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Strategy for Cost Recovery in the Rural Water Sector: A Case Study of Nsukka District, Anambra State, Nigeria

DALE WHITTINGTON[1]

University of North Carolina at Chapel Hill

APIA OKORAFOR AND AUGUSTINE OKORE

University of Nigeria at Nsukka

ALEXANDER MCPHAIL

Johns Hopkins University, Baltimore, Maryland

In-depth interviews were conducted with 395 households in three rural communities in the Nsukka district of Anambra State, Nigeria, concerning their household water use practices, water expenditures to vendors, willingness to pay for improved water supplies, and household socioeconomic characteristics. Households in Nsukka district do not want to pay for water in advance or commit themselves to a fixed monthly payment for water. They want the freedom to buy water only when they use it, partly due to the seasonal nature of water use and partly because they want control over their cash flow in order to meet other more immediately pressing needs. Equally important, they do not trust government to provide a reliable public water supply. They do not want to pay in advance for a service they are not sure they will ever get. If they are required to pay a fixed fee every month, households are willing to pay only relatively small amounts for improved services, even less than they are currently paying water vendors. Current arrangements for cost recovery, fixed monthly fees for both public taps and unmetered private connections, are inappropriate. Kiosk systems, or kiosk systems with metered private connections for some households, are the most promising way to improve cost recovery and meet consumers' cash flow needs.

INTRODUCTION: IMPASSE IN RURAL WATER SUPPLY PROVISION

During the rainy season from May until October, the northern part of Anambra State in Nigeria receives approximately 1,500 mm (about 60 inches) of rainfall and almost all households in rural communities collect rainwater for domestic water use, and in many villages streams and springs provide additional water supplies. From November to April, however, this region receives almost no rainfall. During the dry season, surface water sources are very limited, and the depth of groundwater is relatively great (often over 200 m). People must frequently spend several hours a day collecting water, either walking long distances to streams or queuing at springs with very low flows.

For most households the only alternative to such time-consuming water collection practices is to purchase water from tanker trucks. These tanker truck vendors sell water throughout the rural areas of Anambra State, but are particularly active during the dry season in the northern region (see *Whittington et al.* [1989*a*] for a description of water vending activities in an urban area of Anambra State). The tanker trucks appear to reach almost all rural communities in this region, traveling long distances on unpaved roads and then winding their way through the villages on what are often little more than dirt paths. However, the service from tanker trucks is often unreliable. Households are never sure when a tanker truck will come to their village, or reach their house with sufficient supplies.

To meet the water needs of rural communities in Anambra State, Nigerian federal and state government agencies have drilled hundreds of boreholes over the past two decades. Many were equipped with pumps and generators, and some supply small piped distribution systems with public and private taps. Today the majority of these boreholes are not providing water. Some have never been operational and were simply capped after they were drilled. Other systems ran for a time and then fell into disuse. Of those which do work, many are used mostly to supply water to tanker trucks.

There thus exists this paradox: Why do households continue to spend large sums of money buying water from tanker truck vendors while boreholes in their village stand idle? Although there are some interesting peculiarities about this specific case, the situation in northern Anambra State is not unusual. Rural water systems in many parts of Africa no longer function and have been abandoned, yet water vendors are active in many rural areas of Africa. This is true despite the fact that the delivery of water by vendors is almost always a very expensive service option [*Whittington et al.*, 1989*b*]. An estimated 2 out of 3 rural Africans are still without access to an improved water supply (such estimates, however, never include water vendors as an improved water supply.)

Numerous reasons have been offered for the current crisis in the rural water sector in Africa, and they tend to break

[1] Also at World Bank, Washington, D. C.

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TABLE 1. Socioeconomic Characteristics of Sample Households in the Study Villages

	Village			
	Edem	Ekwegbe	Umunko	Total Sample
Household Size (mean number of persons)	8.0	9.6	6.9	8.2
Number of women as a percent of total adults in household (mean)	60	60	60	60
Number of children in household (mean)	4.2	4.9	3.4	4.2
Education (mean number of years for highest educated person in the household)	2.5	3.1	3.3	3.0
Percent of heads of household who are farmers (mean)	62	69	80	70
Value of household assets (mean), thousands of naira	1.8	1.3	1.0	1.4
Housing construction, %				
Thatch roof/mud wall	23	17	46	28
Metal roof/mud wall	21	16	13	16
Metal roof/brick wall	14	39	18	24
Metal roof/plastered brick wall	42	28	23	32

down along disciplinary lines. Engineers often attribute project failure to inappropriate technology, poor construction, or lack of operation and maintenance. Economists and financial analysts question the affordability of rural water schemes and the wisdom of current pricing and cost recovery policies. Anthropologists see project failure stemming from a lack of sensitivity on the part of donors and government agencies to traditional cultural practices and beliefs. Public health specialists see the problem as one of lack of awareness of the health benefits of improved water supplies. Political scientists cite the lack of community participation and how little is understood of local political realities and their effect on the management of water systems.

This paper looks at the complex of political and economic factors which have contributed to the current impasse in rural water supply provision in northern Anambra State in Nigeria. In-depth interviews were completed with 395 households in three communities in the Nsukka district of Anambra State concerning their household water use and storage practices, water expenditures to vendors, willingness to pay for improved water supplies, and household socioeconomic characteristics. After the surveys were analyzed, follow-up, open-ended interviews were carried out with individuals and small groups of respondents and community leaders in the villages in order to probe some of the results of the surveys. This paper reports on what was learned from both the surveys and follow-up conversations, and examines the implications of these findings for cost recovery strategies in the rural water sector.

THE STUDY AREA AND FIELD PROCEDURES

The field work for this study was conducted in May 1989 in three large Igbo villages in the Nsukka district of Anambra State: Edem, Ekwegbe, and Umunko. The villages were 10 to 30 km from the town of Nsukka, the district center and the site of the main campus of the University of Nigeria. The population of these villages is difficult to estimate because the dwellings are widely dispersed (often with several concentrations of housing and commercial activity) and because the only census estimates are more than two decades old. However, the study villages probably range in size from about 10,000 (Edem) to 25,000 (Ekwegbe).

All three villages are predominantly agricultural communities. The majority of the population are farmers (62% of the sample respondents in Edem, 69% in Ekwegbe, 80% in Umunko; see Table 1). The principal crops grown in the area are cassava, yams, and maize. The second and third largest occupational groupings are "small traders" and "skilled laborers." None of the study villages had electric services, though a handful of households in each village had their own generators. All villages had primary schools and basic market facilities. Table 1 summarizes some of the other socioeconomic characteristics of households in the three villages.

The household questionnaire was developed and then pretested in a nearby village similar to the three study villages. The questionnaire was administered by a team of ten enumerators, who received almost two weeks of training. The enumerators were all secondary school graduates from the Nsukka district who were familiar with local customs and water use practices. In order to facilitate execution of the surveys, the chief and local government leaders for each village were consulted, and their cooperation in the study was secured before work began.

In total, 132 households were interviewed in Edem, 128 in Ekwegbe, and 135 in Umunko. It was impossible to construct well-defined sample frames in any of the villages within the time and resource constraints of this study.[7] Enumerators were simply dropped in different parts of the communities and instructed to walk in a specified direction and to interview every other household. Interviews were conducted in the afternoon and early evening, when people were likely to be back from their work in the fields.

CURRENT WATER SUPPLY SITUATION IN THE STUDY VILLAGES

Past Investments

At the time of this study none of the villages had an operational water supply system. In Ekwegbe the federal government had drilled a borehole and installed a storage

TABLE 2. Household Water Source Choice for Major Water Uses

	Dry Season				Rainy Season			
	Drinking and Cooking		Clothes Washing and Bathing		Drinking and Cooking		Clothes Washing and Bathing	
	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary
				Edem				
Spring	83	16	75	18	30	65	18	70
Stream	...	...	...	...	...	...	...	...
Tanker	17	57	24	51	1	1	1	3
Rain	...	...	1	1	69	29	81	17
No other source	...	27	...	30	...	5	...	10
				Ekwebge				
Spring	33	26	33	27	5	29	5	30
Stream	12	14	12	14	...	12	...	11
Tanker	53	41	53	39	...	3	...	2
Rain	2	1	2	1	95	6	95	9
No other source	...	18	...	19	...	50	...	48
				Umunko				
Spring	44	10	41	12	4	18	5	16
Stream	22	18	22	18	...	6	1	5
Tanker	33	50	35	45	1	1	1	2
Rain	1	2	2	3	95	3	93	5
No other source	...	20	...	22	...	72	...	72

Values given are percentage of households.

tank four years earlier. The system had actually been successfully tested but then was stopped and has never operated again. Now the 50,000 gal. (227 kL) elevated storage tank stands as an ever-present reminder of the failed promises of an improved water supply. (All references to "gallons" in this paper are "imperial gallons.") Umunko has a borehole that was drilled and capped; the village has never received any water from it, and there is no prospect of use in the foreseeable future. In Edem a borehole was being drilled at the time of our survey, and the village leadership was attempting to raise the funds to finish the drilling and to install a pump, generator, and storage tank.

Water Use Practices

In the rainy season the majority of households in all three of the study villages depend on rainwater as their primary source of water for all major water uses: drinking, cooking, clothes washing, and bathing (Table 2). For example, in both Ekwegbe and Umunko, 95% of the households interviewed reported that rainwater was their primary water source for drinking and cooking during the rainy season (Figure 1). In Edem, 69% used rainwater as their primary source, and 30% relied on nearby springs. Only 1 to 3% of the sample households reported purchasing water from tanker trucks during the rainy season. In all of the study villages the majority of the population bathe at home, not at the spring or stream. Clothes washing is done at home and at the spring or stream.

Because of this heavy reliance on rainwater collection, the majority of households have substantial water storage capabilities. In both Ekwegbe and Umunko more than 60% of the sample households have more than 1000 gal. (4.546 kL) of storage (Figure 2). In addition to buckets, clay pots, and 45-gal. (205 L) drums, these households have either a large metal storage tank or a hand-dug, cement-lined rainwater collection pit in the yard. Few households in Edem have large tanks or pits, but 75% of the sample households there still have the capability of storing more than 50 gal. (227 L) of water. (Estimates of storage volumes should be interpreted as only approximate. For example, steel tanks are fabricated by local artisans and are not made in truly standard sizes.)

Not only do most people rely on rainwater, but they also believe that the quality of rainwater is "good" (Figure 3). Only 10% of the sample households rated the quality of rainwater as "poor," and almost half of these were households with thatched roofs. People are even more satisfied with the quality of water from springs than with rainwater. Seventy-five percent of the households reported that the quality of water from springs in the rainy season was "good."

In the dry season, household water use is quite different. Rainwater obviously is not available, and the time required to collect water from traditional sources such as springs increases substantially, because the flows from springs are reduced and queue times may increase to several hours (Figure 4). In Edem the average time households spend per day collecting water from springs in the dry season is more than 7 hours; in Ekwegbe it is more than 5 hours. In Umunko the average time spent collecting water from springs is about 4 hours (this does not vary from the dry to rainy season because the spring there is large and has a more or less uniform flow throughout the year).

Rather than spend so much time collecting water from traditional sources, most households in the study villages bought at least some of their water during the dry season

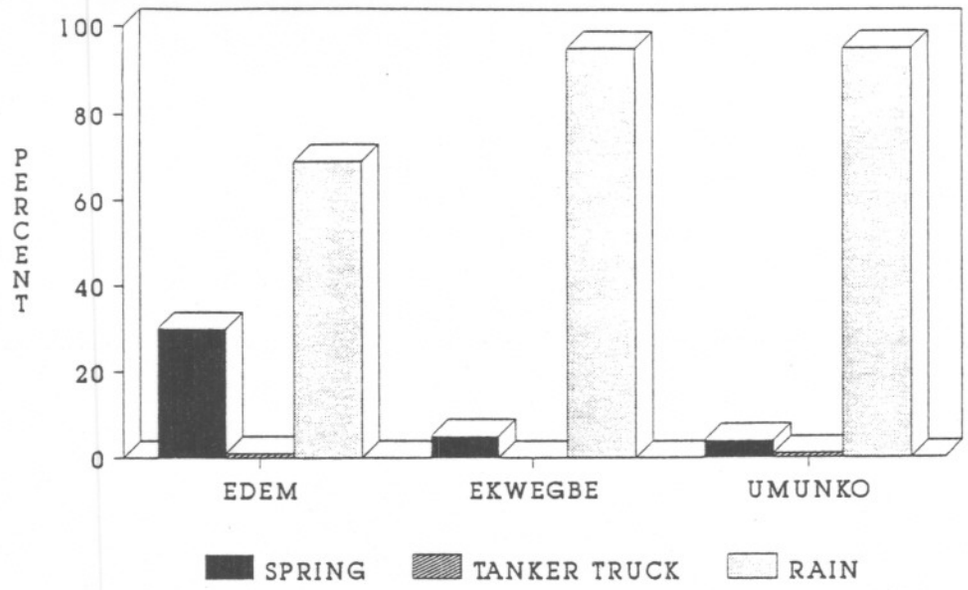

Fig. 1. Primary source of drinking and cooking water in the rainy season by village.

from tanker trucks or from neighbors who were supplied by tanker trucks. In Ekwegbe, 95% bought some water from tankers or neighbors, in Umunko 84%, and in Edem 80%. In Ekwegbe, 53% of the sample households used tanker trucks or neighbors as their primary source of water for drinking and cooking; the comparable percentages in Umunko and Edem were 33 and 17. (Compare with Figure 1, which shows primary water sources during the rainy season.)

The prices charged by tanker trucks were fairly similar in the three villages (Figure 5). A 45-gal. (205 L) drum of water sold for about 5 naira (₦0.11 per gal.). (At the time of the study, ₦1.00 = US$0.133, ₦7.50 = US$1.00.) In Ekwegbe and Umunko it cost about ₦80 to have a tanker fill a 1,000-gal. (4.546 kL) tank (₦0.08 per gal.); in Edem about ₦60 (₦0.06 per gal.). Households purchasing small quantities of water from neighbors paid higher prices per gallon. Four gallons (18 L) of water purchased by the bucket cost ₦0.50 to ₦0.65 (₦0.12–0.16 per gal.) (Figure 6).

What Are Households Spending Now for Water?

Many households spend substantial amounts of money purchasing water from tanker trucks and neighbors during the dry season (Figure 7). Households in Umunko are spending the least (mean monthly household expenditure, ₦35); slightly less than 50% of the households are spending more than ₦26 per month. On the other hand, households in Ekwegbe are spending substantially more than this (mean, ₦63). More than 60% of the households in Ekwegbe are spending more than ₦26 per month, and about 40% are

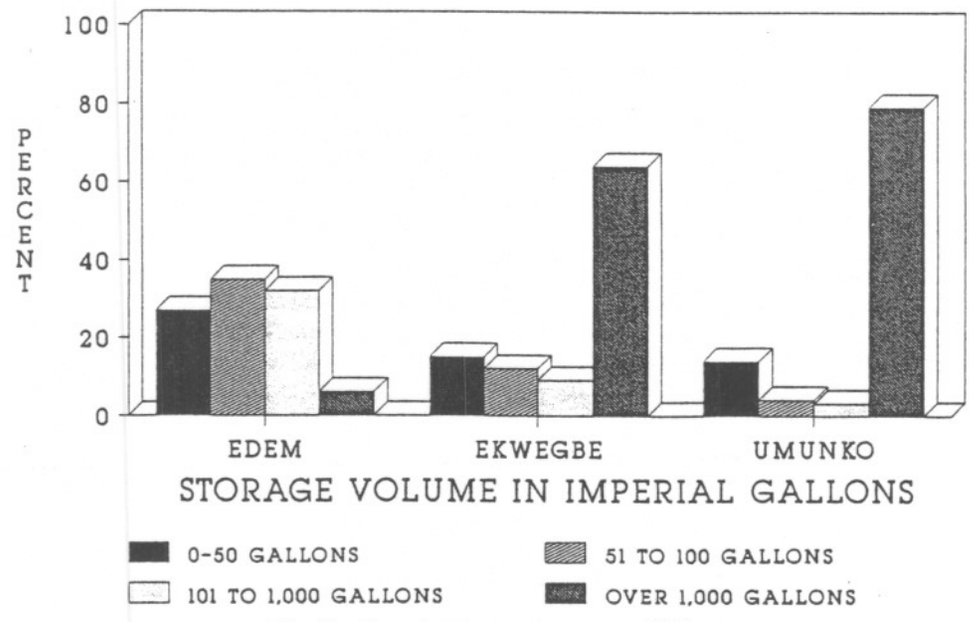

Fig. 2. Household water storage capabilities.

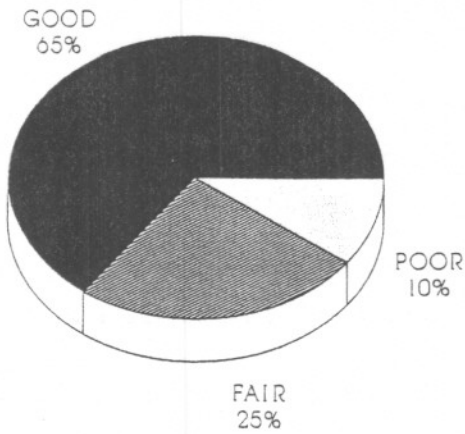

Fig. 3. Perceived quality of rainwater.

spending more than ₦50 per month. In Edem less than 30% of the households are spending more than ₦50 per month (mean monthly expenditure, ₦46). On an annual basis, most households are probably spending between 6 and 10% of their income buying water from vendors. To put the magnitude of these expenditures on vended water in perspective, an average household in rural areas of Nsukka district is spending US$5–8 per month in the dry season, which is about the same in absolute terms as the amount many households in industrialized countries pay per month for much more water and much better service.

These estimates of monthly household expenditure on water are based on the respondents' answers to questions about how much water the household purchased on average per week by different size container, multiplied by the average prices of water in the village. The estimates reflect substantial uncertainty, however, because respondents often had difficulty thinking about an average amount of water purchased, in part because the service from tanker trucks was typically irregular and households only purchased water from a tanker when one appeared.

It was also very difficult to estimate household income. Many households in the sample villages grow a substantial portion of their own food; almost all own their houses. Much of the available cash income can be spent on things other than food and housing. Hence any estimate of the percentage of household income spent on water is highly speculative.

In summary, the survey data clearly show that household water supply in these villages is a seasonal problem and that in the dry season many households are spending substantial amounts of money purchasing water from tanker trucks and neighbors. There would appear to be a great need for improved service in the dry season. But whether households would use or pay for an improved water supply in the rainy season is uncertain.

THE COST OF AND DEMAND FOR IMPROVED RURAL WATER SYSTEMS

What Do Improved Rural Water Systems Cost?

There is little variation in the choice of an improved water supply system in northern Anambra State. The only reliable possibility for almost all communities is a deep borehole. The costs of such rural water schemes denominated in naira have been changing rapidly over the last several years due to the current structural adjustment process in Nigeria, but it is possible to develop some reasonably accurate estimates as of May 1989 [*IWACO*, 1989]. A typical system for a village with a population of 10,000 requires a borehole approximately 200 m deep, a submersible pump and cables, generator, pump house, storage tank, and a limited pipeline distribution network with standposts. Table 3 presents an estimate of the capital costs, operation and maintenance costs, and the total annual costs of a simple water system with a limited distribution network, assuming different capital recovery factors. The costs of such a system increase significantly as the length of the distribution system increases. The cost estimates presented in Table 3 could easily be 50% higher if a more extensive distribution network (e.g., 5 km of pipe) were installed. As illustrated, the total annual

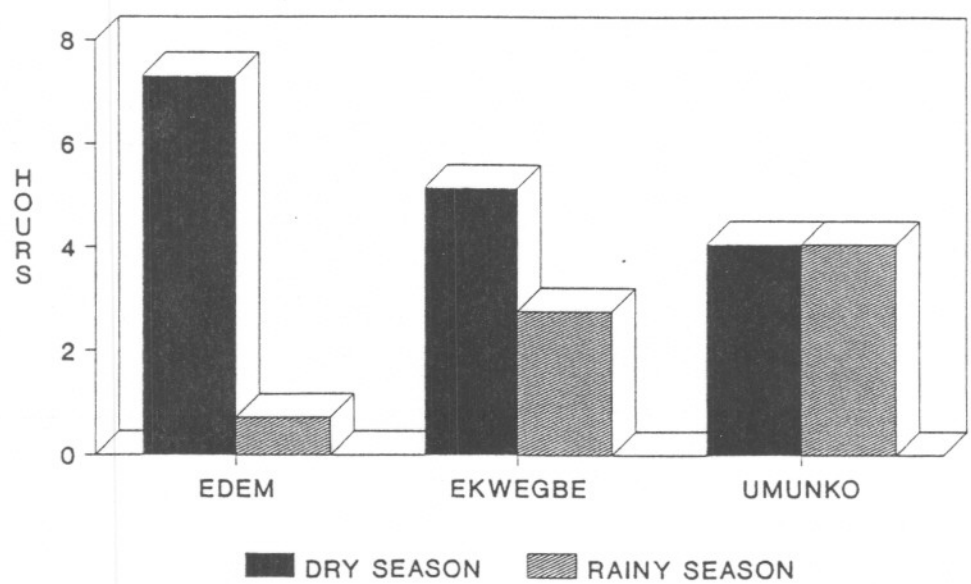

Fig. 4. Average daily time spent collecting water from springs.

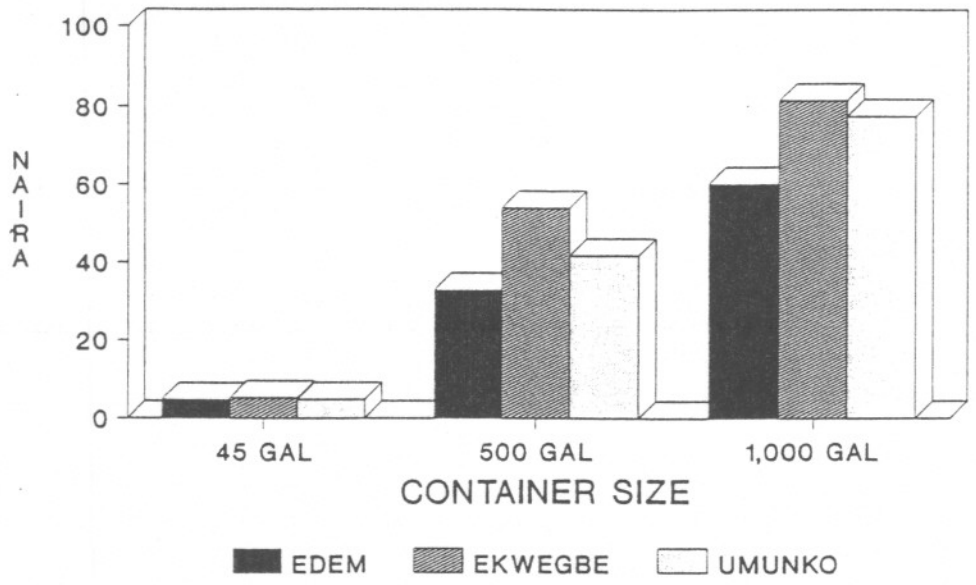

Fig. 5. Average price of vended water purchased from tanker trucks.

costs of such a system are probably on the order of ₦200,000–250,000, or US$2.70–3.30 per capita per year.

The average size of a household in the sample villages is about eight persons. Assuming a conservative population estimate of 10,000 per village, the costs of such water systems could be spread over about 1,200 households per village. If all the households in a village contributed, the total monthly costs (capital and operations and maintenance) per household would be in the range of ₦14 to ₦17 (US$1.90 to US$2.30). The payments required to cover the operation and maintenance expenses alone are much lower, only about ₦2.10 (US$0.30) per household per month.

Current Cost Recovery Practice

The vast majority of the capital costs of boreholes that have been drilled to date in the area have been paid by the Anambra State Water Corporation (ASWC) or the federal government. Increasingly, village councils are being asked to raise money to contribute to the costs of construction, but such contributions are typically difficult to mobilize and cover only a small portion of the total costs.

ASWC does not come close to recovering even the operation and maintenance costs of the rural water systems that are operational. The existing cost recovery policy is to charge the community ₦90 per month for each public tap in the village. A community can have as many taps as it wishes and is willing to pay for. If a tap were installed for every 500 inhabitants, a village of 10,000 people would have to pay ₦1,800 per month for 20 taps (about ₦1.50 per household of eight). This amount would just about pay the operation and maintenance costs of the system, but in practice the village councils are unwilling or unable to raise funds of this

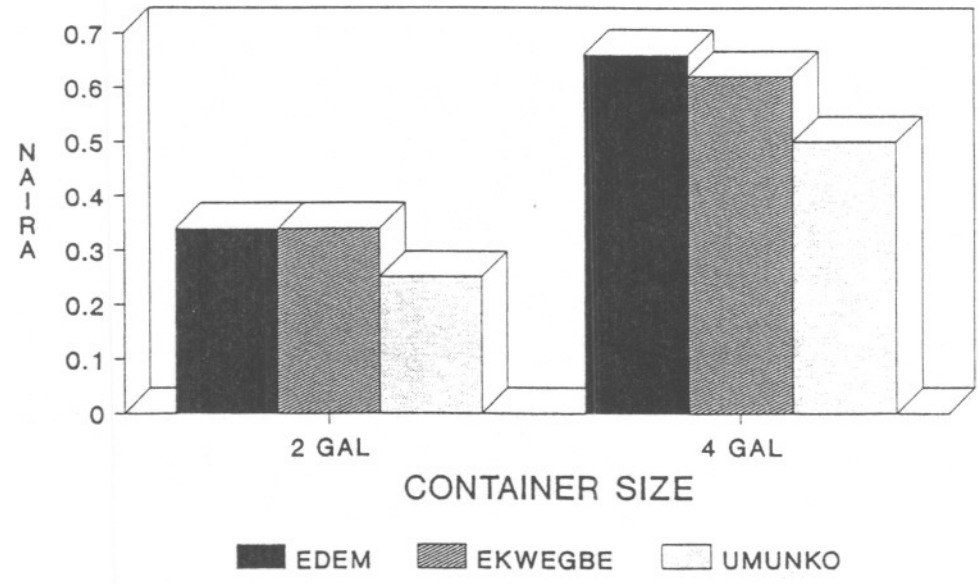

Fig. 6. Average price of vended water purchased from neighbors.

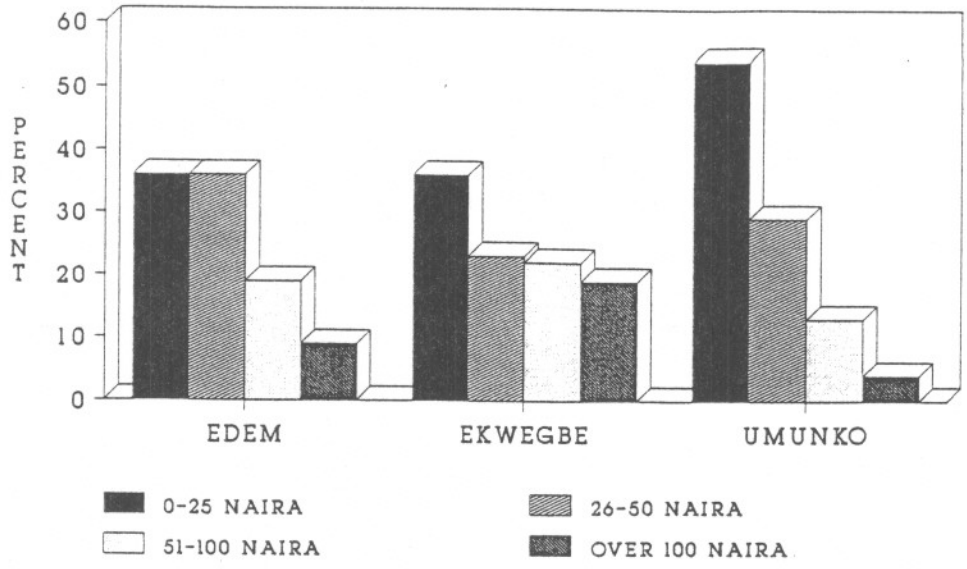

Fig. 7. Average monthly expenditures for water in the dry season.

magnitude on a monthly basis. Communities generally decide to have many fewer taps, with the result that the number of taps is inadequate to service the population, queue times are long, and many people still rely on traditional sources and on vendors, whose service may cost far more within the scope of a single month (see Figure 7, which shows average monthly expenditures for water in the dry season).

ASWC finds it particularly difficult to collect monthly charges during the rainy season. Water systems are often cut off during the rainy season for lack of payment. When the dry season begins, the village leadership and ASWC negotiate the terms under which the water system will be turned on and the community will pay its arrears.

TABLE 3. Costs of an Improved Water Supply System (Deep Borehole Scheme) in Anambra State, Nigeria (May 1989)

Expense Item	Cost, N*
Capital Costs	
Borehole (200 m deep, 300 mm diameter)	200,000
Pump and cables	100,000
Generator	100,000
Pump house	25,000
Equipment installation	10,000
Storage tank, Elevated	250,000
Pipeline distribution system	600,000
Total capital costs	1,285,000
Annual Operating Costs (Excluding Major Maintenance)	
Labor	15,000
Fuel and Lubricants	10,000
Minor maintenance	5,000
Total annual operating costs	30,000
Total Annual Costs	
With 0.12 capital recovery factor	184,000
With 0.16 capital recovery factor	236,000
With 0.20 capital recovery factor	287,000

*N 1.00 = US$ 0.133

How Much Do Households Say They Are Willing to Pay for an Improved Public Water System?

Households in the sample were asked a series of structured questions designed to determine whether they would choose to pay for a public tap or a private connection to an improved water supply if different monthly rates were charged (for detailed discussions of the application of the contingent valuation methodology to the problem of estimating households' willingness to pay for improved water supplies, see *Whittington* [1988] and *Whittington et al.* [1989*c*, 1990*c*]). The questions were designed to elicit a monthly bid for perpetuity with no seasonal variation. Figure 8 summarizes respondents' willingness-to-pay (WTP) bids for access to public taps in all three study villages. The majority of respondents in all three villages indicated that they would be willing to pay ₦5 per month for access to public taps, but that they would not pay more than ₦15 per month. In each village about 25% of the respondents said that they would not pay even ₦5 per month for access to public taps. Most of the costs of an improved water system could be covered by

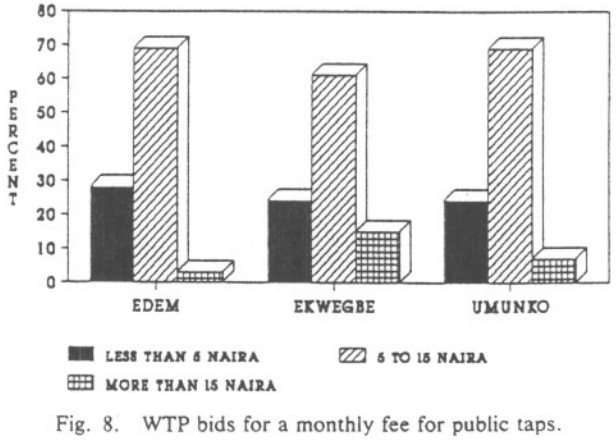

Fig. 8. WTP bids for a monthly fee for public taps.

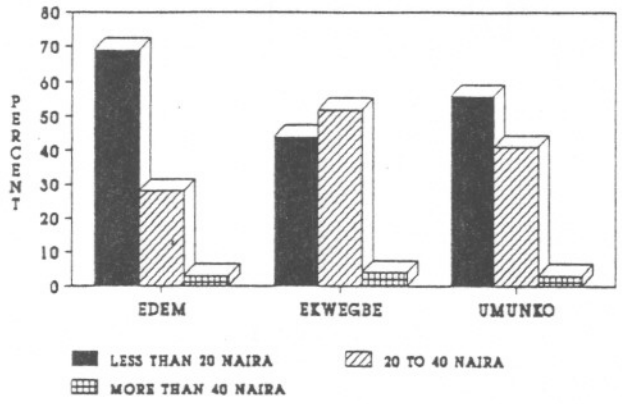

Fig. 9. WTP bids for a monthly fee for a private connection.

a charge of ₦15 per month (see above), but only 5–15% of households were prepared to pay this amount.

Figure 9 presents similar information for respondents' bids for private connections. Slightly more than half of the respondents in Ekwegbe and Umunko indicated that they would pay a fixed rate of ₦20 per month for an unlimited quantity of water from an unmetered private connection, but that they would not pay ₦40 per month. In Edem the corresponding percentage was 42%. About 40% of the respondents in Ekwegbe and Umunko said that they would not pay ₦20 per month for a private connection; in Edem 57% said they would not pay ₦20. Less than 5% of the houses in each village said they would pay ₦40 per month for a private connection. (A multivariate analysis of the determinants of these WTP bids is presented in a companion paper [*Whittington et al.*, 1990*a*]. These results indicate that WTP bids are related to the socioeconomic variables suggested by economic theory, which increases our confidence that the WTP bids reflect respondents' preferences for improved water services.)

Why Do Households Say They Are Willing to Pay So Little for Improved Public Water Service?

These findings from the household surveys are perplexing. Many economic theorists and critics of the contingent valuation method have expressed concern that the results of such surveys will not be reliable because respondents will say they will pay much more than they will in fact pay when confronted with a real decision. In this case the evidence seems to indicate just the opposite. For example, although 57% of respondents in Edem said that they would not pay ₦20 per month for a private connection, about two-thirds reported that they were already paying more than ₦25 per month during the dry season to tanker trucks and neighbors. Only 2% of the respondents in Ekwegbe said that they would pay ₦40 per month for a private connection, but 40% are already paying more than ₦50 per month to vendors in the dry season.

Why do households say that they are willing to pay so little for improved public water service when they are already paying such high prices to water vendors? The answer to this question has important policy implications, because if the majority of households are really unwilling to pay more than a few naira per month for a public tap, full cost recovery is not currently feasible in the rural areas of Anambra State. If the provision of subsidized services is not feasible, the current system of water vending may be the most appropriate service level at this time. On the other hand, if households would pay for the costs of an improved water supply system once they have experience with it, and if it were made available under conditions that they found more attractive than current government projects, then rural water supply projects could be financially viable.

TABLE 4. Analysis of Revised Willingness-to-Pay Bids

	Public Tap	Private Connection
	Edem	
Total bids	60	60
Bids revised, %	23	33
Revised down, %	79	65
Revised up, %	21	35
Mean percentage reduction of downward revised bids	68	63
	Ekwegbe	
Total bids	55	55
Bids revised, %	7	9
Revised down, %	50	0
Revised up, %	50	100
Mean percentage reduction of downward revised bids	80	n/a
	Umunko	
Total bids	68	68
Bids revised, %	16	16
Revised down, %	73	82
Revised up, %	27	18
Mean percentage reduction of downward revised bids	53	57

Here n/a means not applicable.

To better understand households' bids, we reinterviewed half of the sample households in each of the three villages and gave them an opportunity to revise their answers to the WTP questions from the previous day. Table 4 presents (1) the percentage of respondents who revised their bids for public taps and for private connections in each village; (2) the proportion who revised their bids downward (and upward); and (3) the average percentage reduction (and increase) of these revised bids.

If the respondent revised his (or her) answer, the enumerator asked him to explain the reasons why he changed his WTP bid. Because the respondent had also been asked how much the household usually spends on water from tanker trucks, the WTP bid for a public tap could be compared with the current monthly expenditure on vended water. If the WTP bid was less than what the respondent said the household was currently paying water vendors in the dry season, the enumerator asked the respondent to explain why his bid for an improved water system was lower.

Figure 10 summarizes reasons respondents gave for why they were not willing to pay more for an improved water supply. For all three villages "seasonal" represented a substantial percentage of the responses given (20 to 40%). In this context "seasonal" means the respondent stated that the household spends the amount calculated (obtained from responses to previous questions) during the dry season but would not spend that much for water during the rainy season. (The WTP bids given by the household were for a monthly obligation, irrespective of season.)

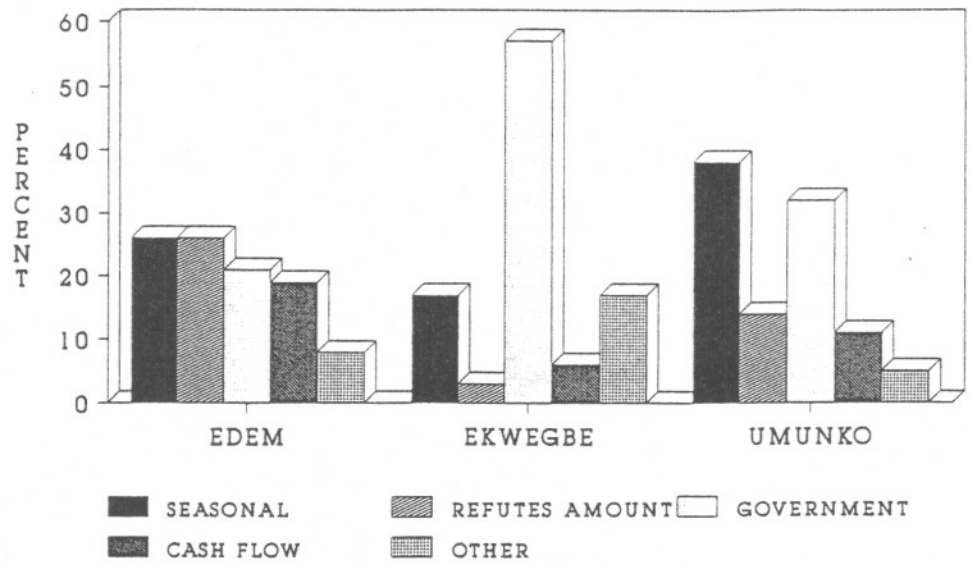

Fig. 10. Reasons respondents pay more versus WTP bids given for improved system.

"Refutes amount" means that the respondent did not believe that the enumerator's estimate of the amount the household spent on vended water was correct. This could be because the household spent an unusual amount during the period inquired about or that the respondent had difficulty understanding the concept of a monthly average.

"Government" means that the respondent answered (1) that he did not trust the government to deliver or maintain an improved water system; (2) that it was the government's responsibility to provide free or cheaper-than-vended water; or (3) that the household had already been paying taxes for water service and it did not want to pay anything more for a water system run by the government. The high proportion of "government" responses in Ekwegbe (more than 50%) is not surprising considering the village's abandoned elevated storage tank and capped borehole. This feeling of resentment could also be exacerbated because a nearby village (only 6 km away) has had a functioning public water system since the mid-1960s. (The explanation given was that one of the ministers in a previous regime came from that other village, and while in office he was able to attract enough resources to the village to have its water distribution system installed.)

A response of "cash flow" meant that the respondent did not feel able to commit to a monthly expenditure in perpetuity because of variations in disposable income from month to month and season to season.

"Other" reasons given included such issues as tenancy, concerns over rights of access to the taps, the fact that the household makes money by reselling water, or concerns that everyone using the water would not pay their fair share.

Reasons People Say They Will Pay Less for an Improved Water System Than They Currently Pay Vendors

On the basis of these responses and more in-depth, unstructured interviews with selected individuals in the study villages, we believe that there are in fact three different and important types of reasons for the discrepancy between what people say they will pay the government for water and what they are currently paying to vendors: (1) affordability of monthly payments, (2) ignorance of the magnitude of current actual expenditures on vended water, and (3) pessimistic perceptions of government reliability, responsibility, and entitlements.

Some respondents' answers and their explanation of them make good economic sense and are probably reliable measures of their true preferences. Many of the households who revised their bids downward cited economic reasons. The specifics of the explanations varied, but the essential message was that the respondents simply felt that they could not afford to pay the originally stated amount on a regular monthly basis.

The seasonality of the expenditures for improved water services was a major concern of many of the respondents who gave economic explanations of why they could not afford to pay more for water. Most households only perceive a need for water from an improved source during the dry season, because during the rainy season water is readily available and is thought to be of good quality. They are thus reluctant to commit themselves to a fixed monthly water payment throughout the year.

This problem is compounded by seasonal variations in the demand for agricultural labor. In the northern part of Anambra State, planting occurs at the beginning of the rainy season, in mid-April to early May. At this time the demand for agricultural labor is high, and the daily wage is about ₦30 (US$4.00). The demand for agricultural labor remains strong throughout most of the rainy season but disappears almost entirely during the dry season, from November to April.

At first glance such high agricultural wages would seem to indicate that the opportunity cost of time spent carrying water would also be very high, and thus trading money for time saved fetching water would appear to be an attractive exchange [*Whittington et al.*, 1990*b*]. However, the period of high agricultural wages occurs precisely when water is most easily available. Nevertheless, during the rainy season cash is in short supply because it is needed to purchase such agricultural inputs as fertilizer. During the dry season, when water collection times may stretch to many hours, there is no agricultural work, and thus the economic value of time saved is very low.

In addition, households lack access to credit and individuals' discount rates are very high in such rural economies. In circumstances where incomes are low and cash reserves almost nonexistent, households place a high premium on maintaining budget flexibility. A recurring cash obligation such as a monthly water fee may not be a large proportion of total annual income, but the fact that it must be paid every month may greatly reduce a household's discretionary income and limit its ability to respond to emergencies. For all of these reasons the reluctance of households to commit themselves to a regular monthly payment for improved water service appears to be a sound economic decision.

In contrast to this economic rationale for the low willingness-to-pay bids, a second, alternative explanation is that households often did not know or seemed unable to calculate how much money they were currently spending on vended water. Because service from the tanker trucks was often unreliable, households' purchases were irregular. In fact households' expenditures over an extended period were substantial, but the notion of calculating an average amount spent on water was difficult to convey in the interviews, and we believe that many households simply did not know how much they are spending in total for vended water. They purchased water when they had the money and when the tanker truck came around. During the interviews respondents often said that they had no choice but to buy from tanker trucks and that they had to pay the price charged. Many expressed a sense of hopelessness at what they often perceived as exploitation by tanker truck vendors (perhaps in part because it was impossible for many households to afford large storage tanks which would have allowed them to obtain water at a lower price).

These first two explanations for the respondents' low bids are based on different conceptions of the determinants of individuals' behavior. The first envisages a rational, utility-maximizing economic actor who carefully considers his consumption choices in light of severe budget constraints. The second assumes that the individual is unable to make such reasoned decisions and perhaps purchases on impulse. On the basis of the survey results and open-ended interviews, we do not believe these explanations are mutually exclusive. It is entirely plausible that some households more closely exhibit one type of behavior, some households the other. It is also possible that a single household understands the time value of money and the cash flow problems associated with making a regular monthly payment for improved water service, but is unable to calculate the amount currently spent on water from tanker trucks.

A third explanation for the low willingness to pay expressed by households is noneconomic. Many respondents indicated that they felt that they were entitled to free or subsidized water and that it was the government's responsibility to provide their village with a new water system. For example, some said that they already paid taxes that should be used to provide such services as water supply. Others indicated that it was not fair that they should be charged more than customers in the nearby town of Nsukka, where the monthly water charge was ₦2.00 per connection.

Answers of this kind suggest that respondents' maximum WTP bids may be heavily influenced by factors other than the economic value of improved water service to the household. As a result, from an economic perspective one could argue that the contingent valuation exercise failed to reveal households' true preferences for water. However, the low bids reveal something equally important for policy purposes: that many households' sense of entitlement and equity may be a major obstacle to an effective cost recovery scheme. In this sense the low bids are an indicator of likely political problems associated with any changes in policy toward increased cost recovery. This is not to imply that attitudes about the appropriate role for the government in the provision of rural water supplies cannot be changed, but simply to emphasize the importance of political leadership on the part of both the water corporation and the community government in any such effort.

If all of these three explanations for the low willingness to pay for water are true to some extent, as we believe to be the case, then attempting to predict how households will respond to a particular service option and payment arrangement is quite problematic. Given this uncertainty in the likely responses of households to water supply projects with different payment and delivery characteristics, how should the government and donors proceed in the rural water sector?

BREAKING THE IMPASSE IN RURAL WATER PROVISION: DISCUSSION AND POLICY RECOMMENDATIONS

The results of this study indicate that ASWC faces two major obstacles to the implementation of a financially viable rural water supply program. First, there is a mismatch between the year-round financial needs of ASWC and the seasonal value of water to households. The majority of the costs of a typical rural water system are for capital: the drilling of the borehole; the generator, pump, and storage tank; and the installation of the distribution line. To be economically justified a water system needs to be used most of the year because these costs are incurred whether or not the system is functioning. However, for a variety of reasons households are very concerned about the timing of payments for water and want to be able to adjust their payments to reflect their other consumption needs. Specifically, they want the flexibility to purchase water only in the dry season.

In practice, if an improved water system is operational, many households may find it more convenient to collect water from the improved source even during the rainy season, but the problem facing ASWC and the community is how to keep systems operational until households have gained this experience. One possibility would be to allow households to disconnect from the system during the rainy season with only a modest reconnection charge. This way people will not feel forced to pay for water when they can get it free. Another possibility would be a seasonal pricing policy which would charge households less in the rainy season in order to encourage them to continue using water from the distribution system.

Second, confidence in governmental institutions has broken down and people no longer trust that the government can construct and manage an improved water system. Households will pay for water when they receive it, but because of poor performance by the government in the past, there is great reluctance to contribute anything close to the true value of the service in advance or to commit to a monthly payment before the household knows how reliable the system will be. Households quite reasonably fear that

they may be required to make a regular payment for a water system that does not work, yet still be forced to buy water from vendors.

These two obstacles, the timing of household payments for water and lack of trust in the government, have important policy implications. Both suggest that the actual financing scheme and cost recovery system used in rural water supply programs are likely to have a major impact on the benefits of the improved water scheme to households, and thus on the probable success of rural water projects. The cost recovery arrangements currently in use in Anambra State have failed to generate any significant amount of resources. However, the fact that so many people purchase water from vendors indicates that there is a large potential customer and revenue base in the rural communities in Anambra State, and that people are able and willing to pay substantial amounts for improved water service. This revenue base cannot, however, be effectively tapped with the existing cost recovery system.

ASWC's present policy of providing unmetered private connections in some rural water systems is a sure recipe for failure in terms of cost recovery. In general, a water utility that provides unmetered private water connections cannot hope to recover its costs unless almost all households in a particular service area choose to connect to the distribution system. This is because households with unmetered connections can provide water at essentially zero marginal cost to households without connections, and thus have a strong incentive to work out arrangements to do so. For example, a single household with an unmetered connection in some parts of Enugu, the capital of Anambra State, may supply water to as many as 20 or 30 other families for a flat monthly fee. The higher the flat monthly fee charged by the water authority for an unmetered private connection, the greater the incentive for other households to purchase water from a household that has an unmetered connection, rather than connecting to the system themselves. The unmetered private connections essentially serve as free enterprise public taps for the unconnected households, a scheme that typically entails major revenue losses for the water authority.

Unmetered private connections have another major disadvantage. Because such systems run large deficits, they must be subsidized. These subsidies almost always benefit the upper and middle income households that can afford the initial costs of a private connection. In many cases, once installed, an unmetered private connection will not cost its owner anything further; it is not unusual for the owner to collect much more in revenues from neighbors than the flat monthly rate he pays to the water authority.

For a cost recovery scheme to be successful, it must adapt to the existing economic and political realities. The present water vending system through tanker trucks and neighbors illustrates one way this can be done. The key feature of the vending system is that households are not obliged to buy from vendors; they are free to purchase water when they wish. The water vending system thus provides households with the flexibility over their cash flow that they demand. Also, tanker trucks do not face the political problems over water service that confront the government, nor do households feel that the owners of tanker trucks should provide them with free or subsidized water. It is generally accepted that vendors are in business to make a profit. Despite the fact that some households do feel exploited by tanker trucks, they still believe that vendors provide a valuable service and they are willing to pay for it.

Improved Water Vending

There are essentially four ways in which improved water services could be organized in the rural areas of Anambra State that would permit households to pay only for the water they use. The first would be to improve the tanker truck vending system itself. The present vending system has two main problems: the price of water is high and the service is often unreliable. Based on previous analysis of the cost structure of tanker truck vending in Anambra State [*Whittington et al.*, 1989*a*], the high cost of water from tanker trucks in urban areas probably reflects both the high real cost of delivery and the monopolistic structure of the tanker truck industry.

If the main reason for the high prices of vended water in the rural areas was monopolistic pricing, then one way of improving the existing vending system would be to lower the price through price regulation or by removing barriers to entry to the business. However, this would probably only exacerbate the present reliability problems, and does not appear to be a promising or practical solution (see *Lee and Anas* [1989] for a discussion of the importance of reliability in the provision of infrastructure services in Nigeria). In our opinion the principal reason for the high prices in the rural areas is probably the high costs of delivery and not monopolistic pricing. For example, households in remote villages often go to urban areas to try to persuade the tanker trucks to come to their village to sell water, but many times are unsuccessful. This suggests that it is more profitable for tanker trucks to sell water in urban areas and easily accessible rural communities. If this is true, then the way to lower the price of water is to find a way to deliver it more efficiently.

In our view lowering the cost of delivery by tanker trucks will be increasingly difficult because of the deterioration of the tanker truck fleet. The tanker trucks are currently in very poor condition, and most will only be in service for at most a few more years. This aging of the tanker truck fleet is a major problem looming on the horizon for rural communities in Anambra State. Most of these tanker trucks were purchased when the naira was much more highly valued, and it is extremely unlikely that it will be profitable to purchase new trucks at current exchange rates (since 1984 the value of the naira has fallen to one tenth of its previous value relative to major foreign currencies.) Therefore tanker trucks will likely provide less and less service to rural areas. Unless another means of water provision is found, households in rural areas will increasingly be forced to return to traditional water sources, with adverse economic and health effects.

Metered Private Connections

The second alternative is metered private connections, where each household pays a monthly bill based on actual consumption (with the costs of connection financed either by ASWC or the household). Our respondents' WTP bids were for a flat rate, unmetered private connection, not for a metered connection. The full costs of a metered private connection would be of the order of ₦30–40 per month for a household with a typical water consumption level. From our

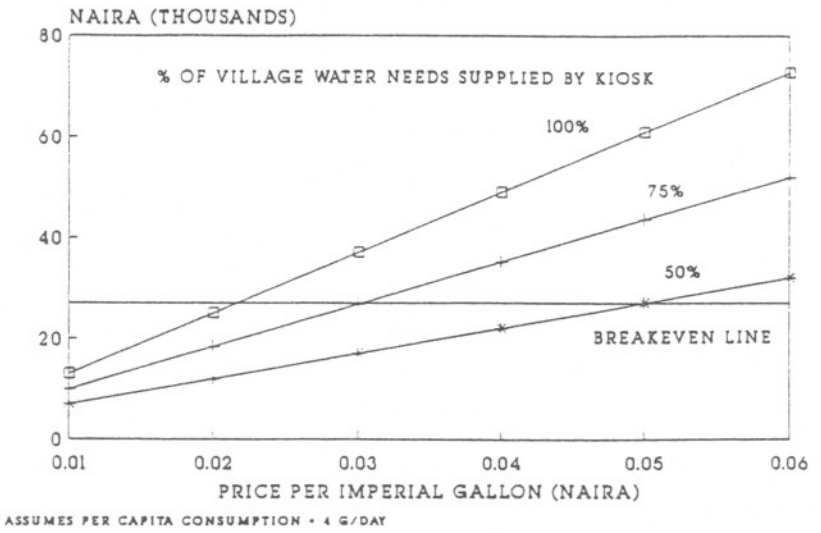

Fig. 11. Projected monthly total revenues versus price of water per imperial gallon.

analysis of these WTP bids for unmetered connections, it appears likely that private metered connections are too expensive for the majority of households in rural areas of northern Anambra State unless substantial subsidies can be provided. However, a sizable minority of households would probably be willing to pay the full costs of a private connection.

Kiosk Systems

The third alternative is a kiosk system, which would also permit households to pay for water only when they use it. Water kiosks have generally been considered an unattractive cost recovery mechanism in developing countries, in large part because of the higher labor costs necessitated by keeping attendants at the kiosks [*van Wijk-Sijbesma*, 1987]. Because the labor of kiosk attendants constitutes a large portion of the operating costs of a kiosk system, the number of taps in the community might have to be limited in order to lower these labor costs and ensure sufficient sales from each kiosk. A kiosk system may thus increase travel time for some households and possibly reduce the amount of water households consume from the new system compared to a water system with free public taps.

However, there are three main advantages of a kiosk system and their importance has generally been underestimated. First, a reliable kiosk system would provide households with even more control over their cash flow than a reliable tanker truck vending system. A kiosk system should run every day for many hours, and household members could purchase whatever quantity they wish at any time.

Second, kiosk systems offer a means of overcoming people's lack of confidence in the ability of the government to provide improved water supplies. A kiosk system does not require an advance payment by the household, nor does it depend on the household's trust in the government: Households do not have to make any payment for water until they receive it.

Third, evidence from a recent study in Tanzania suggests that kiosk systems should be able to generate substantially higher revenues than a flat monthly fee [*Whittington et al.*, 1989*c*]. Households will pay substantially more for water on a monthly basis if they can purchase it by the bucket than if they are required to pay a fixed fee once a month for access to a public tap where they can collect as much water as they want. If this were true just because households are ignorant of the total amount they spend when they purchase water on a daily basis, then the increased revenue available from a kiosk system would simply be a transfer payment from households to the water utility or kiosk licensee. However, in our opinion a substantial portion of this increased revenue is probably payment for a welfare gain, not a transfer payment, because of the greater control the kiosk system offers households over their variable and limited cash flow.

The increase in gross revenues from a kiosk system is not, of course, the appropriate comparison because kiosk systems cost more to operate and manage than a cost recovery system with a fixed monthly fee for public taps. However, even taking account of the added costs of running the kiosks, it seems to be feasible in these areas of Anambra State to recover a substantial portion of the total costs of the water project with a kiosk system, much more than can be recovered with the existing cost recovery system.

For example, for a village with a population of 10,000 inhabitants, the total monthly capital and operating costs of a rural water systems are about ₦19,000 (this figure is based on the cost estimates presented in Table 3; capital costs assume a capital recovery factor of 0.16.) To these costs must be added the expenses of running the kiosks themselves. Assume that one tap would be required per 500 people, and that each kiosk would have two taps from which people could collect water. The community would thus require 10 kiosks. Assuming each kiosk attendant is paid ₦25 per day, the monthly labor costs of the 10 kiosk attendants would be about ₦8,000. Total monthly costs of the water system would thus be about ₦27,000.

The total revenues from such a system can also be approximated (see Figures 11 and 12). Assume that per capita water consumption is 4 gal. (18 L) per day and that 50% of the water consumed in the village would be purchased from kiosks. In this case each tap would only have to

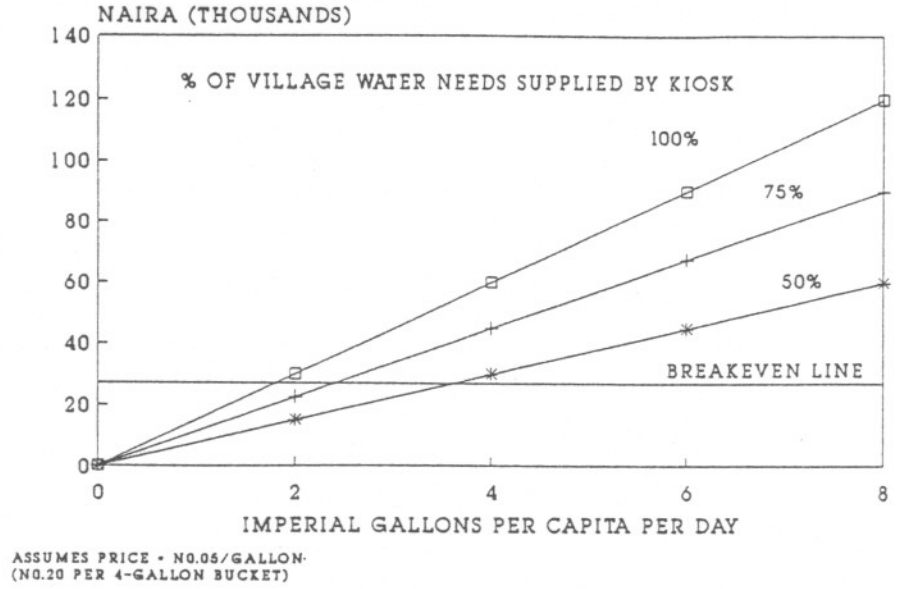

Fig. 12. Projected monthly total revenues versus per capita water consumption.

serve on average 250 people and queue times would not be excessive if sufficient pressure were maintained. Households currently sell water to neighbors for ₦0.70 to ₦1.00 per 4-gal. (18 L) bucket (₦0.18–0.25 per gallon); suppose that the kiosk system only charged ₦0.20 per 4-gal. bucket (₦0.05 per gallon) in the dry season and ₦0.10 per bucket (₦0.025 per gallon) in the rainy season. Given these assumptions monthly gross revenues in the dry season would be ₦30,000; in the rainy season they would be ₦15,000. Such revenues should be sufficient to pay over 80% of the total annual costs (both the capital and the operating and maintenance costs) of the improved water system.

In several respects these assumptions are quite conservative. Per capita consumption could easily reach 5 or 6 gal. (23–27 L) per day when water is readily available from a kiosk, and it is likely that more than 50% of the water consumed in the village would be obtained from the kiosk system [*Whittington et al.*, 1989*b*]. It is thus entirely possible that full cost recovery could be achieved in many places. However, given the volatility of the cost estimates, the extent to which kiosk systems can achieve full cost recovery in different locations must still be considered uncertain. It does appear, though, that the revenue potential from kiosks is significantly higher than for other cost recovery mechanisms. Thus whatever the final capital and operations costs of the water system, kiosks are likely to recover a much higher proportion of these costs than alternative approaches.

There are two main reasons why we believe that most households would prefer to obtain water from a well-run, reliable kiosk system than from tanker trucks. First, in the long run the price of water from the kiosks should be substantially cheaper than water from neighbors supplied by tanker trucks or from tanker trucks directly. Second, since the service provided by tanker trucks is often unreliable, people would be more likely to go to a kiosk for water than to wait for a tanker to come. As communities become more affluent and the value of some households' time increases, vendors using carts, bicycles, or simply poles or yokes may carry water from the kiosks directly to households. Such a development should cause no financial problems for the kiosk system as long as such vendors are charged the same price for water as individuals who walk to the kiosk and purchase water directly.

The principal disadvantage of a kiosk system is the necessity of developing an improved system of financial management to handle the cash collected by the kiosk attendants. A kiosk system may perhaps be more complex from a cash management point of view than a system of flat monthly fees. However, a system based on flat monthly fees is not likely to collect any significant amount of revenue. Any system that is likely to recover a substantial amount of the costs of a water system will entail the establishment of some metering and rendering of bills based on the volume used. Hence in the study area cost recovery is not possible in any case without improved financial management, and a kiosk system does not present especially difficult or unique financial management problems. However, the significance of the financial management problems associated with any cost recovery scheme should not be underestimated for rural water supply projects. Unless the funds generated are properly managed and accounted for, the resources will not be available to provide and maintain reliable, high quality service, and the water system will fall into disrepair.

To reduce the danger of further revenue losses and public complaints of mismanagement, the prudent course would be to meter the water sold by each kiosk and charge by volume dispensed, either direct to the buyer or to a licensed distributor who manages the kiosk. If services are licensed (whether metered or unmetered) it is essential to the success of the system that household users be assured that the retail prices set by the licensee are fair and reasonable. People clearly already recognize that private purveyors of a commodity or service are entitled to a profit, but they also have learned to beware of exploitative pricing. If the majority of villages in a region installed and operated kiosk systems, the availability of information on the price of water sold in neighboring villages should serve to regulate exploitative pricing by kiosk operators in a specific village.

To help meet the year-round cash needs of both the water system and household users, a seasonally adjusted pricing scheme could be implemented to reflect the reduced demand for water by households in the rainy season. It should be designed to cover all capital and operating costs of the kiosk system (and any private metered lines) on an annual basis, i.e., to operate at a substantial profit during the dry season and incur losses during the rainy season. As a practical matter, it may be preferable to initiate service from kiosks during the dry season because then the price differential between the dry and rainy season can be presented to customers as a rainy season discount rather than a dry season surcharge.

A seasonal pricing strategy would try to wean the customers away from traditional sources by charging a very modest rate during the rainy season for an initial period of, say, two years. When people become convinced of the benefits of an improved water system even in the rainy season, they may become willing to abandon traditional water sources almost altogether. If the revenues collected can be used to ensure the reliability of the piped system, this strategy would overcome their distrust in government's ability to deliver and operate an improved water system and gradually increase their confidence in the system and their willingness to pay for the improved and reliable service.

A Kiosk System and Metered Private Connections

A fourth alternative would be a combination of kiosks and metered private connections, in which households with connections were allowed to sell water to neighbors. The data from this study suggest that a substantial minority of households in rural communities in Nsukka district can afford the full costs of a private connection. Households with private connections often sell water to neighbors, in which case household connections effectively become private kiosks. If the water utility charges households with metered private connections at the least the average costs of supplying water, the sale of water to neighbors does not result in financial losses to the water utility and should in fact be encouraged. If a significant number of households in a community sell water to neighbors, competitive conditions should ensure that the price of water sold to the households without connections is not set much above the price of water which households with connections pay the water utility.

If households sell water to neighbors, the number of water distribution points in the community increases, and as a result the average distance households without connections must walk to collect water is reduced. Also, queue times would be reduced. This reduction in travel and queue times is likely to result in a very high percentage of the population electing to obtain their water from the piped distribution system, either directly from kiosks or their own private connections or indirectly from neighbors who have a connection. In the extreme case there may be so many households with private connections supplying neighbors that public kiosks become redundant.

CONCLUSIONS

At the end of one of the household interviews a respondent told one of our enumerators, "Don't forget us; we are waiting for water." This parting remark perhaps best summarizes the current situation in the rural water sector in Anambra State. ASWC does not have the financial resources to construct and run a sufficient number of water systems to serve the rural population, and it is waiting for the villages to mobilize financial resources to pay the costs of improved water systems. On the other hand, many people in the villages continue to wait for subsidized services rather than initiating efforts to help themselves.

This impasse between the people and the state is typical of many rural water supply programs in Africa. Until the underlying political and economic reasons for this situation are simultaneously addressed, cost recovery will remain an elusive goal in the rural water sector. Efforts to achieve cost recovery have often been halfhearted, in part because they have typically been predicated on the assumption that people cannot afford to pay very much for water, when in fact they often pay exorbitant amounts.

Attempts at cost recovery have also floundered because public water authorities are often out of touch with people's preferences about when they want to buy water and how they want to pay for it. The results of this study show that households want more flexibility and control over their expenditures on water than is available from a cost recovery system based on fixed monthly fees that must be paid throughout the year. One of the reasons households are reluctant to commit themselves to a year-round fixed monthly payment is that they sometimes have other, higher-priority uses for their limited cash resources (e.g., medical emergencies, seasonal agricultural expenses).

One of the lessons from this study is that the design of appropriate cost recovery systems must take account of the political consequences of past failures to provide water to communities. In Anambra State the extent of mistrust and lack of confidence in the government is such that people are simply not willing to pay very much for water until they actually receive it. Any cost recovery system which fails to recognize this is not likely to succeed. Although people are very reluctant to pay government based on promises of improved water services in the future, current private markets for water demonstrate that people are quite willing to pay for specific volumes at point of purchase.

In our opinion, kiosk systems (or kiosks in tandem with metered private connections) offer the most promising approach for breaking this impasse in the provision of rural water systems in Anambra State. Such systems can both achieve greater cost recovery and meet the cash flow preferences of consumers. Seasonal pricing may be necessary to compete with traditional water sources in the rainy season, but this is primarily a problem of rate design.

Adequate financial collection and control measures must be part of any kiosk system. The cash management requirements of a kiosk system may be more complex than those for a system based on flat monthly charges. But at least in the rural areas of Anambra State, any system designed to recover a substantial portion of the costs of an improved water system will mean metering and the calculation of bills based on the volume consumed by users. In this regard a kiosk system or a kiosk system with metered private connections does not present especially difficult or unique financial management problems.

Rural water supply programs must be adequately funded if systems are to be reliable and replicable. In most cases such funds can only come from the beneficiaries themselves,

which means that both government water utilities and donors must carefully consider what type of cost recovery system is appropriate in a particular context. This study suggests that the standard arrangements for cost recovery in the rural water sector, fixed monthly fees for both public taps and unmetered private connections, are inappropriate in the Nsukka district of Anambra State, Nigeria. Although it is not yet possible to generalize these results to other parts of Nigeria or to other developing countries, it seems likely that the advantages of kiosk systems and metered private connections discussed here will be equally valid in many other places. Certainly households' desire for greater control over their limited cash resources and their reluctance to make advance payments for improved water supplies based on government promises are not unique to Nsukka district or to Nigeria.

Since kiosk systems and systems with both kiosks and metered private connections appear to be promising cost recovery mechanisms, there is a great need for more experience with their operational and managerial aspects in different field conditions. Managers of rural water programs need to be convinced that kiosk systems and metered private connections have many attractive features and are a legitimate organizational arrangement for recovering the costs of water service.

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A. McPhail, Department of Geography and Environmental Engineering, Johns Hopkins University, Baltimore, MD 21218.

A. Okorafor and A. Okore, Department of Economics, University of Nigeria, Nsukka, Nigeria.

D. Whittington, Departments of Environmental Sciences and Engineering, and City and Regional Planning, New East 3140, University of North Carolina, Chapel Hill, NC 27514.

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