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Averting Expenditure - Measure of Willingness to Pay

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Abstract
This paper makes estimation on demand for quality water. In the absence of an explicit market, individuals are able to value changes in water quality. When the consumers believe to keep up good health they need quality water there will be willingness to pay for improved water. This willingness to pay (WTP) explains economic valuation of improved water quality. Spending power of households and educational background are important determinant factors of WTP. The decision is through income distribution pattern and ability to pay.
Keywords: WTP, Averting Expenditure,Quality of water

1.1.Introduction

The unprecedented urbanization coupled with rapid industrialization is exerting pressure on the quality of water resources placing human health at risk. Industry is one of the major consumers of water resources competing with agriculture in India. In India, based on notifications from the Central Pollution Control Board (CPCB), iron and steel are the highest water polluters contributing 87 per cent of the total water pollution load and also in terms of toxicity (Bhardwaj 2005). Though others follow this industry in terms of total water pollution load, in terms of toxic load, leather industry is one of the major players of water pollution and it is one of the major contributors to the exports from India.

At the all India level, the leather industry contributes to 7% of the country's export earnings; The number of tanneries has multiplied since the banning of the semi-finished leather in the late 1970s. Since then the tanning technology has also changed from eco-friendly vegetable tanning to chrome tanning. Export earnings of the leather industry shot up from a mere Rs. 0.32 billion in 1965 to Rs.100 billion in 2001. This industry provides direct employment to over 2 million people in the country. Fifty-one per cent of leather exports originate from the southern states and 70 per cent of tanning industries are concentrated in Vellore region. Of the total exports from the south, Tamil Nadu alone contributes to about 90%, the value of which is Rs. 50 billion; and 75% of the tanning industries of the state are concentrated in the Palar basin, contributing to over 30% of the country's total exports. These tanneries let out enormous quantity of effluent into the open fields and river streams thereby contaminating the ecosystems.

The basic issue that this paper addresses is that good quality water has emerged as a scarce resource. In such a context, the need of the hour is to analyse people's behaviour for good quality water. In the development stage, valuation of water quality is important. It is useful to know the domestic end users value for safe drinking water. From their observed behaviour and consumers as the main beneficiaries, this paper assesses the demand for water quality, which would show willingness to pay.

2.1.Theoretical Framework

We assume that households need to change the water quality services in the absence of an explicit market. When they feel, by quality water, they can maintain good health; they will be willing to pay money for getting improved water services. The willingness to pay money reflects economic valuation of improved water quality. The amount of money that people are willing to spare to obtain quality water would represent valuation of the water quality. To calculate the effects of the improved water quality in terms of economic value, we face two issues, viz, how to measure the utility levels due to change in water quality and the practical problem is economic value of water quality is not reflected by direct market prices. First issue is solved by using the idea of consumer surplus (CS) will solve the first issue problem – the money measure of change in utility, which will value the changes in water quality. The difference between levels of optimal expenditures in the two states of water quality (existing and improved). It will help to calculate the willingness to pay.

The second issue a number of researchers like Harrington and Portney (1987), Abdalla et al (1992) and McConnell and Rosado (2000) have used Averting Expenditure otherwise called Defensive Behaviour method. It infers values from expenditures that households make to avert being subjected to an environmental pollutant. People combine purchased inputs with time in order to improve health by reducing the pollution. The underlying premise is that a rational person will adopt defensive behaviour as long as the value of the damage avoided is greater than the cost of the defensive steps. Averting expenditure decreases the utility function according to the researchers, the true benefits associated with the improvement in water quality equals COI (Cost of Illness) plus change in AE (Averting Expenditure) plus net direct disutility of illness defined as net of self-valuation of leisure and explicit wage rate. AE provides conceptually valid drinking quality water. AE produce exact welfare measure(Hanley et al 1999) such as; if abating expenditure does not lead to jointers in production, if rise in AE guarantees improved water quality, it is the final household good not the inputs used to produce, it, should enter directly in consumers utility function. Following this logic we formalise the problem under consideration as;

Water quality (Q) an environmental good and one kind of abating behaviour, the use of a purifier (R) a private good, together produce purified water(S) by means of a given technology, concave and increasing in both arguments.

S = S (Q,R)

Drinkable water (S) and Composite consumption good (A)

Income Constraint =M

We assume water quality affects utility only through its effect on the cost of making it drinkable;

U=U (S,A) (2)

In both the arguments, it is increasing. Any level of 'S' can be achieved at any level of Q, i.e. all consequences of water pollution are avertable. The WTP for marginal improvement in the level of water quality (dq>0) is defined as the savings in averting expenditure that would leave utility constant. For simplicity we assume that the production function for drinkable water is such that the marginal product of purifier is increasing in water quality but constant for a given water quality, i.e,

Srq > 0

And, $S_{rr} = 0$

Therefore, MC of drinkable water depends on Q and given Q, a consumer may buy drinkability at a constant cost C (Q). The indirect utility function (IUF) of the consumer is defined as –

V = V (MC(Q)) (3)

Consider the effect of a marginal change in water quality on the consumer. For equilibrium

$dV/dQ = \partial V/\partial W\ dM/dQ + \partial V/\partial C\ dC/dQ$ (4)

Thus,

$$\frac{dM}{dQ} = \frac{\partial V/\partial C}{\partial V/\partial M} \frac{dC}{dQ} \quad (5)$$

From the property of indirect utility function, we know that:

$$\frac{\partial V/\partial C}{\partial V/\partial M} = S \quad (6)$$

And hence that:

$$\frac{dM}{dQ} = S \frac{dC}{dQ} \quad (7)$$

ie, improvement in water quality lowers the price if drinkable water, thereby reducing the cost of buying the consumer's previously chosen level of drinkable water. The expenditure decline is precise measure of consumer's WTP for improve water quality define above. Thus, the benefit of a marginal improvement in water quality or marginal reduction of water pollution is correctly measured by the reduction in the expenditure. The consumers would have to make achieve the same level of drinkable water as achieved before. In reality for a general environmental good, the observed change in the consumers' expenditure on averting behaviour is not the same as WTP, since the amount of its purchase will increase in response to the lower price. In this case

AE = C.S (8)

Its change in response to change in water quality

$$\frac{dE}{dQ} = C \frac{dS}{dQ} + S \frac{dC}{dQ} \quad (9)$$

The latter of the two terms in RHS giving absolute value of consumer's WTP for improved water quality. The absolute value of change in AE,

$$- \frac{dE}{dQ} \gtrless - \frac{DM}{DQ}$$

Accordingly,

$(dS/dQ) \gtrless 0$

[Note: WTP = -(dM/dQ)]

Improvement in water quality means a reduced price of purification (i.e, dE/dQ<0)

When Utility level is fixed (dU/dW =0) the lower price may induce the consumer to purchase more (dS/dQ>0) It shows that AE underestimate WTP when water quality improves. The household will not buy more of purified water only because of its reduced rate. Instead they will buy what they need. So we can take dS/dQ =0 in our model. Here AE gives true estimate of WTP.

3.1..Study Area

To estimate the Averting Expenditure, as a measure, of willingness to pay of the households, information are needed about household expenditure on water purification and the socio economic details. The present work has built up on primary data collected through a field survey, Through direct interview method 250 households were interviewed during March 2013 at Katpadi block in Vellore district. Vellore district has been divided into 7 taluks, 20 blocks, 753 Panchayats and 4827. As per the 2011 census results, Vellore has population of above 3936331. Tanneries let out enormous quantity of effluent into the fields and river streams and contaminated the water. To include households with different income groups and to get a representative sample of the village, the investigator sought the help of the village representatives, and with fundamental consideration that sample should be a random sample. i.e every member of the population should have an equal chance of being selected. A questionnaire based field survey through direct interview method has been carried out in Vellore city for 250 sample households during November 2013.

4.1.Socio- Economic Status of the Surveyed Households

Table:4. 1 Education level of the respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
	no schooling	37	14.8	15.0	15.0
	Primary education	43	17.2	17.4	32.4
	Secondary education	66	26.4	26.7	59.1
	High school	69	27.6	27.9	87.0
	Hr.secondary	27	10.8	10.9	98.0
	Higher education	5	2.0	2.0	100.0
	Total	247	98.8	100.0	
Missing	System	3	1.2		
	Total	250	100.0		

Table:4. 2 Occupation

	Frequency	Percent	Valid Percent	Cumulative Percent
Agricultue	70	28.0	28.0	28.0
Own Business	78	31.2	31.2	59.2
Government Employee	12	4.8	4.8	64.0
Others	90	36.0	36.0	100.0
Total	250	100.0	100.0	

Table4. 3 Income

	Frequency	Percentage	Valid Percentage	Cumulative percentage
Less than Rs. 10,000	32	12.8	13.0	13.0
Rs. 10,000 to 20,000	31	12.4	12.6	25.6
Rs. 20,000 to 30,000	25	10.0	10.2	35.8
Rs. 30,000 to 40,000	30	12.0	12.2	48.0
Rs. 40,000 to 50,000	18	7.2	7.3	55.3
Rs. 50,000 to 60,000	15	6.0	6.1	61.4
Rs. 60,000 to 70,000	21	8.4	8.5	69.9
Rs. 70,000 to 80,000	27	10.8	11.0	80.9
More than Rs.80,000	47	18.8	19.1	100.0
Total	246	98.4	100.0	
Missing system	4	1.6		
Total	250	100.0		

The above tables show the socio economic status of the surveyed household classified according to income ranges. It is evident from the table the 80 per cent of the respondents income is less than Rs. 80,000 Per annum. It is noteworthy the family size of 75% are less than five. Except 15% of the surveyed households are illiterates. Below table, show the frequency distribution of defensive expenditure according to the income level. It depicts the less income group of people are not much aware of the water-borne diseases and also their ability to spend for purification of water is very less. Whereas the people who earn more are afford to spend some amount for the sake of their health. The table explains whenever the income increases willingness to spend for quality product also increase.

Table:4.4 Water Purification Cost Pattern by Households across Income Ranges

Income	Less than Rs 100	100 -200	200-300	More than 300
Less than Rs. 10,000	12	13		
10,000-20,000	18	05		
20,000-30,000	14	09	02	
30,000-40,000	09	20	01	
40,000-50,000	05	12	01	
50,000-60,000	04	10	01	15
60,000-70,000	02	14	04	01
70,000-80,000	02	16	07	02
More than Rs.80,000	-	08	34	04

5.1.Estimation of Averting Expenditure

Averting expenditure, i.e., expenditure on purification methods is effective alternative for production cost of drinking quality water. Start up cost or installation cost and maintenance or operational cost can be taken into account to value the water quality. Each household uses the following formula to calculate aggregate accounting cost of producing one litre of drinking water.

$$C = Cc + Cm \qquad (10)$$

Cc is capital cost and Cm = maintenance cost. The results show that of 250 households surveyed in residential area nearly 68% of households are having positive willingness to pay for good quality drinking water since they have undertaken some purification activity at the household level. Maximum amount AE is Rs.350 and minimum is Rs.25. The estimated average expenditure is Rs. 140.Determinants of WTP

The hypothesis is like any other market good variations in WTP for quality drinking water across households may be explained by the household income.

Least Square Regression Results

Variables	Coefficient	Standard Error	t-value	R-squre
Constant	65.696	10.813	6.076	.207
Monthly Exp.	.004	.001	4.645	
Education	15.97	4. 026	3.969	

The above estimates support the hypothesis of positive relationship between the explained variable, which is monthly per expenditure and with level of education. More than one earning member are able to spend more for preventing methods. More one earns, the more one has spending capacity to avoid the bad effects of water. This supports the standard idea of positive income elasticity.

6.1Conclusion

Water pollution has important and diverse health effects, in leather tannery areas. Awareness programmes about the water borne diseases and its consequences and about the advantages of quality water and improved education may increase the willingness to pay for quality water.

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