

Water vending in urban Sudan

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Water vendors, selling water door-to-door from donkey carts, are an important source of domestic supply in low-income urban areas in Sudan, as in other developing countries. A study of the demand for this service showed that it was of negligible elasticity, with no evidence of direct control of the price by a monopoly or cartel. It follows that the price of water paid by the poor could be greatly reduced by increased availability of water to the vendors or of credit for the purchase of donkeys and carts.

The practice of water vending – the sale of water on the doorstep or at the street corner – is very common in developing countries, especially in poor urban areas. In a brief survey, Zaroff and Okun (1984) found it to be prevalent in urban areas throughout Asia, Africa and South America, and to serve an average of 40% of the households in the 12 low-income communities which they studied in detail. In half of these communities, the cost of water amounted to one-fifth or more of the income of a typical household. Briscoe (1985) has estimated that water vendors serve 20–30% of the urban population of the developing world.

In a variety of settings, money paid to water vendors accounts for a large share of the total income of the water supply sector. One of the few detailed studies of water vending (Whittington *et al*, 1987), found that the total sum paid to water vendors amounted to twice the revenue accruing to the water agency. Their existence is an indication of a demand

unsatisfied by the formal sector provision, which the water supply agency could very probably meet at lower cost and to the benefit of both consumers and suppliers. For example, it was the observation of water vendors in Abidjan, Cote d'Ivoire, which led the city's water supply agency to improve its service to compete with them, and hence to increase its revenue (Lewis and Miller, 1987).

Some have gone further, and advocated the study of the constraints under which vendors operate, with a view to providing assistance to render their service more efficient (Briscoe, 1985) or more hygienic (Antoniou, 1980). It might appear that the water vending systems of the informal sector involving transport by truck, by animals or on people's backs are hopelessly inefficient compared with formal water supply systems using pipelines. However, the fact remains that, for all their efficiency, the formal systems still fail to serve a quarter of the population of a typical tropical city, and the shortfall in service is largely made up by vendors. Rather than further funding for formal water supply construction, an intervention to increase the number and efficiency of these vendors might produce a more rapid and replicable improvement in the standard of service provided to their clientele. Since this clientele consists mainly of the urban poor, they would be the ultimate beneficiaries. The intervention could thus be an effective form of aid to the poorest. It would have the additional advantage of creating or maintaining opportunities for employment, to a degree which the capital-intensive piped systems do not.

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However, the financial, economic and social aspects of vending systems have hardly been studied at all (Okun, 1982). It is therefore impossible to judge the feasibility or most suitable means of providing support for them, without first studying them in the field. This paper presents some findings regarding water vending from four months' research carried out in early 1987, in squatter areas of Greater Khartoum and Port Sudan.

Background

The populations of both Greater Khartoum and Port Sudan have grown rapidly in recent years, largely due to an influx of refugees from other parts of Sudan and from neighbouring countries. This growth has been accompanied by the expansion of large unplanned areas of squatter housing on the periphery of each city. Partly due to insufficient capacity in the cities' water supplies and partly as a result of Government policy not to encourage settlement in these areas, they are not supplied with water by the formal sector, but largely by vendors using donkey carts.

Vendors sell water by the 200 l drum, or more usually by the pair of jerrycans, or *jos*, equivalent to about 33 l. The price depends on the difficulty of obtaining and transporting the water. Typical prices in Greater Khartoum at the time of the study (early 1987) ranged from £S (Sudanese pounds) 7.50 to £S30/m³, where £S1 was then worth roughly US\$0.27. These prices were 30 to 120 times the rate per cubic metre paid by Khartoum residents with private connections.

Without this informal distribution system, however, the inhabitants' water requirements would not be met. Each donkey pulls a cart consisting of two oil drums welded together as one, to give it a capacity of roughly 400 l. This is supported by a framework attached to the wheelbase (Figure 1). The vendors obtain the water they sell from standpipes and boreholes, run by the local authorities, by licensees or by community groups, and usually pay a small price for it.

In February 1987 the *Sakan al Ashwai*, or Administration for Squatter Areas, in Khartoum issued a directive to the water vendors supplying an area in Omdurman, prohibiting the sale of water to the inhabitants. Police were ordered to arrest any vendors contravening this law. Legislation exists to prevent the sale of water in such areas since it is held to promote the illegal building of new houses on land designated for other planned uses. The main construction material is mud, which dries in the sun. Water is therefore an essential part of the process.

However, there is no evidence that restriction of the provision of water supplies to unplanned areas has limited the growth of Khartoum's population or of the unplanned areas. Many migrants to Khartoum, interviewed during our fieldwork, stated that their first place of residence there was in an established area of the city where facilities are already available although rents are high. The subsequent move to the urban fringe enables a family to build its own house and join people of the same ethnic origin, although the saving in rent is counterbalanced by the high cost of water. Water for house construction, if not available locally, is purchased from vendors.



Figure 1. A water vendor's donkey and cart, queuing at a borehole north of Kartoum Kassala.

Water demand and consumption

Detailed studies of water consumption and its determinants were carried out in two squatter communities; Meiyu, on the southern fringe of Khartoum proper, and Karton Kassala in Khartoum North. The results have been presented in detail elsewhere (Cairncross and Kinnear, 1991); the three principal findings are summarized here. Table 1 summarizes the comparison between the two areas, in terms of household size and income and of water prices and consumption. The first conclusion to be drawn from the consumption data is that expenditure on water accounted for a substantial part of the budget of an average household.

The second, unexpected, finding was that, although the residents of Karton Kassala faced a price for water that was three times higher than that paid by the people of Meiyu, this did not reduce their consumption. This is to say, the price elasticity of demand, judged from these data, was effectively zero. This surprising result was borne out by a comparison of households within Karton Kassala which paid different prices for water. It was found that 44% of the water was used for bathing and a further 18% for washing clothes. The other main uses were the washing of food and utensils, cooking and drinking.

The third, equally surprising result was that the amount of water purchased was not affected by household income, although reported incomes varied between less than £S100 and more than £S700 per month in both communities. This meant that the poorest households spent the greatest proportion of their income on water. The remainder of most families' income was spent almost entirely on food; it therefore seems that the poorest households sacrificed some of their expenditure on food in order to be able to purchase enough water for their needs. Malnutrition was very common in the areas studied (Hughes, 1987).

Table 1. Comparison of mean household size and income, water prices and water consumption in the two consumer survey areas.

Area	Meiyu	Karton Kassala
Mean household size ¹	7.3	8.3
Mean household income ² per head (£S/month)	42.0	47.0
Mean water price (£S/drum) ¹	1.50	4.64
Mean daily water consumption ² (l/person)	24.2	27.0
Mean income spent on water (%) ¹	16.5	55.6

¹Averaged by household.

²Averaged by individual.

Incomes and prices are in Sudanese pounds (£S).

Market control

In view of the high expenditure on water by the poorest consumers, it is pertinent to ask whether this was due to exploitation by unscrupulous vendors or donkey cart owners, or to a shortage of donkeys and carts. Given the extremely low elasticity of demand for water, economic theory would indicate that only a slight improvement in supply could provoke a very large fall in price before a corresponding rise in demand would result. Could access to water be improved by government assistance to the vending sector, and would this cause prices to fall?

During our many interviews with vendors and their customers, we found no evidence of monopolistic or oligopolistic control of donkey carts. Most donkey cart owners had only one or two carts, although they did tend to belong to a limited number of ethnic groups. In both Khartoum and Port Sudan, the vast majority of the owners were Northern 'Arab' Sudanese. In Karton Kassala, most of them lived outside the area. The same was true of those who operated the carts, roughly half of which were driven by the owners themselves. The usual arrangement, when the owner does not drive his own cart, is for the driver to pay 75% of his net takings to the owner, who will usually feed the donkey himself although he may make allowance for the cost of donkey fodder and leave this expense to the driver. The water requirements of the owner's household may also have to be provided free of charge.

One mechanism by which water vendors appear to exercise a degree of control of their market is by limiting access to water sources. In 1986, Oxfam (a British voluntary agency) ran a project to facilitate the purchase of donkeys and carts for water vending among the southerners living in a squatter area in Khartoum North. The aim was to offer them a source of income as well as allowing them to exercise a certain amount of control over the price of water. However, these men were effectively barred from using the water source, which was controlled by Northern Sudanese. In another area local water vendors lobbied (unsuccessfully) against the extension of the piped water distribution network, as it would reduce their market.

The degree to which a cartel operates among vendors to regulate prices is unclear. In Port Sudan, water prices increase in summer when donkey fodder is more expensive and the queues to fill up the carts are longer, because fewer standpipes are operating. The water price increase, and the subsequent drop in price later in the year, occurs in a single jump simultaneously throughout the city. However, even those who know the market well are unable to point

to any single group or forum in which the decision is taken. The sudden jump may be a consequence of the difficulty of charging anything other than multiples of £S0.25 for a single *jos* of water. News of the price change appears to travel by word of mouth once one or two of the more astute vendors have judged that it is what the market will bear. Similar price changes follow increases in the price charged for water at the source. However, the slightly differing prices charged by various vendors in Karton Kassala, Khartoum (£S5 and £S6 per drum) demonstrate that, if any attempts are made there to control the price, they are not completely successful.

Many vendors have some regular customers, known as *zabuun*, who may be charged a slightly reduced price for the convenience of regular delivery, since this saves the vendors from the time-consuming task of searching for custom. The vendor will sometimes extend short-term interest-free credit to these customers, so that they can pay when money is available. However, at times when water demand increases and the queues of vendors at the standpipes lengthen – in Port Sudan, for instance, in the summer season – the vendor may reduce the number of customers to whom he will extend these benefits. In this way he can keep his income up, since the higher price charged to casual customers can compensate for the reduction in the number of journeys he can make each day.

Government control

The Government does exert some control over the prices charged to water vendors at its standpipes and boreholes, the official price being £S0.50/m³ at the time of our survey. Nevertheless, at boreholes operated by private licensees, consumers have complained of being overcharged by as much as 70% (Antoniou, 1979).

No attempt is made by the authorities to control the price of water resold by vendors. Legal powers exist for the issue of vendors' licences, but in practice their possession is not normally enforced, and in any case they were introduced for public health reasons rather than to control the market.

Costs and profits

The first major outlay for a water vendor is the purchase cost of a donkey and cart. At the time of our survey, this ranged from £S1000 to over £S1500 in Port Sudan, while in Khartoum the prices quoted were relatively uniform at around £S1600–1700. Roughly two-thirds of the cost was for the donkey. Allowing a 10 year working life for the donkey under the hard conditions of urban life and a 5 year useful life for the cart, this can be expressed as a deprecia-

tion rate of a little over £S200 per year. Including the costs of lubricant and minor running repairs (but not the rate of interest) would suggest an overhead cost for the vendor's equipment of about £S20/month.

The major running cost was fodder for the donkey. In Port Sudan, the daily cost of fodder was made up as follows:

grain	1.00
dry grain	1.00
dura	1.25
Total £S	3.25

In Khartoum, the daily cost of fodder, mainly alfalfa, was variously quoted as £3.50 to £S5, occasionally substituted by a tin of *marisa albeit*, a waste product from beer production, costing £S0.50 for a day's supply but only infrequently available. A typical cost of the donkey's subsistence can hence be estimated at roughly £S4 per day.

How the profit margins work out in practice can be seen from case studies of two vendors, one in Dar el Neim, Port Sudan, and the other in Meiyu, Khartoum.

Case study 1: Dar el Neim, Port Sudan

This vendor made two trips a day, an average number for Port Sudan. He paid £S1.00 at the source for each cartload of two 200 l drums. Roughly half his customers were regulars (*zabuun*). These were charged £S0.75 per *jos*, while casual customers paid £S1.00. Each cartload holds 12 *jos*. Not including overheads on the cart, his monthly operating expenditure and income worked out roughly as follows:

	Unit cost	Total (£S)
<i>Income</i>		
Regular customers:		
12 <i>jos</i> /day × 30 days	0.75	270
Casual customers:		
12 <i>jos</i> /day × 30 days	1.00	360
Total income		630
<i>Expenditure</i>		
Fodder:		
30 days	4.00	120
Water:		
2 carts/day × 30 days	1.00	60
Less:		
total expenditure		180
Monthly operating profit		450

Even after deduction of £S20/month for depreciation and overheads on the cart, plus a reasonable income of, say £S200/month for an unskilled worker such as a water vendor, it is clear that a sizeable profit remains. However, two important factors need to be

taken into account. First, the cost of fodder in Port Sudan is highly seasonal, and it may be that profits are considerably lower at other times of the year when fodder prices are higher. Vendors in Port Sudan state that it can then cost as much to feed one donkey as a family of five. Moreover, profits are held down for part of the year by the seasonal influx of donkey owners from outside Port Sudan.

Second, the depreciation rate on the cart takes no account of interest. Interest rates among low-income groups throughout the developing world are notoriously high. Since the poor have no security to offer to formal lending agencies, they are charged by money lenders in the informal sector who are outside government control. Since the opportunity cost of capital to the poor is very great, they are willing to pay many times the rates prevailing in the formal money markets.

Case study 2: Meiyu, Khartoum

The second vendor made four trips per day. Three to five trips was a common figure in Meiyu, where the queuing time at the borehole and the travelling distance were shorter than in Dar el Neim. He paid £0.50 at the borehole for each cartload of 12 *jos*. He had some regular customers, but these received no price discount. All paid the same rate of £0.25/*jos*. His monthly income and expenditure account was therefore roughly as shown below:

Income	Unit cost	Total (£S)
Water sales: 48 <i>jos</i> /day × 30 days	0.25	360
Expenditure		
Fodder: 30 days	4.00	120
Water: 4 carts/day × 30 days	0.50	60
Less: total expenditure:		180
Monthly operating profit		180

After deducting £S20/month for depreciation and overheads on the cart, this leaves only a modest income of £S160 for the donkey driver, which is a typical monthly wage for an unskilled worker. For a driver who has to share half his profit with the owner of the donkey and cart, it leaves a very bare subsistence.

Vendors in Meiyu stated that they made a profit of £S7 to £S10 per day, but this appears to refer to their takings, net only of the cost of water at source, and without deducting the cost of fodder, which is not purchased during the normal day's trading. The ven-

dor in our case study, taking £S12 each day for 48 *jos* and paying £S2 daily for the water, was making a direct trading profit at the top of the range.

Vendors in Karton Kassala, selling water for £S1 per *jos*, claimed to make £S20–30 on an average day. After deducting fodder costs and overheads, this leaves a net monthly profit of £S500 or more. At this level, a vendor could make a living, albeit a very modest one, even after surrendering 75% of his profit to the cart owner, which was the usual percentage demanded under such profit-sharing arrangements in Karton Kassala.

Sources of credit

There are obvious advantages to a vendor in owning his own donkey and cart. However, raising the necessary capital to purchase them is not easy. This is illustrated by the lack of southerners who have managed to do so, as the money lenders are almost exclusively Sudanese of northern origin. Young southerners in Karton Kassala quoted this as their chief difficulty. Even among northerners, it appears that most of those owning their own donkeys are older men.

One way in which capital can be obtained without incurring debt obligations is through a *sanduk*, or rotating credit association. These are common among low-income communities in Sudan. However, anyone joining one will probably have to make quite a few monthly payments into the communal kitty before his turn comes to withdraw from it. For those without a secure income, even the modest commitment this involves may be an undertaking they can ill afford, so the arrangement is not very suitable for those who will only be able to repay the capital after they have invested it.

In Port Sudan, an interest-free credit scheme to promote small businesses is run by Acord, a non-governmental aid agency. Water vendors account for one in five of the loans. Typically, these will be for £S1000, repayable at an agreed rate such as £S50 a month. Only applicants with dependants are considered, however.

Discussion and conclusions

In the conditions of inelastic market demand and limited supply which currently prevail in Khartoum, Port Sudan and presumably in many other tropical cities, there is a strong incentive for vendors to increase prices. Indeed, it is remarkable that the price of water in Meiyu is not higher than it already is. The fact that it is not supports the view that vendors do not operate an effective price cartel.

On the other hand, it also follows that a small change in the supply of water – that is, the amount available through vendors – could have a more than proportionate effect on prices. In the circumstances, it is not surprising that water vending and moneylending should largely be in the hands of the same ethnic groups. By controlling access to capital they can control supply, and hence exert significant control over prices indirectly.

Could government support to water vendors be a cost-effective intervention to improve access to water by the poor, in comparison with conventional engineering interventions to extend and improve piped water systems? Certainly, water vending is a relatively inefficient and expensive method of water distribution. It is clear from the case study in Meiyu, for instance, that no one makes a large profit there from water vending.

However, it is also clear from this example that a vendor's profit is very sensitive to the number of cartloads he can sell each day. With his own subsistence and the donkey's fodder as his principal costs, a vendor's time is literally money to him. Much of this time is spent queuing at the water source to fill his cart. If this could be reduced, so also would his costs.

The low price elasticity of demand and the micro-economics of water vending both suggest that the most effective way to bring down the price of water would be to increase the supply of water at the public sources from which water vendors fill their carts. By reducing queuing times, this would lower the costs of vending, making price reductions possible in those areas, such as Meiyu, where profits are low. It would also create opportunities for more vendors to collect water, particularly in those areas, such as Port Sudan and Karton Kassala, where profits are high. A greater number of vendors would lead to increased queuing times, but the increased competition, and especially the increase on the supply side, could bring about substantial price reductions and help to keep profits within reasonable limits.

Direct evidence of the strong impact of changes in supply on the prevailing prices is provided by the fourfold increase in the price of water in Karton Kassala which followed the closure of two nearby water sources in 1986. There is no reason to believe that such powerful market forces should work to raise prices when supply is restricted, but not to bring them down when the restriction is relaxed. Indeed, it has been reported that the provision in 1989 of a number of new water sources in El Geneina, another Sudanese town, produced a significant fall in vendors' prices for water (Mathew, 1990).

Greater availability of public water points would

offer a further benefit by providing an opportunity for households to exercise their only sanction and dispense with the services of water vendors entirely. This would exert a strong downward influence on prices; the threat of it probably helps to keep down profits in Meiyu, where the borehole is not far away. Moreover, it would provide an escape for the poorest households which at present suffer most from the necessity of paying for all the water they consume.

The beneficial impact on prices of an improvement in the supply of water to squatter areas is thus potentially great. It is not a necessary result, however, as markets are subject to political as well as economic forces. Water vendors, moneylenders and water point concessionaires are an important political force with a considerable financial interest in maintaining the status quo. Improved supply makes price reductions possible, but not inevitable. That might require a measure of government intervention.

There are ample precedents for such interventions. Water is one of the necessities of life, and governments frequently intervene to control the prices of such necessities, though direct price control would be neither prudent nor feasible in the context of an informal market such as water vending.

A more practical intervention for the Government would be to facilitate credit for those wishing to purchase their own donkeys and carts, while ensuring that enough public water points were available for them to collect the water. The success of the scheme in Port Sudan demonstrates that there is a demand for such credit, and shows that loans can be recovered under such circumstances. It might not be necessary to subsidize this credit. Even if it were decided to charge commercial rates, administration costs, and a reasonable additional percentage to make provision for irrecoverable loans, the rates would probably be much more favourable than those currently charged by the moneylenders of the informal sector.

An estimate of the sums involved can be made by the following calculation. A typical vendor selling four cartloads of 400 l each day can serve over 50 people, if their average daily consumption is between 25 l and 30 l per capita. It has been estimated that some 300 000 people in the low-income areas of Greater Khartoum depend on water vendors; these can be served by 6000 vendors. Increasing the number of vendors by 10% each year would require an annual investment of less than US\$ 300 000. Since this sum could be recovered within two years, a total of less than half a million dollars would be sufficient to set up a long-term revolving fund for the purpose.

This sum is small by comparison with the amounts invested in conventional civil engineering works for water supply improvements in any large city. It is

also small by comparison with the millions regularly lent by the commercial banks of the formal sector in Khartoum and by the major donors. Spent to assist water vendors, it would have the advantage of providing benefits targeted on the poor, particularly on the poorest of the poor, and of creating employment by promoting the use of labour-intensive technology.

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