditure by the state and the latter by the households. Our objective is to value both components.

3.4.1 Public expenditure

Public health expenditures on diseases vary according to season. This is especially true for water borne and sanitation related diseases in water logged regions during the monsoon. Moreover, the chances of drinking water getting contaminated through faecal matters during summer is likely to be very low because of deep groundwater table and high temperature during the season. Our interviews with key informant, private and public medical personnel, suggest that the rate of occurrence of water borne diseases during rainy season is about three to four times that of summer. As regards public expenditure for the sample region, there is no systematic record either with the primary health centre or with the health department. Therefore, we have taken annual per capita rural health expenditure published by the government for arriving at the public expenditure per household. The details are given below:

Table 5: Estimation of annual public expenditure per household

(in Rupees)

a)	Per capita health expenditure for the year, 1997-98,	= 159
b)	Health expenditure per household per year	= 159*6.4 = 1018.
*c)	Expenditure attributable to water-sanitation related illness	= .67* 1018 = 682

Source: Same as in Table 4 and GOK (1988).

* 67 is the proportion of water and sanitation related illness treated at the primary health centre.

This recurring annual public expenditure per household, Rs.682, is taken as the likely saving of the government with the project. Let us now move on to the estimation of the second component - averted annual private expenditure per household.

3.4.2 Private expenditure

Private expenditure comprises mainly of medical expenses incurred by the household and the opportunity cost of time, both direct and indirect, lost during the illness. The annual expenditure can be assessed only if the seasonal nature of the illness is known. For assessing this, sample households were revisited during Northeast monsoon. In the re-survey, it was found that about 57 percent of the households had been again infected by water borne and sanitation related illness. The repeated infection has the following implications. During rainy season, these households have meagre income from fishing due to their inability to venture into the sea with the traditional technology. An increase in health expenditure, in such situations, would mean reduction in expenditure on necessities such as food. As a result, the poverty levels of households increase during the season and most of them may have to resort to borrowing at usurious rate of interest leaving them in perpetual indebtedness. The indirect burden is extremely difficult to measure and not included in the expenditure estimates. With these limitations, per household private cost is estimated below.

Table 6: Estimation of annual private expenditure per household

(in rupees)

a)	Average treatment cost per household during summer*	= 163
b)	Percentage of households with recurrence of water borne diseases in the post monsoon, Northeast	= 57 %
c)	Additional treatment cost per household during Northeast Monsoon	= 163 * 0.57 = 93
d)	Estimated expenditure per household during South west monsoon**	= 93
e)	Annual per capita treatment cost adjusted for seasons per household	= a+c+d = 349
f)	Opportunity cost of man-days of bystanders lost in summer	= 75
g)	,, in Northeast monsoon***	=.57*75 = 43
h)	,, in Southwest monsoon	= 43
i)	Annual cost of man - days lost per household	= 75+43+43 = 161
m)	Annual private expenditure per household	=(e) + (I)=3 = 510

Source: Survey

Notes:

* Treatment cost is the sum of hospital cost and transportation cost. Hospital cost includes cost on medicines, laboratory charges, consultation

** The same rate of occurrence is assumed during the second rainy season, i.e, South-West monsoon.

*** The adjustment for seasonality is same as in the case of treatment cost.

The total averted annual expenditure per household, private and public, comes to be rupees 1192 which is likely to recur until water borne diseases are eliminated completely by providing water, sanitation and hygiene education. The total benefit from the project would be equal to the present value of the recurring expenditure, which is given in Table 7. If the values of the streams of benefits and costs are known, the net present value (NPV) is obtained by discounting future net benefits at an appropriate discount rate, selection of which remains the most controversial issue in project evaluation.

Jenkins and Harberger (1991) suggest four measures of discount, 1) Marginal productivity of capital in the private sector; (2) Accounting rate of interest; (3) Social rate of time preference for consumption; and (4) Weighted average of the first and the third. From the four options, they recommend the fourth as the most appropriate. In the present case, we have taken the accounting rate, 12 %, as the discount rate.

Table 7: Present value of gross benefits from WATSANGENE

	Per household per year (Rupees)	Present value (discount rate =12 %)
(a) Water supply		
Value of time	2431	22,681
Value of energy	6618	61,745
(b) Sanitation		
Value of time	1062	9,908
Value of energy	4223	39,401
(c) Averted health expenditure		
Public	682	6,363
Private	510	4,758
Total	1192	11,121
(d) Gross benefits :		
Value of time	4685	43711
or		
Value of energy	12033	112268

Table 7 clearly shows that the social benefit arising from sanitation per year alone is Rs. 4223 with capability approach but only 1062 using shadow pricing. The conventional approach estimates only 25 % of the benefits by energy method. Hence the shadow pricing grossly underestimates social benefits. The present value of this recurring benefit is less than the cost of compost latrine, which is the appropriate technology for the coastal region. It may be noted that even complete subsidy is lower than the present value of public expenditure involved in treating the cost of water-borne and sanitation related illness[17] . Let us compare the benefit with the cost (financial) of providing WATSANGENE per household in the coastal belt.

Having estimated all the major benefits indirectly, let us examine the least-cost of providing it. There are several options for providing drinking water in the coastal belt. They are (1) hand-pump, (2) piped water, (3) fresh-water lens, and (4) roof water harvesting. Roof water harvesting is not feasible because the majority of the houses are of poor quality and very little space available between the houses. If space available, it is used for cultivation of coconut trees. The per capita cost of supplying drinking water from different system is given below:

Per capita cost of drinking water

(Rupees)

Piped water	1800 -2500
Fresh water lens	185
Hand-pump	250

This would mean that the least cost of provision is based on fresh water lens as the source of water supply. In the case of latrines, the cost of compost latrine is taken since it is the appropriate technology for the coastal region available now. Since the maximum social benefit is realised only if drinking water, sanitation and hygiene education is provided simultaneously. The total cost per household for all the three components are given in Table 8.

17 The Unit cost of compost latrine is estimated to be 4,500.

Table 8: Cost of water supply, sanitation and hygiene education per household

(Rupees)

(a)	Per capita cost of piped supply with fresh water lens as the source	= 185
(b)	Cost of piped water supply per household	= 185*6.4 = 1184
(c)	Operation and maintenance [10 % of (b)]	= 118.4
(d)	Present value of (c) at 12 % discount rate	= 118.4*9.33 = 1105
(e)	Total cost of water supply per household (d + b)	= 2289
(f)	Cost of sanitation (unit cost of compost latrine)	= 4,500
(g)	Cost of operation and maintenance of compost latrine [10 % of (f)]	= 450
(h)	Present value of (g) at 12 % discount rate	= 450*9.33 = 4199.
(i)	Total cost of sanitation (f + h)	= 8699
(j)	Total for water supply and sanitation [e + i] = 10987	
(k)	Cost of hygiene education [(10 % of (j)]	= 1099
(i)	Cost of the project per household [j + k]	= 12086.

Source: Same as above

The estimates show that the benefit -cost ratio, per household, is 3.6 by shadow pricing of labour and 9 by energy expenditure method. The interesting observation is the present value of the avoidable expenditure itself is enough for covering water supply, sanitation and hygiene education in the coastal belt provided cost-effective and appropriate technology is considered. The unusually higher social rates of return suggest that government can even resort to commercial loans for the complete coverage of the coastal belt with drinking water, sanitation and hygiene education.

VI

Summary and Conclusions

Public investment in rural supply and sanitation as a proportion of GDP in India shows a downward trend in the 90's. This trend can be reversed if private investment with institutional alternatives were encouraged in the sector. A prerequisite for such a policy change is the availability of social/private rates of returns from these sectors. Very few studies exist in this regard. This paper makes such an attempt in this direction. First, it modifies the UNICEF model of water supply, sanitation and hygiene education (WATSANGENE) in terms of commodities and capabilities approach for measuring the returns. The various characteristics of the commodity, WATSANGENE, affect the functioning levels of people with respect to poverty, health, longevity, education and quality of environment. Only two of the five capabilities -education and longevity- have been considered for valuation here because of the high degree of subjectivity in the valuation of the remaining ones. The methodology follows case study method, and "with" and "without" project approach. For the case study, two villages from the coastal belt of Kerala inhabited mainly by fishing community were selected. The study clearly shows that the social benefits are substantially higher with capabilities approach than with the conventional shadow pricing method. More precisely, the value of time saved with the project by shadow pricing is only 35% of the value of energy expended for fetching drinking water. In the case of sanitation, it is only 25% of the value of energy expended. This excess energy loss leading to higher incidence of nutritional deficiency among females may be another contributing factor to the higher female mortality rates as reflected in the unfavourable sex ratio among fishermen households. The improvement in health arising from the likely elimination of water borne and sanitation related illness with the project has two implications for public and private expenditure. The averted annual public expenditure per household is estimated to be Rs.682. The annual saving per household on medicines and other related expenses is Rs.510. The benefit-cost ratio is 3.6 in the case of shadow pricing of labour time and 9 in the case of energy expenditure method. This result supports strongly that the social benefits from WATSANGENE in poorer regions should be measured using capabilities approach in order to reduce the underestimation of benefits and to bring out the gender aspect of poverty arising from the lack of provision of water supply, sanitation and hygiene education.

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