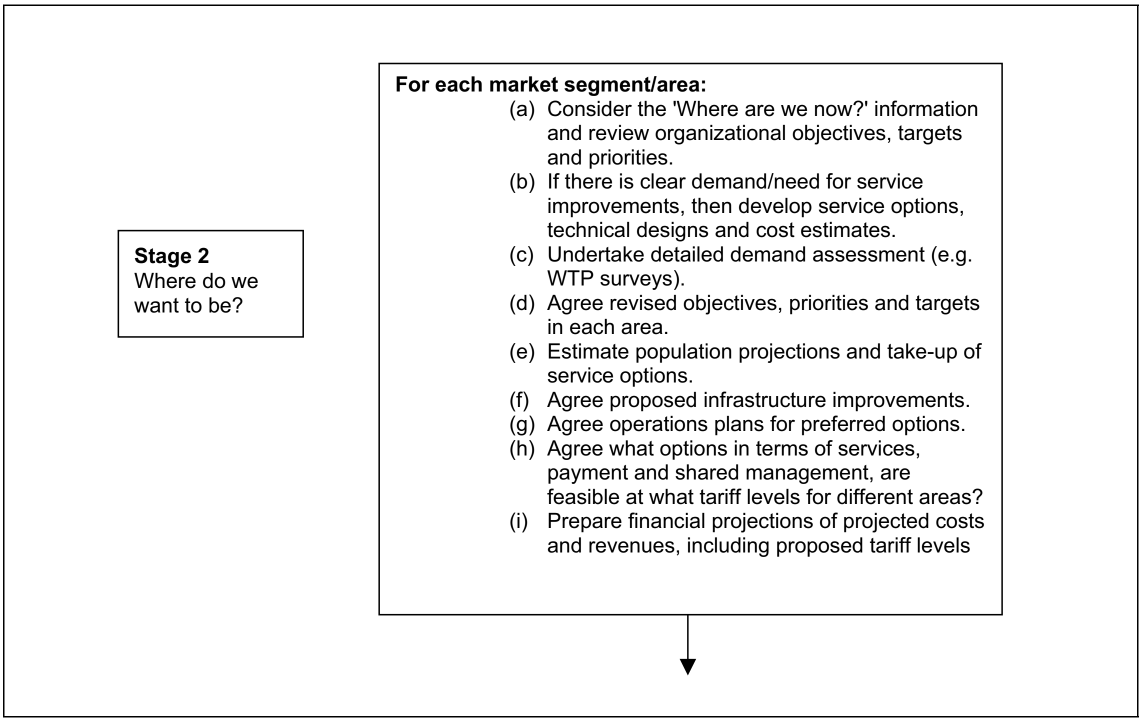
Chapter 7

Stage 2: 'Where do we want to be?'



7.1 Overview

The completion of a thorough situation analysis (Stage 1) of the utility, and its services, consumer groups and working environment, provides a good basis for beginning to answer the question *'Where do we want to be?'* The typical key activities in Stage 2 are listed in the figure above.

Suggested outputs from Stage 2, assuming an investment plan for service improvement is being developed, are:

- outline design options and proposals;
- a review of utility objectives, targets and priorities;
- a detailed demand assessment (e.g. WTP survey report) for target areas;

- proposed service/payment and management options to be offered for each market segment or area; and
- financial projections of cost and revenues as part of an investment plan, including different investment scenarios.

As the ultimate aim in the process is to develop viable and comprehensive investment or strategic marketing plans, it is useful to think about a typical investment planning process and the inter-linkages between the various key activities. An outline process showing such inter-linkages is shown in Figure 7.1. The process begins with Box 1 - an assessment of current service levels and operations which should reveal key problems and any need for service improvements. It is also important to regularly conduct consumer surveys (Box 2) to find out consumers' (existing and potential customers) perceptions about both the service provision and the utility. Activities in Boxes 1 to 3 help answer the question 'Where are we now?'.

The key stage in the 'Where we want to be?' section of the flowchart in Figure 7.1 is Box 4 - 'Review objectives, targets, priorities and investment plans'. This should be done with the best available information, such as the data from the 'assessment of current service levels and operations (Box 1) and well-designed consumer surveys (Box 2), as well as the issues in Box 3.

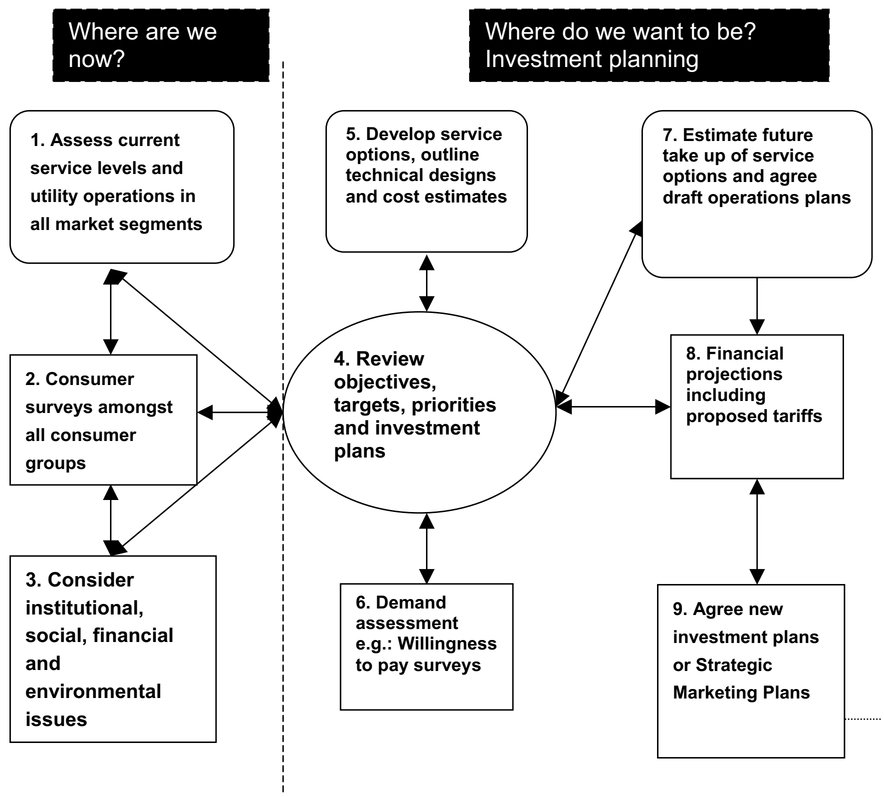


Figure 7.1. Outline investment planning process[1]

1. Source: Sansom, adapted from Revels (2002)

If significant new or revised investments are proposed, then it is worthwhile developing 'service options, outline technical designs and cost estimates' (Figure 7.1 Box 5) and conducting '´demand assessment (Box 6). Both these activities provide valuable information for developing the 'financial projections including proposed tariffs' (Box 8), as well as the 'operations plans for preferred options' (Figure 7.1 Box 7). The willingness to pay survey results not only provide useful data on consumer preferences, but also the average maximum willingness to pay data is valuable in determining tariff policies.

The financial projections are best done on computer spreadsheet programmes, such as Excel over a 10 to 20 year period, using a number of investment scenarios. An example financial projection sheet is shown in Annex 4. The preferred investment scenario can then form the basis of the agreed investment plan that needs to be discussed with key stakeholders. Note that many of the arrows in the outline investment planning process figure point in both directionsñ this emphasizes that the process is both iterative and ongoing.

7.2 Review priorities and objectives

In many developing countries the water utility's financial positions are often problematic. There are many reform initiatives taking place, such as decentralization, creating more autonomous utilities, embarking on various PPP contracts and regulation, developing poverty reduction strategy plans (PRSPs), as well as the continuing process of subsidy reductions. In this changing environment it is beneficial for utilities, government departments and regulators to regularly review their objectives and priorities. The situation analysis from Stage 1 provides a good basis to review broader objectives as well as specific targets.

Lack of customer orientation has contributed to the low levels of revenue in many water utilities. A more proactive consumer orientated marketing approach can substantially improve the utilities' financial position, whilst improving water services to existing and potential customers.

For most progressive water utilities, the key priorities are likely to cover:

- improvement in service provision to customers, including customer services such as billing and dealing with requests and complaints;
- improvement in the utility's financial position;
- expansion of the revenue base by capturing more of the water market (expansion of services to those people who may not be currently served and who rely on alternative sources); and
- achievement of equity in service provision by improving services to the poor.

One key area of improvement is likely to be customer services such as billing, revenue collection and general customer relations. These 'software' issues ought to go hand-in-hand with the 'hardware' issues such as infrastructure improvements and O&M that together constitute service quality. Improvements in service quality can result in the enhancement of customers' perception of the value of the service. Customers are often willing to pay more for a perceived increase in service quality, so the scope for increasing water tariffs increases. Increased revenues are required for investment in new infrastructure for bulk supply, treatment, transmission and distribution to meet both current and future needs.

Broader utility objectives are generally captured in mission statements, policy documents, customer charters, etc. Examples of mission statements for some water utilities in Africa are provided in Box 7.1.

Box 7.1. Utility mission statements

The mission statement for the National Water Conservation and Pipeline Corporation (NWCPC) in Kenya (NWCPC, 1999) is:

'The corporation is committed to providing high quality water to its customers at an affordable price and at a reasonable profit to the corporation.'

The mission statement for the National Water and Sewerage Corporation (NWSC) in Uganda is (Kayaga and Sansom, 2001):

'To be financially a self-sufficient organization developing and providing water supply and sewerage to customers at an affordable price.'

It is interesting to note from the mission statements from utilities in Kenya and Uganda that both of them only refer to their customers. But what about the people who are not their customers, people that do not have their own piped connection? Potential objectives that could be used for mission statements are set out in Box 7.2. Mission statements will also need to take account of current government policies and the current state of services in the utility's service area.

Box 7.2. Potential utility objectives

Key strategic marketing objectives for progressive water utilities :

- Provide adequate and reliable water and sewerage services whilst improving customer satisfaction through continuous service enhancements to all consumer groups.
- Through the development of cost-reflective tariffs and targeted subsidies achieve a reasonable return on the capital employed as an efficient provider.

Successful improvements in service delivery are also dependent on the utility's pricing policies, which are discussed in the next section.

7.3 Proposed tariff policies

Water utilities in many low-income countries are often unable to collect enough revenue to cover both operation and maintenance costs and the capital funds required to improve the system. The level of water tariffs are often too low to meet all the utility's full costs. Another common problem is that tariff structures penalize some consumer groups unfairly.

Approval of the water tariff is generally the responsibility of the central or state governments. This responsibility is also being transferred to regulators in some countries as a means of achieving more objective assessments. The onus is on governments to encourage regulation of water utilities to improve revenue collection through viable water tariffs. Increasingly, efficient urban water utilities in low-income countries are applying tariffs designed to cover return on investments and major capital expenses. The following text provides guidance on tariff setting and the provision of subsidies.

General principles

The determination of tariff policies should seek to address both commercial and social welfare concerns. It is beneficial if revised tariff levels can be finalized based on mutually agreeable principles. The simple but comprehensive 'AESCE' principles (which we pronounce 'ace') are outlined in Box 7.3.

Box 7.3. Developing tariff policies using the 'AESCE' principles

When considering appropriate tariff policies, AESCE is a useful memory aid:

Adequate. The average tariff should be cost reflective, which means it should cover the cost of 'OPEX' - operating costs; 'CAPEX' - capital maintenance (infrastructure renewals and depreciation); and the cost of capital - to ensure that loans can be repaid and future investment financed whilst the existing system is maintained.

Equitable. The required level of revenue should be allocated between customer groups in a fair and equitable manner for both the poorer members of the community and the different levels of service options, relative to the costs they impose on the system and to reflect social welfare objectives to achieve public health.

Simple. The tariff structure should be simple for the utility to administer and easy for customers to understand. Customers usually display greater willingness to sustain payment of water bills when they understand the bills.

Conserving. The tariff structure should influence consumption in such a way that customers are able to purchase enough water to meet their needs without being wasteful.

Enforceable. The utility should be able to enforce the tariff through viable sanctions such as court action, disconnections, etc. Tariffs that cannot be enforced are unlikely to be sustainable.

To ensure that adequate tariff levels are achieved, calculations need to include proposed future loans and investments. Section 7.4 provides some guidance on calculating tariffs using the Average Incremental Costs (AIC) approach based on future investment proposals.

In many countries rising block tariffs have been introduced to try to ensure that consumers of small amounts pay less per kilolitre than larger consumers, as well as to encourage the conservation of water. In practice problems have emerged with this system, as is described in Box 7.4

Box 7.4. Block tariffs to subsidize the poor?[1]

Many urban water utilities use a block system of tariffs for metered households. The principle is that families using less water pay less per kilolitre up to a threshold consumption per month. More affluent households who use more than the threshold pay more per kilolitre of water consumed above that threshold, in accordance with the next tariff 'slab'. This is in recognition of the fact that water is a social as well as an economic good.

Problems can arise in developing countries where a number of poor families use the same metered connection, illegally or otherwise, and they use more than the threshold amount, thus paying more for their water. Under such circumstances poor families can pay more with a block tariff system than if there was a flat tariff per kilolitre consumed. Such disparities can encourage a climate of not paying.

In Santiago, Chile they have dealt with this problem by not subsidizing the poor through lower water charges, e.g. with block tariffs, but providing separate well-targeted subsidies. Other cities that suffer water shortage problems will wish to retain the block tariff system to send economic signals to consumers to conserve water. In which case they will need to carefully design and market service options and tariff levels to ensure equity for multi-family pipe connections.

1. Source: DFID (1998)

So rising block tariffs do not always achieve the 'equitable' component of the 'AESCES' principles, as described in Box 7.4. Some more specific ideas for tariff setting and subsidies are:

a) Getting the tariff level and the tariff structure right helps all consumers, including the poor.

b) Subsidize access (and lack of access), not consumption.

c) Subsidized delivery mechanisms should be targeted, transparent and triggered by household indications of demand.

d) New information is often required to evaluate whether a proposed tariff or subsidy will hurt or help poor households.

e) Because tariffs and subsidies require modifications over time, decisions that must be made about social equity concerns should be incorporated into the tariff and subsidy revision process.

Source: WSP & PPIAF (2002) and Whittington (1992)

When negotiating tariff levels there are a number of key issues to be borne in mind, which are summarized in Table 7.1.

Table 7.1. Key issues for setting tariffs

Issue	Potential impact on tariff policy
National policy priorities	National or state policy might impact on tariff setting. For example, if government policy is to move to full cost recovery, including capital costs, this should impact on tariff increases.
Cross subsidization of poorer communities	If an aim is to improve equity, tariffs can be set at different levels for different user groups and service options.
Consideration of the cost of water supply and sewerage	As populations and demands increase, utilities invariably have to consider using more distant water sources. The full costs of using such sources as well as the bulk water supply and distribution networks need to be included in the tariff calculation. Sewerage and appropriate wastewater treatment is invariably higher in cost than water supply. Where sewerage programmes are envisaged the full costs should be considered in determining tariff levels.
Willingness to pay of communities	This is an important factor and is becoming increasingly accepted as a key element of tariff setting. Tariffs can be raised for those individuals / communities who are willing to pay more for water supply.
Willingness to charge	Policymakers/politicians may often be unwilling to increase water charges because they perceive that tariff increases are likely to be unpopular with the public. Orientation of policymakers is often required to demonstrate the benefits to all stakeholders of generating adequate funds through increased tariff levels.

Proposed tariff levels in the medium term are likely to be considered when doing financial projections for future investments. Where substantial tariff increases are required, they should preferably be within the willingness to pay levels that are derived from surveys. Increases are best done on an incremental basis that is acceptable to key stakeholders. Addressing the 'willingness to charge' issue mentioned in the above table is critical, so careful thought is required in developing a strategy for advocating tariff increases.

Agreeing tariffs for different service levels

By offering different options to different customer groups, there are opportunities for setting lower water prices for options that are less convenient to consumers, or where options cost the utility less to provide, or where subsidies to the poor are proposed. For example, a water kiosk that is managed by a community group will have lower operational costs for a utility than a kiosk managed by the utility itself. Trickle feed supplies are cheaper than full water pressure, so tariffs can be lowered accordingly to capture people's willingness to pay.

A simplified calculation for balancing projected income for each service option with utility costs is set out below:

If we assume that the average calculated tariff for financial sustainability for a city is, say, US$1.0 per cubic metre, and that the average consumption per household is 10 cubic metres a month, then for 50,000 paying households in a city, the total domestic water income for the utility will be:

$1.00 x 10 cubic metres x 12 months x 50,000 households = $6 million

(Average tariff x Volume of water sold = Total domestic water sales income)
(excluding connection charges, etc.)

If the total expected income from commercial/industrial and other institutions in the city is $2 million at the same tariff level, then the total projected yearly income for financial sustainability is:

$6 million + $2 million = $8 million

The tariff levels for each service option offered will need to be adapted to generate this same level of income ($8 million) as is shown in the simplified calculation in Table 7.2 below. Note the tariffs can be adjusted to match the WTP of customers for each option offered, as well as reflecting the reduced costs of provision for the different service levels offered to poor or unserved communities.

Table 7.2. Balancing service option tariffs with income

Service option	Proposed option tariff ($ per cubic metre)	Projected sales volume (cubic metres of water)	Projected income from each option
Utility-managed water kiosks	$0.8 X	300,000 =	$0.24 million
Community-managed water kiosks	$0.6 X	400,000 =	$0.24 million
Yard connection in informal settlements where customers sell on to neighbours	$0.8 X	500,000 =	$0.4 million
Individual house connection with 12 hours supply to roof tank at full pressure	$1.0 X	4.8 million =	$4.8 million
Commercial/ industrial users	$1.16 X	2 million =	$2.32 million
		Total Income	$8.0 million

The figures in Table 7.2 do not include sewerage charges, which would need to be added for household supplies where sewerage service are provided. The calculation is rather simplified, as demand for water will vary with price, but it offers the basic approach of differentiating service options at appropriate prices in order to maximize both income and the numbers of satisfied customers. The key principle behind this approach is subsidizing 'access', or options that have less access, rather than consumption. In a similar way private sector companies in general charge more for better services than they would for less convenient options.

A tariff balancing exercise such as the one shown in Table 7.2 can form the basis of a future utility tariff structure that reflects both commercial and equity objectives.

7.4 Projected costs

Achievements of financial sustainability by water utilities require that sufficient attention be given to the costs of water provision.

Cost concepts

The economic cost refers to the benefits foregone elsewhere in the economy by using scarce resources for a given purpose. In terms of providing water services, the economic cost has three components:

- the cost of raw water;
- the investment cost; and
- the operation cost.

Together, the three components constitute what is commonly referred to as the total costs. The cost of raw water consists of drawing related charges, which are important, especially with increasing scarcity of water resources. The investment cost refers to the amount spent during the planning and implementation phase of the project. This is essentially the cost of installing the water supply infrastructure, and includes financing costs. The operation cost (or recurrent cost) refers to the amount spent during the operations and maintenance phase of the project.

Total costs = cost of raw water + capital cost +recurrent cost

The average cost is determined by the total costs divided by the water production.

Average cost = Total costs/water production

The average cost starts at a very high level and falls rapidly with increasing volume. It is at a minimum at the optimum production level. With higher production, the average cost rises again. Thus, the first cubic metre is very expensive to produce, but thereafter total costs increase only slowly. Costs will rise faster as production approaches capacity.

Marginal Costs are the additional operating costs for an additional unit of output (short run). Where extensions of capacity are required to allow for increasing consumption, marginal costs includes the necessary investment costs (long run). There are two distinct situations under which marginal costs can be determined. In the first case, the average costs of service are decreasing for a certain range of output. This can happen particularly in large urban schemes where economies of scale apply. In this case, marginal costs are below average costs. The opposite is the case where the average cost is increasing. This can be the result of, for instance, expansion of the service area, development of more remote water sources or more cases of peak demand. Thus the marginal cost is above the average cost. In this case average cost pricing results in inefficiency.

On the basis of efficiency, marginal cost pricing is the most optimum. It is however difficult to apply in practice for two main reasons:

- Strict application of marginal costing can cause large and sudden fluctuations in price. The marginal cost price should change continuously according to production, which is difficult to manage in practice.

- Water supply investments are usually large and often vary substantially from year to year.

A special feature of the water sector, like other infrastructure, is that it is typically capital intensive. This feature and other difficulties in the application of marginal cost pricing have resulted in its limited use in charging for water. It is rare that one encounters any reference to marginal cost pricing in practice, since even economists do not agree on the details of its practical implementation. Due to these difficulties, the concept of average incremental cost has been introduced. To overcome the constraints of marginal cost pricing, it is assumed that average incremental cost equals marginal costs.

The average incremental cost is obtained by dividing the project's incremental costs by the incremental water sales of the same project. The cost and sales over the economic life of the project are discounted by applying the present value method. This is discussed further in the section on average incremental costs.

Estimates of costs for water supply components

Where detailed costings are not available, cost formula are a useful means of developing water supply component cost estimates. Examples of such formulae are shown below using cost functions produced by the Water Research Centre and presented in their Technical Report TR61 on 'Cost Information for Water Supply and Sewage Disposal, and Cost Index Value' published in June 1995. The figure derived from the formula is then multiplied by a suitable index also provided in TR61.

Box 7.5. Estimation of water treatment plant costs[1]

Total cost of installation ('000 British £) = $0.160 * NORMCAP^{0.77}$

Where NORMCAP is the normal total installed capacity in m^3/hour.

1. Source: Water Research Centre (1977, page 116)

Box 7.6. Estimation for transmission mains[1]

Total cost ('000 British £) = $0.0702 * LEN^{0.73} * DIAM^{0.91*(DIAM/(1000+DIAM))}$

Where LEN is total length of pipe network in metres

DIAM is mean diameter of pipe work in millimetres

1. Source: Water Research Centre (1977, page 90)

Box 7.7. Estimate of construction costs of concrete reservoir tanks[1]

Total cost of concrete covered tank (million UK £) = $0.0726*CAP^{0.62}$

Where CAP is the capacity of tank in thousands of cubic meters.

1. Source: Water Research Centre (1977, page 353)

When using such formulae it is preferable to cross check the results with the actual costs from similar local projects, in order to determine the applicability of the formulae to the local situation.

Determination of Average Incremental Cost (AIC)

The AIC represents the average or long run marginal cost over a long period of time. The Average Incremental Cost (AIC) is determined by assuming that the most economic output is where long run marginal costs equal long run marginal revenue.

AIC is calculated by dividing the present value (PV) of all incremental capital, operating and maintenance costs (C) by the present value (PV) of the incremental consumption (W) over the design life of the facilities to be constructed.

AIC = PV C ($) / PV W ($m^3$)

The present values are determined by discounting the cash flows and consumption quantities at a discount rate that equals the opportunity cost of capital to the national economy. The opportunity cost is taken to be the real value of resources used in the most desirable alternative. This formula can be used to determine the AIC for different development scenarios for a water utility.

An example of determination of projected costs for Mombasa and the coastal area using the AIC method is presented in the Annexes. The calculation of accurate projected costs is important for determining tariffs that are at adequate levels for the sustainable management of services.

7.5 Selecting water service options

The range of different service options such as: house connections, yard connections, water kiosks, standposts, etc. are discussed in Chapter 3. Different service options are appropriate in different situations depending on the existing water supply infrastructure, utility finances and the perceptions of consumers. The consumer surveys and focus group discussions should provide indications of what are likely to be the type of options that people will prefer in the various market segments.

Table 7.3 and Table 7.4 show examples of service options offered to different market segments in Mombasa, as part of a willingness to pay survey and strategic marketing research. The willingness to pay survey form that was used is in Annexe 2.

Table 7.3. Service options offered for 1 to 3-roomed dwellings in Mombasa

Service level (option)	Brief description of service option
Service level 4	Continuous supply at yard connection
Service level 5	Continuous supply with storage tank at shared yard connection
Service level 6	12-hr supply at shared yard connection
Service level 7	4-hr supply at shared yard connection

Table 7.4. Service options offered to people in informal settlements in Mombasa[1]

Service level	Brief description of service option
Service level 8	Continuous supply with storage tank at shared yard connection (about 10 dwellings)
Service level 9	12-hr supply at shared yard connection (about 10 dwellings)
Service level 10	Ditto but 4-hr supply
Service level 11	Privately managed kiosk with shelter and tank
Service level 12	Community-managed kiosk with shelter and tank
Service level 13	Privately managed kiosk without shelter or tank

1. Source: Njiru and Sansom, 2001

Note that six options were offered to respondents in informal settlements (Table 7.4). It is usually preferable to offer between three and five options to any group, as this has been found to be a practical range, both from the perspective of having a manageable survey and during the analysis phase.

There are also different criteria for segmenting consumers. In the Kampala marketing research, the market was segmented based on income levels. The service options offered to low-income areas are shown in Table 7.5.

Table 7.5. Service options offered in low-income areas in Kampala[1]

Service level	Brief description of service option
Service level 5	Individual house connection through ground tank (trickle feed)
Service level 6	Community-managed water kiosk
Service level 7	Privately operated water kiosk
Service level 8	Utility-supported water vending
Service level 9	Smart token operated water kiosks (pre-paid meters installed in kiosks, then operated by smart tokens)

1. Source: Kayaga and Sansom, May 2001

Apart from the service options presented here, others can be developed depending on the particular circumstances faced by respective water utilities and the preferences of consumers. Once the service options have been developed and costed, the demand assessment can proceed.

7.6 Willingness to pay for selected options

The contingent valuation method

In the context of the water sector, a key feature of the marketing methodology is to offer feasible service options, to learn how much people are willing to pay for each service option and to select the most popular options.

The contingent valuation method (CVM) is widely used to estimate how much households are willing to pay (WTP) for various service options. (Refer to Part II for an explanation of the key concepts.) The bidding ranges and approaches used are evident from the sample willingness to pay format in Annexe 2.

One of the most common techniques for eliciting respondents' maximum willingness to pay is the *bidding game,* which requires the respondent to either go through a series of bids for each option until a negative response is generated and a threshold established or to select from a range of values. The last accepted bid is the maximum willingness to pay. This method provides the respondent with time to respond and the opportunity to develop an opinion about the payment for the improved water supply.

In general, the amount that two-thirds of the market segment are willing to pay for a service option is a reasonable figure to use in reporting the willingness to pay for the particular market segment. An example of willingness to pay results for different service options in different market segments is presented in the tables below.

Table 7.6. WTP results for people in 1,2 or 3-roomed dwellings in Mombasa[1]

Service level (option)	Brief description of service option	Market segment	Percentage of respondents within market segments who bid for the stated service option	Weighted mean WTP (KSh)	Amount which two-thirds of respondents are WTP (KSh)
Service level 4	Continuous supply at yard connection	People in 1, 2 or 3-roomed dwellings and Swahili houses	100%	1124	834
Service level 5	Continuous supply with storage tank at shared yard connection	Ditto	100%	1023	800
Service level 6	12-hr supply at shared yard connection, rationing	Ditto	62%	537	447
Service level 7	4-hr supply at shared yard connection	Ditto	54%	395	336

1. (Exchange rate is KSh73 = US$1)

Table 7.7. WTP results for people in informal settlements in Mombasa[1]

Service level (option)	Brief description of service option	Market segment	Percentage of respondents within market segment who bid for the stated service option	Weighted mean WTP (KSh)	Amount which two-thirds of respondents are WTP (KSh)
Service level 8	Continuous supply with storage tank at shared yard connection (about 10 dwellings)	People living in dwellings in informal settlements (slums)	98%	1103	592
Service level 9	12-hr supply at shared yard connection (about 10 dwellings), rationing	Ditto	95%	610	500
Service level 10	Ditto but 4-hr supply	Ditto	63%	302	236
Service level 11	Privately managed kiosk with shelter and tank	Ditto	54%	3.50 per 20-litre container	3.25 per 20-litre container
Service level 12	Community-managed kiosk with shelter and tank	Ditto	48%	3 per 20-litre container	2.65 per 20-litre container
Service level 13	Privately managed kiosk, no shelter or tank	Ditto	10%	1.50per 20-litre container	1.60 per 20-litre container

1. (Exchange rate is KSh73= US$1)

Note that both the weighted mean willingness to pay results and the 2/3 values given in Table 7.6 and Table 7.7 reveal a WTP that is much higher than the current tariff level in Mombasa. These results, along with the consumer survey information, can therefore be used to advocate for increases in tariff levels and flexible service options amongst key decision-makers.

Alternative methods of demand assessment

Apart from conducting a willingness to pay study using the contingent valuation method, focus group discussions (FGDs) can be used to obtain customer perceptions of existing water services and their preferences for improved service options. FGDs using approaches such as PREPP (which is described in Section 2.9) are particularly useful as an initial demand assessment or where a conventional willingness to pay study is not feasible due to factors such as lack of skills or resources (time or cost).

As part of PREPP a costed option ranking is done by the group and also individually by secret ballot. Table 7.8 shows individual ranking results of service options by participants in three informal settlements in Mombasa. The lower values (1 and 2) show the preferred options.

Table 7.8. Individual ranking of options in Mombasa informal settlements[1]

Service option	Kisumu Ndogo (by men)	Kisumu Ndogo (by women)	Muoroto Paradise (by men)	Muoroto paradise (by women)	VOK(by men)	VOK(by women)	Overall ranking of option
Service level 8: Shared yard connection with storage, 18-24 hrs of supply; KSh1200 per month	4	5	4	6	3	5	5
Service level 9: Shared yard connection, no storage, 12-hr of supply; KSh800 per month	5	4	5	5	6	6	6
Service level 10: Shared yard connection, no storage, 4 hrs of supply; KSh500 per month	5	2	6	3	4	4	4
Service level 11: Privately managed kiosk with storage; KSh3 per 20 litres	2	6	1	4	2	3	3
Service level 12: Community-managed kiosk with storage; KSh2 per 20 litres	1	1	3	1	1	1	1
Service level 13: Privately managed kiosk; KSh2.50 per 20 litre	3	3	2	2	5	2	2

1. (Exchange rate is KSh73 = US$1)

Table 7.8 shows that community and privately managed kiosks are in higher demand than shared yard connections. It is interesting to note that respondents in the informal settlements in Mombasa generally preferred water kiosks to shared connections, even though water would be cheaper in terms of cost per jerrican from a shared connection than a water kiosk. These results contrasted with India, where there was a good demand for shared or group connections.

The reason group members gave for preferring kiosks in Mombasa was that there would be less potential conflict with their neighbours with water kiosks than with shared connections. Whereas surveyed communities in Guntur in India and small towns in Uganda seemed willing to co-operate with their neighbours on cheaper more convenient shared connections. Such differing perceptions between consumers in different cities, highlights the need to conduct surveys to find out local community perspectives, rather than just make assumptions about people's demands.

The results of the ranking of priced options by FGDs can be used to inform selection of options and design of tariffs. However, it should be noted that this approach provides information on the relative demand for different options at the stated prices, which should be carefully determined to correspond to proposed tariff levels. But it does not provide values for the maximum willingness to pay for each option and the results are not, therefore, so valuable in determining future tariff levels as well designed WTP surveys. The FGDs do, however, provide a good basis for ongoing dialogue between the utility and community groups.

7.7 Population projections

Population growths in cities and towns in developing countries can range from 1 to 7 per cent% per annum. It is important that an accurate estimate of growth in particular towns and cities is obtained in order to inform the planning of future infrastructure and services. It is beneficial to use a 20 to 30 -year planning horizon and prepare population projections on that basis. This information can usually be obtained from census data or planning departments.

There may also be differential growth rates between market segments. Informal settlements, for example, typically grow faster than other parts of cities because of factors such as the rural - urban drift of poor people in search of income- generating opportunities. The use of recent aerial photographs and GIS can assist in monitoring the erection of new dwellings and current growth rates in informal settlements.

7.8 Estimates for service option take- up

Estimates for take- up of service options are made for each option that is to be offered in future, on the basis of the results of the demand assessment. Results of willingness to pay studies can be used to estimate the proportion of consumers within each market segment who demonstrate effective demand for each respective service option.

Knowledge of how many people live in a city and how that population and its distributed in respective market segments is also important. Water utilities can obtain population and its distribution information from census data, which provides an important source of information, especially on residential water users. By knowing the population and its distribution within each market segment, the total number of people who might population who takes up the different respective options can be estimated.

Apart from willingness to pay studies, infrastructure deficiencies should be taken into account. This is particularly important in low-income settlements where willingness to pay for higher levels of service may exist, but basic infrastructure to support high levels of service is lacking. In such an area, a gradual take- up of service options or the use of intermediate service levels such as shared connections and kiosks may be more feasible in the shorter term in order to allow time for the development of infrastructure to support the desired higher levels of service.

Social issues can also influence take- up of options. For instance, the social dynamics of an urban community might be conducive for community management of water kiosks, in which case the take- up of such an option could be high. A community that is not cohesive may not wish to have community- managed kiosks, in which case privately managed kiosks may be preferable. Focus group discussions can provide key information in this respect.

An example of estimates for the take- up of service options in the Mombasa research are summarized in Table 7.9, based on survey data and knowledge of what is feasible. Note that the suggested number of options to be offered to each market segment is less than was originally offered to respondents in the willingness to pay survey (refer to Annexe 2.). This refinement in the number of options is based on selecting which options have the highest demand and what are the most feasible for the utility to deliver. It may be necessary to further reduce or adapt the options in the light of experience in promoting the options and witnessing the level of take- up of each option, during implementation phases.

Table 7.9. Take-up of service options by Market segment in Mombasa[1]

Market segment by type of dwelling	Estimated Population in market segment	Service options and estimated proportion of option take-up
Bungalows and maisonettes	175,000	12-24hr supply at individual house connection (100%)
Flats	105,000	1. 12-24hr supply at individual connection (80%) 2. 12-24hr supply through shared connection (20%)
1, 2 or 3-roomed dwellings and and Swahili houses	280,000	1. 12-24hr supply at individual connection (25%) 2. 12-24hr supply at shared yard connection (30%) 3. 12-24hr supply at shared yard connection with storage tank (30%) 4. Privately managed kiosks with storage (10%) 5. Community-managed kiosks with storage (5%)
Informal settlements (slums)	140,000	1. 12-24hr supply at shared yard connection (10%) 2. 12-24hr supply at shared yard connection with storage tank (10%) 3. Privately managed kiosks with storage (40%) 4. Community-managed kiosks with storage (40%)

1. Source: Njiru and Sansom (2001)

Note that where there are alternative non-utility water supplies such as wells or springs, these options need to be taken into consideration when estimating the take- up of utility service options.

7.9 Estimating water consumption

There are no universally accepted levels of water consumption. Engineers and planners often use their own figures for project design, basing them on local circumstances.

Water consumption is the amount of water consumed by one person in one unit of time, and is expressed in litres per capita per day (lpcd). Consumption levels vary from place to place depending on factors such as:

- location of the area (climate, culture, etc.;)
- availability of water (method of supply/delivery/service option);
- time and distance to collect water;
- reliability of water services;
- whether internal plumbing in the house is provided;
- level of income;
- presence or absence of water borne sewerage;

- cost of water and method of payment; and
- whether water is metered or not.

Water consumption and health risks

The quantity of water delivered and used for households is an important aspect of domestic water supplies, and is one which influences hygiene and therefore public health. Based on estimates of requirements of lactating women who engage in moderate physical activity in above-average temperatures, a minimum of 7.5 litres per capita per day will meet the requirements of most people under most conditions. This water needs to be of a quality that represents a tolerable level of risk. This water volume does not account for health and well-being-related demands outside normal domestic use, such as water use in health care facilities, food production, economic activity or amenity use. (Howard and Bartram, 2002).

Accessibility to water can be categorized in terms of service level. A summary of both the degree to which different levels of service will meet requirements to sustain good health and the interventions required to ensure health gains are maximized is shown in Table 7.10 below.

Table 7.10. Water service levels and health concerns

Service level	Access measure	Needs met	Level of health concern
No access (quantity collected often below 5 l/c/d)	More than 1000m or 30 minutes total collection time	Consumption - cannot be assured Hygiene - not possible (unless practised at source)	Very high
Basic access (average quantity unlikely to exceed 20 l/c/d)	Between 100 and 1000m or 5 to 30 minutes total collection time	Consumption - should be assured Hygiene - handwashing and basic food hygiene possible; laundry/ bathing difficult to assure unless carried out at source	High
Intermediate access (average quantity about 50 l/ c/d)	Water delivered through one tap on-plot (or within 100m or 5 minutes total collection time	Consumption - assured Hygiene - all basic personal and food hygiene assured; laundry and bathing should also be assured	Low
Optimal access (average quantity 100 l/c/d and above)	Water supplied through multiple taps continuously	Consumption - all needs met Hygiene - all needs should be met	Very low

The estimated quantities of water at each level may reduce where water supplies are intermittent and the risks of ingress of contaminated water into domestic water supplies will increase. (Howard and Bartram, 2002). To minimize health risks, governments and utilities should be seeking to reduce water collection times so that increased household water volumes increase. This essentially means that on-plot service options are most preferable, and water points should at least be nearby, such as buying water from neighbours. Where these options are not feasible for the time being, water kiosks or standposts can be provided.

Estimating consumption

Engineers typically use conventional methods of estimating water consumption using design standards, where specific consumption is assumed based on the type of water supply. In the context of a commercial approach to management of water services and, project design should be based on effective demand (demonstrated by willingness to pay) rather than perceived levels of consumption.

The relevant consumption figure is the minimum necessary for health and well being (say 20 lpcd). Any amount above the minimum for health (and thus required for convenience) should be provided on the basis of supply and demand. It is therefore recommended that consumption should be estimated on the basis of willingness to pay and the likely water availability.

Estimating the water consumption in a particular city requires consideration of the service option, the market segment and willingness to pay. Assuming that billing is based on metered consumption, the water tariff will also influence the actual consumption. Table 7.11 shows estimated water consumption per market segment and service options used in the Mombasa research.

Table 7.11. Estimated water consumption for service options in Mombasa

Market segment by type of dwelling	Service option	Estimated consumption (litres/capita per day)
Bungalows and maisonettes	12-24hr supply at individual house connection	· 150
Flats	3. 12-24hr supply at individual house connection 4. 12-24hr supply through shared yard connection	· 100 · 100
1, 2 or 3- roomed dwellings and Swahili houses	6. 12-24hr supply at individual house connection 7. 12-24hr supply at shared yard connection 8. 12-24hr supply at shared yard connection with tank 9. Privately managed kiosks with storage tank 10. Community- managed kiosks with storage	· 100 · 60 · 60 · 20 · 20
Informal settlements	12-24hr supply at shared yard connection 12-24hr supply at shared yard connection with tank Privately managed kiosks with storage tank Community-managed kiosks with storage tank	· 60 · 60 · 20 · 20

If the assumed consumption figures for the design of new schemes are a little high, it should not present a problem, because the spare capacity generated can be used when there is increased demand for water in that particular area, as a result of the population growing or as people can pay more for water. However, if the assumed consumption figures are much higher than the quantities customers want, then there is a clear risk of too much spare capacity in the water supply infrastructure, which represents wasted investments. Hence it is important to only promote viable service options and respond to consumer demand for services.

Once consumption estimates have been made for each service option and market segment, the volume of water sold through each of the service options to different market segments can be calculated using the population distribution and the assumed option take up. The calculation should be done bearing in mind the results of the demand assessment.

7.10 Infrastructure improvements

.Many water utilities need to invest in new infrastructure and/or rehabilitate the existing networks, in order to provide services adequately and reliably, to more consumers and attain financial sustainability.

It may be necessary to invest in new sources of water, and to increase the capacity of treatment works and also water transmission to meet future demands. The distribution network often requires expansion in order to extend services to un-served areas and to meet the utility's equity objectives of serving those who are currently not served. In the Mombasa strategic marketing study (2001), the following broad areas of investments were envisaged in order to achieve the projected water consumption rates:

- the development of a new distant water source and 220km- long transmission main, with an abstraction rate of 1.0M3/sec;
- an expansion of the distribution network to meet demands up to the year 2020;
- reduction of water losses; and
- provision of sewerage to some areas.

Network extension also improves the utility's customer base with potential for improvement in revenue. Some old sections of the network may require replacement in order to reduce leakage and improve the quality of water supplied to customers.

Infrastructure improvements, however, need to be well planned, as they are typically capital intensive. Water utilities can define infrastructure improvements either by using their own (in-house) capacity or commissioning private engineering consultancy firms to undertake engineering studies and define the most feasible investment option. The detailed designs for infrastructure improvements should be based on precisely defined performance targets for each element of the water supply system.

The estimates of option take- up with an allowance for future population projections and demand for options should inform the design of the infrastructure. Several alternative project scenarios are usually identified and compared. Selection of the most feasible infrastructure development scenario is done on the basis of technical, environmental and financial considerations. The choice of technology is particularly important in developing countries. Technology that is simple to operate is preferable to sophisticated technology that may be easy or cheaper to install but poses problems during the operation and maintenance phase. Availability of technology back-up and spares should be considered in selecting the technology to be adopted. For instance, gravity systems (that are often more expensive to install) are preferable to pumping systems wherever possible. It is particularly important to consider both the capital costs and the life- cycle costs.

Water requirements should be considered for both the short/medium term and the long term, in order to discover the most feasible solution, in terms of reliability and simplicity of operation. In particular, selection of water sources requires meeting not only technical and economic considerations but also environmental criteria.

The design of all components should include costings to determine the unit cost of water provision. If the projected revenues cannot meet the projected costs with tariffs set at acceptable levels (bearing in mind willingness to pay and willingness to charge levels), then alternative project components or concepts should be considered.

Selection of the infrastructure improvement scenario should also take into account the sources and cost of finance. The final selection of which infrastructure improvement scenario should be implemented should be made on the basis of technical, environmental and financial viability. These factors have implications for the options that the utility can reliably provide to customers in a financially sustainable manner.

7.11 Agreeing tariff levels

The utility's financial objectives and the projected costs of service provision ought to be the main determinants of the criteria for tariff design. In practice, however, setting and implementing water tariffs is a contentious issue in most countries and will depend on the 'willingness to charge' of policymakers and the 'willingness to pay' of water users. The AESCE principles (adequate, equitable, simple, conserving and enforceable), as outlined in Section 7.3, provides a good basis for agreeing both the tariff structures and the tariff levels. Experiences in setting tariffs as part of a marketing analysis for Mombasa are outlined in Box 7.8.

Box 7.8. Matching tariffs with projected costs and willingness to pay[1]

In the Mombasa strategic marketing analysis, the full costs of acceptable water services were estimated at US$1.21 (KSsh88./30) per m^3 using the average incremental cost method (AIC). The tariff was designed in such a way that customers' willingness to pay amounts for each service option and respective customer market were not exceeded. This resulted into an average tariff of KSsh89./20 (US$1.20) per m^3, which was sufficient for the utility to meet all its costs and record a modest profit.

1. Source: Njiru and Sansom (2001)

In order for water services to be provided in a financially sustainable manner, utilities should be committed to setting tariff structures that fully cover the costs of efficiently managed water operations. Tariffs can be designed using the principles of flat rate, declining block rate, and increasing block tariffs, although block tariffs reduce the simplicity of the tariff structure and can affect equity considerations (as is discussed in Section 7.3). An example of a proposed tariff structure is provided in Table 7.12. The basic principle used in this example is that the tariff is set depending on the level of service provided, i.e. subsidizing those options that are less convenient for users.

Table 7.12. Proposed tariff structure for Mombasa[1]

Proposed water supply options	Proposed water tariffs based on WTP survey (KSh/m^3)
12-24h Hour supply at individual house connection	60
12-24h Hour supply at shared house (flat) connection	55
12-24h Hour supply at yard connection with a utility storage tank	50
12-24h Hour supply at yard connection without a utility tank	45
12-24h Hour supply at privately managed water kiosks with storage and structure	25
12-24h Hour supply at community- managed water kiosks with storage and structure	25
12-24h Hour supply to commercial, industrial or institutional customers	120
Proposed average tariff	KSh89.20 per m^3

1. (Exchange rate is KSh73/ = to the US$1)

In the Mombasa study, the proposed tariff of KSh 89/ per m^3 to pay for the proposed investments is substantially more than the current equivalent tariff (in 2000) of about KSh 21/m3. A carefully organized promotion campaign would be required for the proposed tariff increases to be accepted. Incremental increases over a number of years are likely to be necessary.

The final agreed tariff levels may of course need to be adjusted in the light of an assessment of the projected revenues and the overall financial projections, which are considered in the following sections.

7.12 Projected revenue

Projected revenues can be calculated for respective service options on the basis of the consumption estimates, assumed take- up of options and proposed tariffs. Revenues are estimated with proposed tariffs set at levels that are adequate for full cost recovery and within willingness to pay levels for each service option and market segment of the population. Calculations for projected revenue also require consideration of unaccounted for water (water that is produced but not sold) and bill collection efficiency.

The calculation is iterative and aims to balance projected costs with projected revenues. The calculation is repeated until the projected revenue exceeds (or equals) the projected costs of providing the required services. An example of results of a sample calculation for Mombasa is shown in the Table 7.13 below.

Table 7.13 shows that the total projected revenue for the utility is KSh 3, 906, 704, 500 per annum, with an average water tariff of KSh 89.20 (about US$1.20) per m3. Assuming that the total annual costs to cover both capital and recurrent expenditure (including loan repayments) remains at the estimated amount of KSh3, 854,400,000, then the utility can make a modest profit of KSh52, 304, 500 (about US$716, 500) per annum. This means that the utility can meet both social and financial objectives and still make a profit. This profit could be used to improve water services in other un-served areas.

Table 7.13. Projected revenues in Mombasa[1]

Proposed water supply options	Expected volume of water sold and paid for (m^3/yr)	Proposed water tariffs based on WTP survey (KSh/m^3)	Projected income from each option (KSh)
12-24 Hour supply at individual house connection	14 691 250	60	881 475 000
12-24h Hour supply at shared house (flat) connection	766 500	55	42 157 500
12-24h Hour supply at yard connection with utility storage tank	2 146 200	50	107 310 000
12-24h Hour supply at yard connection (no utility tank)	2 146 200	45	96, 579, 000
12-24h Hour supply at water kiosks with storage and structure (privately or community-managed)	1,124,200	25	28, 105, 000
12-24h Hour supply to commercial, industrial and institutional customers	22 925 650	120	2, 751, 078, 000
Total	43,800,000m^3	Average tariff is KSh89.20/m^3	3, 906, 704, 500

1. (Exchange rate is KSh73/ = to the US$1)

7.13 Financial projections and investment scenarios

Financial projections that cover the loan period will be needed, as has been done for in the Kampala marketing study (refer to Annexe 4) so that incremental tariff and revenue collection increases can be balanced with loan repayments and other costs. A major responsibility for a water utility is maintaining an adequate level of revenue, which is collected equitably from all consumer groups. Total revenues should be sufficient in order to:

- provide adequate customer service to maintain and sustain the water supply services;
- to pay government taxes;
- to earn an appropriate return; and
- to ensure a secure financial status necessary to obtain credit at reasonable rates from lending institutions for any system expansion or improvement.

To ensure availability of funds on a day-to-day basis, water utilities need to plan and manage cash flows over the project period. Cash-flow planning assures that sufficient cash is available when it is required, and minimizes the need for short-term borrowing. Excess cash, if any, may be temporarily invested. Cash- flow management involves synchronizing cash inflows with outflows. Operating revenue accounts inform management decisions regarding amount and type of capital expenditures that is variable. An iterative solution could then be sought to find out what tariff structure is feasible in order to carry out service coverage expansion and service quality improvements according to the strategic marketing plan.

Each water utility has different objectives and operates under different conditions, and therefore has different cash requirements and needs. It is important that the tariff structure reflects the objectives and needs of the utility. If the cash flow is not planned for and properly managed, the corporate objectives may not be fulfilled. In planning for appropriate cash flows over the project period, the specific financial objectives of the utility must be considered. The financial objectives can be examined by answering the following:

- Is the utility fully self financing or does it receive any form of subvention from the state?
- Does the utility cater for amortizsation? Does it cater for depreciation?
- Does the utility keep depreciation and amortizsation expense accounts?
- Is the utility servicing any loans? How is the loan repayment scheduled?
- Does the utility subsidize any other entity or other departments?

A case study conducted in 2000, in Kampala, Uganda came up with a strategic marketing plan for water services for a 25- year project period. As an example, Box 7.9 shows highlights of scenarios considered in computing cash flow projections for the Kampala water supply service area. Note that different investment scenarios have been considered, in order to develop the optimum investment plan.

A summary financial projection can be seen in Annexe 4 with a planned increase in coverage from 31% to 100 per cent%. Note that the financial projections include different service options in each market segment (high, middle and low-income) and show incremental tariff increases and the cumulated surplus/deficit.

The investment scenarios should reflect the investment choices that seem most viable. These choices could be technical, such as the choice between developing different water sources. Or the choice could be between different tariff levels that are linked to different service levels. High, medium and low- cost scenarios would be examples of such choices. In determining the preferred investment scenario(s) it is useful to do sensitivity analyses by experimenting with key variables using the spreadsheet financial model to develop the option that is preferred by the key stakeholders. The final projections must include achievable infrastructure improvements and be affordable.

Box 7.9. Example financial projections for investments in Kampala[1]

During the dictatorship regime in Uganda in the 1970-1980 decade, the service coverage of corporatized urban water utility, the National Water & Sewerage Corporation (NWSC), suffered in two major ways: there was virtually no investment into expanding the water service coverage; and the existing infrastructure deteriorated because of poor O&M practices. Consequently, since 1986, NWSC has injected substantial investment funds into the infrastructure, using grants and loans sourced by the government from bilateral and multi-lateral financing institutions, with a loan repayment period ranging between 10 and 30 years. Since the early 1990s, the loan portfolio for the Kampala water supply service area has grown to about US$64 million.

Scrutiny of the investments carried out shows that expansion of water treatment plants was not matched by extension and rehabilitation of NWSC's water reticulation network, a situation that has resulted into low service coverage of about 40 per cent of the total population in Kampala. On top of the high level of un-accounted-for -water and low collection efficiency, the low coverage contributed to low revenue collection. Subsequently, NWSC asked for a reschedule of loan repayments as follows:

US $ 7.5 million in 2002/2003
US $ 8.3 million in 2003/2004
US $ 8.8 million in 2004/2005, leaving a principal balance of US $ 14.45 million on the historical loansAnalysis carried out shows that it is not possible to comply with this loan repayment schedule, and also be able to use internal sours to capitalize the infrastructure expansion projects that are critical for growth of NWSC. Consequently, to illustrate how to derive a 25-year strategic marketing plan for NWSC Kampala supply area, four scenarios were considered as follows:

- *Scenario 1:* Assumptions were made that the central government will take on payment of historical loans, and treat them as equity contributions. In this case, revenue collection would fully cater for operation and maintenance costs, as well as service expansion to cover 100% of the projected population by the 25th year of the project. The average tariff would be 0.67 US $ per cubic metre.
- *Scenario 2:* Assumptions were that revenue collection would cater for historical loans and service expansion to enable 100% population coverage by the 25th year of the project cycle. However, NWSC would have to negotiate for loan rescheduling for the last 10 years of the 25-year project cycle. The average tariff would be US $ 0.76 per cubic meter.
- *Scenario 3:* Assumptions were that the Central Government will take on payment of historical loans, and revenue collection would cater for service expansion to enable 100% population coverage by the 25th year of the project cycle. Kampala Area could also provide cross-subsidies of US$ 8 million in the first six years and step it up appropriately thereafter, to cater for operation and maintenance of other secondary towns under NWSC. The average tariff would be US $ 0.76 per cubic meter.
- *Scenario 4:* Revenue collection to cater for both historical loan repayment and subsidies specified in Scenario 3. The major assumption is that NWSC would negotiate for rescheduling of loan repayment to after the 15th year of the project, to enable capitalisation of service expansion in the early period of the project. The tariff would be US $ 0.78 per cubic meter.

All the above scenarios ensured that there are no cash-flow problems in the daily operations of NWSC.

1. Source: Kayaga and Sansom, 2001