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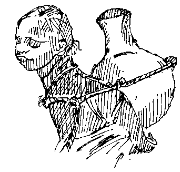
INTEGRATED DEVELOPMENT FOR WATER SUPPLY AND SANITATION



Designing to meet demand in South Africa

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THE SOUTH AFRICAN water sector faces two main challenges in rural water supply:

- serving the 11 million rural people (65 per cent) without adequate access to water; and
- implementing water supply projects in a sustainable way.

The Department of Water Affairs and Forestry (DWAF) has responded to this challenge by proposing to supply a 'basic level of service' [1] to all South Africans within the next ten years. However, there is serious doubt as to whether this aim will be realised and as to the sustainability of the existing and proposed projects.

DWAF policy is to subsidise the capital cost of a communal standpipe supply while communities are expected to pay for the running costs. If recurrent costs are to be financed solely through user charges, this paper argues that supply needs to respond to effective demand. Effective demand for water means the quantity of water that people demand and are prepared to pay for at a particular price level. This can also termed 'willingness to pay' (WTP) and varies for different levels of service e.g. WTP for a communal standpipe may be different to a yard connection. WTP will vary within communities and in order to respond to this varied demand, a mixed level of service needs to be supplied. This paper investigates methods by which demand can be assessed and considers, using a case study, the technical and financial implications of designing to meet demand.

The problem

DWAF has made progress in addressing the backlog of supply by constructed rural water schemes serving over 3 million people over the past four years, however, the sustainability of these systems is under threat. Although DWAF policy states that users should pay the recurrent costs of supply, payment levels on current projects are negligible (DWAF, 1998). DWAF cannot continue to finance recurrent costs as it does not have sufficient budget allocation from the national fiscus, and the increasing subsidy burden from recurrent funding is depleting the funds available for capital development.

The policy and practice of DWAF is resulting in projects being implemented in a supply-driven approach (despite policy objectives to the contrary). Supplying a fixed level of service is not enabling consumers to choose the level of service for which they are willing to pay. This is resulting in inappropriate design and projects not allowing for upgrading. Many householders aspire and are WTP for a higher level of service, in particular a private connection, however other householders are unable or unprepared to pay for even a basic supply. Supplying a fixed basic level of service is not capturing the diversity in WTP and therefore not adequately responding to consumer demands.

Towards better solutions

Water is increasingly being shown to have economic as well as social value. The economic benefits of an improved supply are illustrated by users WTP for the service. If users are required to pay the cost of supply, this economic value needs to be understood and exploited.

The 'demand-responsive approach' (DRA) is an integrated approach to water provision -influencing social, technical, financial and institutional aspects. The primary measure of 'demand responsiveness' is the degree to which consumers have choices over their level of service. Services should be based on these consumer preferences and charges set to recover the economic cost of supply i.e. including externalities.

The DRA is intended to improve project sustainability (World Bank, 1998) and indeed evaluations of projects within South Africa of the Mvula Trust (who advocate demand-responsiveness) have proved to be significantly more sustainable than equivalent DWAF projects (using a variety of 'sustainability indicators'). However, even these projects fall short of being truly demand-responsive in that they seldom allow mixed levels of service and the potential for the household to upgrade.

Designing to meet demand

Responding to demand requires an overall consumer-orientation of the service provider, however, there are two specific stages within the project cycle where demand-responsiveness is essential to design:

- the financial (cost recovery principles) and institutional environment (roles and responsibilities of the Water Service Authority, Water Service Provider and the community) need to be negotiated before project identification or planning is done; and
- at project feasibility stage, communities need to be offered a broad range of levels of service with associated costs and tariffs in order for householders to choose the type of supply for which they are willing to pay.

This paper investigate three aspects of designing to meet demand:

- ways of assessing (effective) demand;

- how a mixed level of service affects engineering design; and
- the implications for project financing.

Demand assessment

Three distinct interpretations of demand are used by different stakeholders within the water sector:

- social scientists: refer to needs or 'felt needs'. Communities themselves and politicians often equate needs with demand (a basic level of water supply is regarded as a 'basic human need' in the South African constitution). These are often assessment by the use of 'needs assessments';
- engineers, planners and designers have traditionally equated demand with consumption based on level of service (i.e. population (or other water users) x average per capita consumption x certain safety factors and other adjustments); and
- economists refer to demand as the willingness to pay for a service at a prevailing price (this is the meaning used in this paper).

Methods of assessing demand can be classified into:

- *direct methods*: where people are asked to state their WTP for an improved supply using hypothetical scenarios; and
- *indirect methods*: where WTP is elicited through observation of certain behaviour.

The contingent valuation method is the most commonly used direct valuation method for water supply projects. It uses carefully designed surveys to ask people to choose the amount they are WTP between different supply options. It is useful to inform policy regarding cost recovery and levels of service but does not seem to have broad application for small rural projects (DFID, 1998). The link between eliciting WTP from the survey and setting tariffs related to actual costs of supply is not clear. It is expensive and time consuming to conduct and attempts to estimate demand to an accuracy inappropriate to small projects.

Indirect methods range from measures of the affordability of proposed systems (for example using a percentage of peoples' income to predict the amount they will spend on water) to observation of current behaviour e.g. the amount paid to water vendors. Up-front community contributions to an O and M fund has been found to be an effective indirect indicator of demand. Methods can be used in tandem for increased reliability.

Community participation in the planning, design and implementation of projects will contribute significantly to demand-responsiveness. Demand assessment attempts to predict initial demand for an improved service, however what seems to be more important in the South African context is for projects to be able to respond to demand over the entire project life.

Implications for engineering design

Rural water supply design is an iterative process involving many assumptions. At one level, demand assessment is only useful to the designer in estimating the average water demand i.e. m^3/day. Water demand is influenced by:

- the number of households choosing different levels of service (estimated through some demand assessment technique);
- estimated consumption per level of service (this will need to be assumed from local information or reliable guidelines); and
- change in demand: due to population growth and upgrading (difficult to estimate).

Design will also be influenced by the choice of peak factors, estimations of 'unaccounted for water', and design guidelines. The designer needs to model the sensitivity of these different assumptions to the average daily water consumption. Designing for a mixed level of service, in effect, adds another factor to this set of assumptions.

In order to design bulk and distribution infrastructure, an average per capita daily demand is needed to calculate the capacity required from the system. In a mixed supply, instead of designing for 25 l/c/d (or 60 l/c/d), this figure will need to be estimated from the average consumption of the different levels of service. Different system components need to be designed for different projected demands e.g. distribution needs to be designed for future demands whereas source and storage can be increased incrementally as demand increases. The capacity of the system to cater for households upgrading from a standpipe supply to an individual connection over the project life is a key design feature of a mixed level of service.

Financial issues

Many factors affect the cost of different levels of service and tariffs a service provider may set. Financial implications of a mixed level of service are best illustrated through a case study. A financial modelling exercise was completed to consider various demand scenarios and the sensitivity of design parameters to the tariffs (Webster, 1998).

Table 1 presents costs and tariffs of three initial demand scenarios where levels of service are restricted to standpipes and individual connections for a typical rural village in the Northern Province. Cost are inclusive for May 1998 in SA Rands (1 US$ = R 5.00).

What can we conclude from the case study?

- tariffs can be structured similarly regardless of the initial demand scenario;
- significant economies of scale exist as can be seen in the reducing O andM cost with the increased demand;
- initial demand assessment exercises, for example, establishing whether the demand is scenario 1, 2 or 3 is significant to the capital financing as expected.

However the author has shown (Webster, 1998) that the change in demand over the project life (due primarily to upgrading and population growth) is potentially of greater significance to the design than estimating the initial demand.

Table 1. Mixed levels of service

	Unit	Scenario		
Base year demand		1	2	3
Communal standpipes	%	80	50	20
Yard connections	%	15	35	50
House (kitchen) connections	%	5	15	30
Average domestic water demand	l/c/d	39	60	84
Total daily demand (including institutional demand and unaccounted for water) [1]	m^3/d	99	155	217
Capital cost	R/capita	350	462	553
O & M cost	R/m^3	2.52	1.93	1.60
Possible tariffs (based on typical household size & consumption)				
Standpipe (flat rate based on O & M of basic level of service)	R/house/ month	16	16	16
Yard connection (average incremental cost) [2]	"	64	55	65
House connection (average incremental cost) [2]	"	103	89	105

[1] Village of approximately 1,900 people

[2] Average incremental cost based on operation and maintenance costs + depreciation + capital needed for upgrading (less subsidy); 2.5 per cent population growth; annual fixed rate of upgrading at 4 per cent; and additional connection fee.

This questions the importance of accurate demand assessment prior to design relative to assessment of other design parameters.

Demand assessment is needed to estimate initial demand i.e. proportion of households choosing different levels of service. This assessment will determine the capacity of the system (and therefore the capital cost), but will have little impact on tariffs. In general, designing for a mixed level of service has the following financial implications:

- *subsidy*: current subsidy is set at the capital cost of a basic level of service. If systems are to be designed to allow for a mixed supply, the capital cost will increase. The difference in capital cost between the subsidy and the actual cost needs to be financed, either through tariffs or some other means. Subsidies are a mechanism for wealth redistribution, but need to be used with care in order to signal the economic cost of supply to the consumer;
- *cross-subsidy*: can enable individual connectors (and other users) to subsidise standpipe users, however the price elasticity of demand, and the proportion of individual connectors will dictate the extent to which cross-subsidy is possible;
- *tariffs*: are complex to model. Theoretically, there are a myriad of tariffing options. Practically, it is sensible for standpipe users to pay flat rates and individual connectors a metered rate. In order to satisfy equity and financial objectives, it is recommended that communal standpipe users be charged a tariff linked to the O and M of a basic level of service (also considering affordability); and individual connections be charged the 'average incremental cost' of the O and M, depreciation and capital cost (difference between the subsidy amount and the actual cost) of supply. Tariffs will also be affected by political, institutional and social issues; and
- *loan finance*: is necessary for micro-financing of individual connections and financing bulk infrastructure. Additional capital expenditure can be financed through tariffs, but loan finance will need to be available to finance the initial negative cash flows.

Facing the reality

Projects currently implemented by DWAF, using a supply-driven approach, are not sustainable. Projects need to respond to effective demand in order to capture users WTP. In South Africa, many communities express the desire for a higher level of service, however their WTP is untested. A range of WTP within a community requires the provision of a mixed level of service and systems need to be able to respond to a change in demand over the project life. Supplying a mixed level of service is expensive and effective demand needs to be demonstrated by up front contributions for yard and house connections.

At one level, demand-responsiveness in rural water supply can be realised through greater community participation throughout the project cycle. Technical and financial considerations in designing for a mixed level of service are complex and rely on modelling many assumptions. The extent to which the Water Service Provider - be it a private contractor or community water committee - is consumer-oriented will dictate the financial viability of the project.

References

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[1]This is defined in the White Paper (DWAF, 1997) as a communal standpipe supply of 25 l/c/d of potable water to within 200m of every resident.

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