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Why Public Enterprises fail to provide basic needs in developing countries: The case of rural water supply

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Abstract

This paper examines the role of public enterprises in providing safe drinking water in developing countries and analyses the factors influencing households' water source choices using a revealed preference model. The study, conducted in rural Nepal, reveals a substantial willingness to pay for convenient access to safe water, challenging the notion that rural households, especially women, do not value time savings from improved water access. The findings suggest that the predominant supply-driven, heavily subsidised approach of public water utilities warrants reconsideration. The paper argues that the willingness to pay exists but the willingness to charge is stymied. This policy creates a vicious cycle of poor service and poor cost recovery. The paper suggests a paradigm shift towards a more demand-responsive approach, allowing households to choose and pay for their desired service levels while ensuring a minimum level of safe water for all. This could enhance sustainability, welfare, and financial viability of public water utilities. The study concludes that public enterprises have a critical role in ensuring universal access to safe water but should adopt a more dynamic, accountable, and service-oriented approach, incorporating user preferences and contributions while retaining their core public mandate.

KEYWORDS: Public provision; public utilities; demand-driven approach; pricing structure

Introduction

In many developing countries, public enterprises play a crucial role in providing basic needs to the population. These state-owned entities often focus on delivering essential services such as healthcare, education, housing, water supply, and electricity. By prioritizing these fundamental necessities, public enterprises aim to improve the living standards of citizens, particularly those in low-income and marginalised communities. One critical area where public enterprises can make a significant impact is in the provision of safe drinking water which is essential for maintaining health and preventing waterborne diseases. Public enterprises can invest in water treatment plants, distribution networks to ensure that communities have a reliable and safe water supply. By prioritizing water infrastructure and management, these entities can reduce the burden of water-related illnesses and improve the overall quality of life for millions of people in developing countries.

However, the effectiveness of public enterprises in meeting basic needs varies across countries. Some face challenges such as limited resources, inefficient management, and corruption, which hinder their ability to deliver quality services. One problem often overlooked is pricing the services. Without addressing this issue, public enterprises cannot address the basic needs of developing countries.

Safe drinking water has long been recognised as a 'basic need' (e.g., ILO, 1976). At the end of the International Drinking Water Supply and Sanitation decade, Global Consultations were held in New Delhi, India in September, 1990. In the field of drinking water, while delineating policies for achievement of universal coverage by the year 2000, the New Delhi Declaration calls for "some for all rather than more for some" (Asthana, 1997). Coming, as it did, at a time when nee-classical counter-revolution was in ascendance, it is somewhat surprising that an egalitarian declaration, achieved a broad consensus at the Global Consultations. Inevitably, when policy initiatives emerged out of this declaration, the neo- classical economists of the World Bank and some donor countries found the "welfare state" connotations of the Delhi Declaration disconcerting and criticised these initiatives as the "first standard paradigm" (World Bank Water Demand Research Team 1993).

World Bank's criticism of "free drinking water", however, has had little influence on the rural water supply program in in poor countries, where water supply programmes continued to be a supply-driven program. The recognition of demand for drinking water as an economic good has been marginal in policy making.

Earlier literature on rural water supply in the developing countries is mainly descriptive in nature (e.g., Saunders and Warford, 1976; White et al., 1984) and the new studies in villages of developing countries concentrate on analysis of water vending activities (e.g., Whittington et al., 1990; Whittington et al., 1991). This paper proposes to analyse the demand for safe drinking water in rural areas of Nepal; the 'demand' in this case meaning the ability to pay and the willingness to pay. While "some for all rather than more for some" has been adopted the United Nations General Assembly as the "strategy for the nineties", it had already become clear that this strategy was leading nowhere towards the then objective of "Water for all by 2000". People were already viewing water as an economic private good though the policy makers are loath to change their paternalistic approach. There is a need to see if a policy of 'some for all *and* more for some' could be a better policy from the point of view of universal coverage and sustainability.

The government is committed to bring safe water nearer homes by installing hand pumps. Under the government sponsored programs, first priority is given to those villages where no source of drinking water exists. Next, those habitations are covered where the people have to walk more than 1.6 kilometres (1 mile) to fetch safe water. Thereafter, those habitations are covered where the distance to the nearest source of safe water is 1 kilometre. Piped water supply is provided only to those habitations where population is comparatively dense.

The model

Contingent valuation studies are being used in developed economies primarily to value public goods and other untraded commodities. An open-ended question asking people how much they would be willing to pay for commodity under consideration does not produce useful results. Some improvement is possible through a double-bounded dichotomous choice approach and other innovations (Cummings et al., 1986; Whittington et al., 1992). This approach has now been applied in the analysis of water policy of developing countries also (e.g., Altaf et al., 1993; Briscoe et al., 1990; Singh et al., 1993; Whittington et al.,1990) with variable results. Despite these innovations in survey methods, contingent valuation approach could include the following biases in the answers of the respondents: (1) Hypothetical bias due to the hypothetical nature of the question; (2) Strategic bias because the respondent may perceive an opportunity to manipulate the outcome; (3) Compliance bias because the respondent attempts to anticipate responses the interviewer wants; and (4) Starting point bias with bids being influenced by interviewer's suggestions. These biases could be more pronounced in populations with low rates of literacy. Accordingly, this study uses revealed preference method rather than contingent valuation approach. The dependent variable is the choice decision and *not* the maximum willingness to pay.

Choosing a source of water is an economic decision that involves choice among discrete alternatives. Accordingly, for this research, a discrete choice probabilistic model will be appropriate. Since the utility is not directly observable, an indirect utility function will be used.

Assumptions

For the simplicity of analysis, an individual household is considered as a single rational decision-making unit; intra-household conflicts, if any, are being ignored. In other words, though the composition of the household is being taken into account, the utility function is for the household as a whole and not for individual members. It is assumed that consumers would demand access to cheap safe water at the shortest possible distance for two reasons: (a) perceived health benefits; and (b) saving of time/effort in bringing water from a distance.

Water is classified either as safe or unsafe. U.N. organisations, viz., UNICEF and WHO, follow this classification and leave it to the individual countries to decide chemical, biological, or other characteristics that classify water as safe. In this study, water has been classified as 'safe' or 'unsafe' as per government norms, i.e., water from hand pumps and piped water supply schemes was considered safe whereas water from dug-wells was classified as unsafe. Thus, we have three types of water-unsafe water (subscript u), safe water from public sources (subscript s) and safe water from private yardtap (subscript t). In the habitations without piped water supply, the choice is between the first two types whereas in habitations with piped water supply, the choice is between the last two types.

Model specification

Conditional indirect utility function of households *h*:

$$U_{ih} = U_{ih}\,(X_{ih}, Z_{ih}) \qquad (1)$$

where i indicates the water source

h denotes the household;

X is a vector source characteristics; and Z is a vector of household characteristics.

According to random utility theory, such unobservable or unmeasurable in- fluences are assumed to be captured in a random term, which for operational purposes is usually assumed to be added to the systematic term:

$$U_{ih} = V_{ih} + e_{ih} \qquad (2)$$

where V is the systematic term and e is the random term. Let the variable yjh indicate household h's choice decision on source j such that

$$y_{ih} = \begin{cases} 1 \ if \ V_{jh} + e_{jh} > V_{ih} + e_{ih} \ for \ i, j = 1, \ldots J \ and \ i \ not \ equal \ to \ j \\ 0 \ otherwise \end{cases} \quad (3)$$

The expected value of y_{jh} is thus

$$\begin{aligned} E(y_{jh}) &= P(y_{jh} = 1), \\ &= P(U_{jh} > U_{ih}), \\ &= P(V_{jh} + e_{jh} > V_{ih} + e_{ih}), \end{aligned} \quad (4)$$

In habitations without piped water supply, the dependent variable is the choice decision between bringing unsafe water (subscript u) from a lesser distance and safe water (subscript s) from a larger distance. The price is not a relevant variable because water from both the sources is free. In habitations with piped water supply the dependent variable is the Choice decision between bringing safe water from yard tap (subscript t) and safe water from a public standpipe (subscript s). The source specific independent variables are taken to be time for collection in person—hours per day and the price for domestic water connection in rupees per day.

The independent variables in vector X_{jh} vary across sources. The standard statistical method of dealing with them is a logit model. The independent variables in vector Z_{jh} do not vary across sources. The standard approach for them is the polychotomous model. Our data structure will include both types of independent variables. However, since source characteristics do not influence household characteristics and vice versa, the household's utility function may be assumed to be additive:

$$V_{ih} = BX_{ih} + \alpha_j Z_h \quad (5)$$

According to McFadden (1981) and Maddala (1983), the following conditional logit model can be used to deal with the data structure which includes both groups of independent variables:

$$P_{hj} = \frac{e^{BX_{ih} + \alpha_j Z_h}}{\sum_{i=1}^{J} e^{BX_{ih} + \alpha_j Z_h}} \quad (6)$$

The estimation procedure for this conditional logit model is essentially the same as for a standard logit model because the household-specific vector Z_h can be transformed into a choice-specific vector. Therefore, the maximum likelihood method will give a consistent estimate of the parameter vector B.

Habitations without piped water supply

The probabilities of a household choosing safe water $P_h(s)$ and choosing unsafe water $P_h(u)$ are given by substitution *s* and *u* respectively for *i* in equations (5) and (6). The two resulting equations allow a ready interpretation of the selection probabilities in terms of the relative representative utilities of alternatives and are relatively amenable to computation.

Unlike linear models, this model does not permit direct computation of effect of change in an independent variable on a dependent variable. However, within the parameter vector, the marginal rate of substitution of coefficients can be calculated. If the value of time is defined as marginal rate of substitution between the time spent collecting water and the money paid for the water, it can be calculated from two of the estimated parameters by a simple division.

Sampling frame and survey methodology

Previous studies relating to water supply have used a sample of 50 to 60 observations. Whittington et al. (1990) in their study in Kenya cover a cross-section of 59 households. McFadden (1973) has shown that maximum likelihood estimator is well behaved in samples of sizes 50 and greater. This study covers 480 households — half the Observations (30 households from each of the 8 villages) are from habitations without water supply and the other half from the villages that have piped water supply.

Survey was conducted on the basis of schedules of inquiry. A stratified two stage sample was adopted for survey—the first stage units are census villages—16 in all; the second stage units are the households—30 from each first stage unit. The time for collecting water includes travel time and queue time but does not include fill time and time taken in using water at (or near) the source itself. Accordingly, collection time for use of water from a yardtap can be considered as zero. The households who had applied for private connection but were not able to get it on account of various reasons like distance from the main pipeline or lack of political clout are deemed to have exercised their choice in favour of private connection. In this study, household consumption has been used as a surrogate for household income. The household income divided by the household size is the per capita income.

4. Interpretation of regression results

Maximum likelihood estimation of the conditional logit model can be shown under very general conditions to provide estimators that are asymptotically efficient and normally distributed. Examples suggest that the approximation is reasonably good, even in small samples. The problem of selection of independent variables in logit models is more acute than in linear regression. The selection has to be on the basis of economic theory and intuition rather than a computer dictated algorithm where forward or backward selection depends on Wald statistic or change in likelihood ratio.

Since the sample size is large, the test of significance of a coefficient can be based on Wald statistic, which has a chi-square distribution. When a variable has single degree of freedom, the Wald statistic is equal to the square of the ratio of the coefficient to its standard error. An alternative-set specific constant is included for regression. As explained by Train (1986), this is not a restriction on the model but only a normalisation. Results of successive regressions based on the conditional logit model of the households' water choice in habitations without piped water supply have been summarised in Table 1.

Table 1

Maximum likelihood parameter estimates of safe water decision model[a].

Independent variable	Regression				
	1	2	3	4	5
Distance travelled extra in kilometres	6.04[b] (0.86)	-	-	-	-
Household size	0.02 (0.11)	-	-		
Time extra in hours per day	-	-0.84[b] (0.24)	-0.60[b] (0.12)	-0.60[b] (0.12)	-0.60[b] (0.12)
Proportion of women in household	12.37[b] (2.03)	7.37[b] (1.61)	7.37[b] (1.61)	7.37[b] (1.61)	7.07[b] (1.61)
Proportion of men in household	2.24 (1.74)	2.14 (1.64)	2.24 (1.74)	2.14 (1.64)	2.24 (1.74)
Female educational level	0.35 (0.10)	0.32 (0.09)	0.35 (0.10)	-	0.35 (0.10)
Household educational level	-0.09 (0.11)	-0.09 (0.08)	-	-0.09 [b] (0.04)	-
Income per capita in rupees per day	0.56[b] (0.09)	0.56[b] (0.09)	0.56[b] (0.09)	0.56 (0.09)	-
Intercept	-9.61 (2.04)	-7.51 (2.00)	-9.63 (2.04)	-7.51 (2.00)	-7.52 (2.01)

Notes: Standard errors in parentheses. [a]Dependent variable is choice of source (Safe = 1, Unsafe = 2). [b]Wald statistic significant at 1% level.
No. of observations is 240.

The results in respect of households in the habitations with piped water supply are in Table 2.

Table 2

Maximum likelihood parameter estimates of Yardtap decision model[a]

Independent variable	Regression				
	1	2	3	4	5
Price in rupees per day	-8.73[b] (1.35)	-8.73[b] (1.35)	-8.73[b] (1.35)	-8.73[b] (1.35)	-8.53[b] (1.29)
Household size	0.29 (0.38)	-1.17[b] (0.20)	1.10[b] (0.17)		
Time extra in hours per day	-8.05[b] (2.76)	-	-	-9.71[b] (1.80)	-9.60[b] (1.20)
Proportion of women in household	-2.61[b] (1.74)	-2.13[b] (1.61)	-2.10[b] (1.61)	-2.73[b] (1.35)	-2.73[b] (1.35)
Proportion of men in household	7.99 (2.40)	7.78 (2.35)	7.87 (2.35)	7.58 (2.56)	7.77 (2.50)
Female educational level	0.02 (0.10)	0.02 (0.09)	-	0.02 (0.09)	-
Household educational level	-0.09 (0.11)	-0.09 (0.08)	-	-0.09 (0.08)	-
Income per capita in rupees per day	0.56[b] (0.09)	0.56[b] (0.09)	0.56[b] (0.09)	0.56[b] (0.09)	0.56[b] (0.09)
Intercept	-9.63 (2.04)	-7.51 (2.00)	-9.63 (2.04)	-7.51 (2.00)	-7.51 (2.01)

Notes. Standard errors in parentheses. [a]Dependent variable is choice of source (Yes=1, No=2). No. of observations is 240.
[b]Wald statistic significant at 1% level.

Habitations without piped water supply

The time spent in collection of water is highly correlated to the distance of the water source as also to the household size. In Table 1, regression no. 1 shows that if distance and household size are included, and time excluded, the distance is significant but the household size is not. Better results in terms of likelihood chi-squares are obtained by including time as a variable rather than distance and household size as variables. In either case, income is not significant as a determinant variable. This is acceptable because both sources of water are free. Since the income is correlated to the educational levels, better results are obtained by removing this non-significant variable in later regressions.

Female educational level is correlated with the household educational level. If both these variables are included in the equation, only the female educational level is found to be significant. Only when we remove the female educational level in regression no. 4, do we find household educational level significant, and then the results are not as good as those obtained by removing the household educational level. It may be concluded that the female educational level rather than the educational level of the household is significant. The parameter estimate of female educational level is consistently positive and highly significant. We conclude that the determinants of the choice of safe water are as follows:

(1) Distance of the source from home is highly significant with a negative sign. Lesser the difference between the distance from home to the safe source and that from home to the unsafe source, higher the probability of choosing safe water.
(2) The proportion of women (above the age of 15 years) in the household is a significant factor in choosing a safe source. Considering that 79% of water is hauled by women, a household with a higher proportion of women among its members has a higher capability of hauling water from larger distance.
(3) The proportion of adult men in the household and their educational level are not significant.
(4) Household size is not a significant factor. Though bigger households need more water, they also have more person-hours available for hauling water and it appears that the two effects cancel out.

Habitations with piped water supply

In Table 2, regression no. 1 is an uninformed regression with all relevant independent variables. We find that price, time, proportion of men in the household and income are significant. However, not much credence can be given to this regression because time is highly correlated to household size.

In regression no. 2, we remove time variable but keep all other independent variables including household size. This is an informed regression and we find that Price, Household size and Income and proportion of men in the household are significant variables, whereas proportion of women, educational level of women and educational level of the household are not significant.

Educational level is correlated to income. Since the price is a significant factor, it was to be expected that income will also be a significant variable. There is no reason to expect significance of educational level because the choice is between two sources of water, both of which are safe. In regression no. 3, when we remove the two variables indicating the educational level, the significance and signs of other parameters remain unaffected.

In regression no. 4, we include time and remove household size. Again, we find that the two variables indicating educational level are not significant. All other variables viz., price, time, proportion of women and men in the household and income are significant. Removing the two educational level variables in regression no. 5 does not alter the signs and significance of other variables.

We conclude that the determinants of choosing private household connection (yardtap) are as follows:

(1) Price of water has a negative effect on the choice variable. Higher the price, lower is the probability of households opting for private connection.
(2) Income has a positive effect on choice of yardtap. In other words, economically better off households prefer private connection whereas poorer households make do with public standposts.
(3) Household size has a positive effect on the choice variable. Controlling for other household characteristics, bigger households prefer to pay for a yardtap rather than obtaining free water from a public standpipe. This could be due to the fact that in absence of metering, the tariff for yardtap is the same and the bigger households can get more water for their money.
(4) Households with higher proportion of men prefer a yardtap, whereas households with higher proportion of women prefer to spend time at the public standposts. This could be so due to the fact that hauling water is mainly women's work.
(5) Neither the educational level of women nor of men is significant. This could be due to the fact that the choice is between two sources of safe water and therefore it is the economic status rather than educational level that determines the choice.

Value of time

Since the value of time is the marginal rate of substitution between the time spent in collecting the water and the money paid for the water, it can be calculated from two of the estimated parameters as mentioned earlier. We use maximum likelihood parameter estimates from regression no. 5 of the yardtap decision model for this purpose.

The minimum wage rate for unskilled labour in the study area in Nepal as fixed by the government is 89 rupees per hour. Because of problems of implementation, it could be assumed that the going market rate would be a little less than that. Our study finds that on the average people value time savings resulting from improved access at 49 rupees per day which is a little less than half the market wage rate for unskilled labour in the local economy. Willingness to pay is significant.

Policy implications

While theoretical adequacy and empirical validity are important to any economic analysis; in this research, policy effectiveness is also a major consideration. The conventional wisdom that water research and planning in developing countries is not very different than that in industrial countries is slowly giving way to interest in country-specific problems especially where the planning process is often flawed (Brookshire and Whittington, 1993).

It appears that notwithstanding occasional dissenting voices from the neo-classical economists of the World Bank and some donor countries (e.g., Churchill, 1987; Feder and Le Moigne, 1994), the U.N. agencies focus on cost reduction, appropriate technology and advocacy as means of progress. Cost recovery and demand analysis are peripheral issues.

The problem caused by the paternalistic approach to basic needs is that of sustainability. In the push towards the universal coverage, the operations and maintenance gets neglected. Moreover, the government coffers can sustain the heavy drain only to an extent and the level of service cannot be improved any further.

Table 1 indicates that the variables distance and time are highly significant. In other words, people are traveling larger distances and spending more time to fetch safe water even when unsafe water is near at hand. Apparently, people's perception of benefits of safe water is significant. We find that female education is an important determinant in choosing safe water while income is not important.

A perusal of Table 2 indicates that variables price and time are highly significant indicating that the people are ready to pay cash instead of spending time in water collection. On the average, the amount they are willing to pay for saving in time is equal to half the wage for unskilled rural labour. The hypothesis that in view of involuntary unemployment in rural areas, time, especially women's time, has no value is incorrect. We find that the important determinant in this case is the income, as in case of most economic goods.

1980's, onwards, there has been a decline in the level of rural poverty in in the developing countries, though the extent and the reasons for this decline are as yet a matter of academic dispute. If this trend continues, people will ask for a higher level of service and will be even more willing to pay for it, because income is a significant variable for choosing higher level of service. A case exists for review of the present policy rooted in egalitarianism. People could be allowed to choose the level of service they want.

In view of externalities relating to health, there could be no controversy in the matter of minimum service to all. Beyond this level, the people should have the right to demand a higher level on payment. Some thought has been given to the cost recovery by the egalitarian school of social scientists who feel that the people should pay for water for the following reasons:

- By having a financial stake in water facilities, a sense of ownership is created which contributes to better operation and maintenance.
- The original sense of dependence, both financial and psychological, on the government is replaced by a feeling of partnership.
- A sense of confidence is created in the community about the ability to make important financial decisions based on a complete understanding of the outcome of these decisions.

The factors mentioned above cannot be quantified. But this policy denies the people's right to choose. The critical ingredient in effecting a change is a change in perceptions about the financing and purpose of a rural water supply system. Rather than trying to provide a free or heavily subsidised minimum-service-to-all system, the policy makers need to consider an improved service to all and higher level of service to those who are willing to pay more.

Conclusion

The results of this study have important implications for the role and approach of public enterprises in meeting the basic need of safe water supply in developing countries. The revealed preference model employed demonstrates that both source characteristics (distance, time, price) and household characteristics (income, household composition, education levels) significantly influence water source choices in rural areas. In habitations without piped supply, the key determinants are distance to the safe source and the proportion of adult women. Interestingly, income and male education are not significant factors, suggesting that public provision of accessible safe water is valued across socio-economic strata. For habitations with piped supply, price, income, household size and gender composition are the main drivers, while education is not influential.

Importantly, the analysis reveals substantial willingness to pay for convenient access to safe water, with the value of time saved being around half the unskilled wage rate. This challenges the notion that rural households, especially women, place little value on time savings from improved water access. These findings suggest that the predominant supply-driven, heavily subsidised approach of public enterprises in the drinking water sector warrants reconsideration. While public enterprises have contributed significantly to expanding access in rural areas, the study indicates that households are willing to contribute financially for higher service levels that match their preferences.

Moving forward, a more demand-responsive approach that allows households to choose and pay for their desired service level, while still ensuring a minimum level of safe water for all, could enhance both sustainability and welfare. As incomes rise, the willingness to pay for higher service levels will likely grow. Adopting a service orientation that recognises water as an economic good, at least beyond the basic level of provision, could improve cost recovery and financial viability of public water utilities. However, this does not imply a full-scale privatisation of rural water supply. Rather, public enterprises could leverage the demand-side information to provide differentiated service levels that balance efficiency, equity and sustainability considerations. Community consultation, participatory planning and innovative public-private partnerships could be explored to complement core public provision.

In conclusion, while public enterprises have a critical role in ensuring universal access to safe water, a paradigm shift towards demand-responsive provision is needed. Incorporating user preferences and contributions, while retaining the core public mandate, could lead to more sustainable and welfare-enhancing outcomes. As the custodians of this vital public good, public water enterprises should adapt to the changing landscape and adopt a more dynamic, accountable and service-oriented approach. Empowered by information on user demand, public utilities are well-positioned to pioneer this transition towards a more sustainable and equitable water future.

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References

Abubakar, I. R. (2019). Factors influencing household access to drinking water in Nigeria. *Utilities Policy*, *58*, 40-51.

Altaf, M. A., Dale, W., Jamal, H., & Kerry Smith, V. (1993). Rethinking Rural Water Supply Policy in the Punjab, Pakistan. *Water Resources Research, 29*, 1943–1954.

Asthana, A. N. (1997). Household choice of water supply systems. Loughborough, University.

Black, M. (1990). *From Hand Pumps to Health*. UNICEF.

Brookshire, D. S., & Whittington, D. (1993). Water Resources Issues in the Developing Countries. *Water Resources Research, 29*, 1883–1888.

Churchill, A. A. (1987). *Rural Water Supply and Sanitation: Time for Change*. World Bank Discussion Paper No. 18. The World Bank.

Cummings, R., Brookshire, D., & Schultze, W. (1986). *Valuing Environmental Goods: A State of the Art Assessment of the Contingent Valuation Method.* Rowman & Allenheld.

Feder, G., & Le Moigne, G. (1994). Managing Water in a Sustainable Manner. *Finance & Development, 31*(2), 24–27.

ILO International Labor Office (1976). *Employment, Growth and Basic Needs: A One-World Problem.* Praeger.

Maddala, G.S. (1983). *Limited-dependent and Qualitative Variables in Econometrics.* Cambridge University Press.

McFadden, D. (1973). Conditional Logit Analysis of Qualitative Choice Behavior. In Zarembka, Paul (ed.), *Frontiers in Econometrics.* Academic Press.

McFadden, D. (1981). Econometric Models of Probabilistic Choice. In C. F. Manski, & D. McFadden (Eds.), *Structural Analysis of Discrete Data with Econometric Applications.* Cambridge: MIT Press.

McFadden, Daniel and Marcel K. Richter (1990). Stochastic Rationality and Revealed Stochastic Preference. In J. S. Chipman, D. McFadden, & M.K. Richter (Eds.), *Preferences, Uncertainty and Optimality* Boulder: Westview.

Munasinghe, M. (1992). *Water Supply and Environmental Management: Developing World Applications*. Westview.

NDWM National Drinking Water Mission (1993). *Rural Water Supply & Sanitation Programs in India.* Government of India.

Saunders, R. J. & Warford, J. J. (1976). *Village Water Supply*. John Hopkins University Press.

Singh, B., Ramasubban, R., Bhatia, R., Briscoe, J., Griffin, C. C., & Kim, C. (1993). Rural Water Supply in Kerala, India: How to Emerge from a Low-level Equilibrium Trap. *Water Resources Research, 29*, 1931–1942.

Train, K. (1986). *Qualitative Choice Analysis: Theory, Econometrics, and an Application to Automobile Demand.* MIT Press.

White, G. F., Bradley, D. J., & A. U. White (1984). *Drawers of Water*. Chicago: Chicago University Press.

Whittington, D., Okorafor, A., Okore, A. & McPhail, A. (1990). Strategy for Cost Recovery in the Rural Water Sector: A Case Study of Nsukka District, Anambra State, Nigeria. *Water Resources Research, 26*, 1899–1913.

Whittington, D., Mu, X., & Roche, R. (1990). Calculating the Value of Time Spent Collecting Water: Some Estimates for Ukunda, Kenya. *World Development, 18*, 269–280.

Whittington, D., Lauria, S. T., & Mu, X. (1991). A Study of Water Vending and Willingness to Pay for Water in Onitsha, Nigeria. *World Development,* 19(2/3), 179–198.

Whittington, D., Kerry Smith, V., Okorafor, A., Okore, A., Liu, J. L., & McPhail, A. (1992). Giving Respondents Time to Think in Contingent Valuation Studies. *Journal of Environment, Economics & Management* 22, 205–225.

World Bank Water Demand Research Team (1993). The Demand for Water in Rural Areas: Determinants and Policy Implications. *The World Bank Research Observer* 8(1), 47–70.