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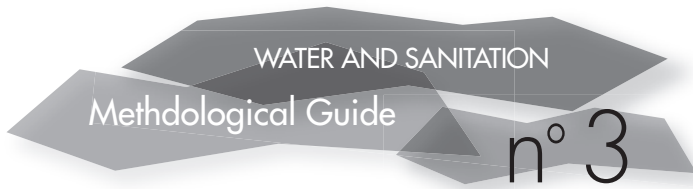
How to analyze the demand of current and future users for water and sanitation services in towns and cities in Africa

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How to analyze the demand of current and future users for water and sanitation services in towns and cities in Africa

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coordinated by the Municipal Development Partnership (MDP)
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ABBREVIATIONS AND ACRONYMS

AFD	Agence Française de Développement [French Development Agency]
AfDB	African Development Bank
CD	Census District
CMS	Concerted Municipal Strategies
CVM	Contingent Valuation Method
CWIIQ	Core Welfare Indicators Questionnaire
DHS	Demographic and Health Survey
EA	Enumeration Area
GDP	Gross Domestic Product
GIS	Geographic Information System
GPHC	General Population and Housing Census
IE	Inhabitant Equivalent
IEC	Information - Education - Communication (program)
MDG	Millennium Development Goal
MDP	Municipal Development Partnership
MICS	Multiple Indicator Cluster Survey (UNICEF)
MIS	Multiple Indicator Survey
NGO	Non-Governmental Organization
OECD	Organization for Economic Co-operation and Development
ONEA	Office National de l'Eau et de l'Assainissement (Burkina Faso) – National Office for Water & Sanitation (Burkina Faso)
PAQPUD	Programme d'Assainissement dans les Quartiers PériUrbains de Dakar Sanitation Program in Peri-Urban Neighborhoods of Dakar]
PN-AEPA	Programme National d'Approvisionnement en Eau Potable et d'Assainissement – National Program for the Supply of Drinking Water & Sanitation (Burkina Faso)]
PPS	(sample drawing) by Probability Proportional to Size
PPES	(sample drawing) by Probability Proportional to Estimated Size

Contents

PRA	Participative Rapid Appraisal
pS-EAU	Programme Solidarité Eau – Water Solidarity Program
PU	Primary Unit (in sampling)
PWSMP	Potable Water Supply Master Plan
REGIDESO	Régie de Distribution d'eau de la République Démocratique du Congo – State Department for Water Distribution in the Democratic Republic of Congo
RPS	Revealed Preference Surveys
SEEG	Société d'Eau et d'Electricité du Gabon [Gabonese Water & Electricity Company]
SPHERE	Group project of several NGOs, including the Red Cross and Red Crescent, Care, etc. (humanitarian charter and minimum standards for disaster response)
TdE	Togolaise des Eaux – Togolese Water Company
UC	Unit of Consumption
UDMP	Urban Development Master Plan
UNDP	United Nations Development Program
VIP	Ventilated Improved Pit latrine
WHO	World Health Organization
WI	Wealth Index
WTMP	Wastewater Treatment Master Plan

Introduction

Why a guide on how to analyze demand?

The main aim of any water and sanitation public service is to satisfy the demand of the population, regardless of whether they already benefit from this public service (the 'users') or not (the potential 'future users'). Demand is therefore a key issue in any water and sanitation services improvement project; one that is vital for decision-makers, planners and designers to analyze and understand.

Analyzing demand makes it possible to:

- maximize the allocation of financial resources (improve the effectiveness of any subsidies or Output-Based Aid);
- promote equity between the users of the relevant public services.

Despite its importance, however, demand analysis is often perceived as an obscure and complex

discipline, conducted by only a few specialists and for which there is insufficient information available. This guide has, therefore, been developed with two main aims in mind:

- to encourage water and sanitation service developers to undertake a demand analysis, on the one hand;
- and to provide the key concepts and tools of intervention required to carry out demand analyses that are both robust and usable, on the other.

In many small and medium sized towns, quality data is rare, or non-existent. It is for this reason that this Guide sets out a coherent approach, based on solid methodological elements, to enable an assessment to be conducted that will no doubt be of great strategic importance to the future development of the town.

Who is this Guide for?

Whilst this Guide is aimed at a wide range of people, it is nevertheless possible to identify two distinct groups:

- **Local authority members, political and administrative managers, technical service members and other local practitioners.** The

aim is to raise their awareness of an approach whereby they gain an understanding of demand and of the water and/or sanitation market. This understanding should help them to examine the current situation in more detail and to set realistic objectives for the future.

It is of secondary importance whether the local authorities are the sponsors or end users of such assessments (which are often financed by a donor): in both cases, it is vital that the managers of these authorities have a good understanding of the issue and the approach used. As a result, they will be better able to appreciate the usefulness of the approach and fully understand the implications of the results and their practical repercussions.

• **Project designers and managers, operators and contractors, state stakeholders.** Here, the aim is to propose clear and rigorous approaches that give results of satisfactory quality by drawing

on a set of data from different origins and a wide range of methods.

The Guide also aims to act as a bridge between those conducting assessments of demand for water and/or sanitation and those using these assessments (from the engineers who will use the results for investment planning to those local managers responsible for developing the water and sanitation strategy).

This publication is particularly aimed at small and medium sized towns (from 10,000 to 200,000 inhabitants), as well as cities. The guide does not, however, directly cover the issue of rural water and sanitation.

What are the objectives of this Guide?

This Guide should provide everyone with a clear idea of: all the stages and implementation methods involved in carrying out a demand assessment for water and/or sanitation services; the pros and cons of each approach and method; the key elements to be aware of at each stage and the pitfalls to be avoided, etc.

For local authority managers and, more generally, for all those managers needing to commission a demand assessment for water and/or sanitation services, the Guide should provide a better understanding of the ins and outs of such assessments, as well as enable them to act more rigorously:

• **When commissioning an assessment, this guide will enable managers to:**

– specify the objectives of the assessment, by providing the response to the question: ‘why is

an assessment of demand for water and/or sanitation services necessary?’; what is the point of a demand assessment? What can it be used for?;

– select an approach and methods, by providing the response to the question ‘how is an assessment of demand for water and/or sanitation to be conducted?’; ‘What can be done within a given timeframe and budget?’; which assessments, with which methods, what organizational set up, etc.?’;

– establish the methodology outline: survey/no survey, quantitative/qualitative, even the size of the sample to be studied, etc.;

– establish the organizational outline: expert(s) required, composition of teams, etc.;

– outline the schedule (or, at the very least, the overall timeframe for the demand assessment

What are the main steps involved in demand analysis?

- **Collecting information from all relevant stakeholders (the public authorities, economic players, households, etc.) by conducting individual or group (meetings) interviews, carrying out surveys with the various partners, etc.;**
- **Processing information by processing the data and then carrying out statistical and financial analyses using the appropriate methods;**
- **Providing the decision-makers with a proposal for a complete vision of the water and/or sanitation sector following in-depth consultation with all partners.**

and the deadlines) and develop an overall budget;

– draw up the Terms of Reference, with full knowledge of the facts.

• **For an assessment in progress, this guide will enable managers to:**

– actively participate in discussions organized as part of consultation, particularly those dealing with forward planning;

– control the execution of work carried out by internal services or by the contractor;

– check that the results meet expectations, such as those defined within the Terms of Reference.

For professionals likely to be conducting assessments of demand for water and/or sanitation services, this Guide should enable them to:

– have a common methodological platform, not only with project colleagues (when developing a Master Plan for example), but also with the ordering party (as part of Concerted Municipal Strategy¹ development, for example);

– draw up a study outline that is rigorous, operational and balanced, that corresponds to the budget and schedule imposed by the ordering party: between processing existing information and gathering new data;

– use study models and operational methods, which means producing only information that is strictly necessary for the demand assessment, in both quantity and quality², without any needless embellishment;

– get straight to the heart of the matter, by putting a proper diagnosis of the current situation in place based on observation of the actual situation in the field, and to put forward assumptions for future evolution in consultation with authority managers.

¹ See table 3, p. 27

² For example, collecting a lot of information during a survey and then not really using it is seriously counter-productive: indeed, it is a waste.

Which topics and issues are dealt with in this Guide?

Due to the wide range of people for whom this Guide is intended, an intermediate level of content has been selected to ensure there is no over-simplified or over-complicated methodology included. For those wanting simpler or more complex guidelines, this Guide is unlikely to contain the operational information required.

This Guide covers all topics that need to be addressed in an assessment of demand for water and/or sanitation services. The topics dealt with in this guide can be grouped into two categories: those topics that have their own specific chapter; those topics and sub-topics that relate to more than one theme.

Topics that have their own specific chapter

As they are clearly headed, finding these topics should be straightforward: population, urban development, access to supply, unit consumption, domestic demand, non-domestic demand and demand for sanitation.

- The objectives of a demand assessment for water and/or sanitation services

Chapter 1: The water demand assessment: What is it? What is it for? → **parts 1, 2 and 3.**

- The step-by-step methodology

This includes a short overview of what constitutes an assessment. General assessments (such as a Master Plan or CMS) are presented, as are topic-based assessments:

Chapter 1: The water demand assessment: What is it? What is it for?, → **part 4.**

- Understanding the urban context

Chapter 2: A prerequisite: understanding the urban context.

- The demand for water

The usual main topics are dealt with here in a more in-depth manner, although without entering into too much detail of the methods.

Chapter 3: The demand for water.

- The demand for sanitation

Chapter 4: The demand for sanitation

- The economic factors influencing consumer behavior

Chapter 5: Consumer behavior → **part 1:** Economic factors influencing the consumer's capacity to pay / willingness to pay for an improved service.

- The marketing factors influencing consumer behavior

Chapter 5: Consumer behavior → **part 2:** Marketing factors influencing the consumer.

- Communication of the demand assessment results

Chapter 6: Communicating and using the results → **part 1:** Communicating the results

- Using the demand assessment results

(tariff, marketing policy / social policy, communication)

Chapter 6: Communicating and using the results → **part 3:** Using the results.

Topics and sub-topics that relate to more than one theme

As these topics and sub-topics pertain to more than one theme, they are covered in different chapters. This is the case, for example, of the different survey types, the economic and financial aspects of the assessment and the communication of results. These topics are presented, in brief, below.

Quantitative surveys

• The information provided

Quantitative surveys are mentioned in several chapters as they are used to produce information on nearly all the topics involved in a water demand assessment. As a result, the contribution of quantitative surveys in the analysis of:

- access to water supply is dealt with: in the chapter on access to water;
- unit consumption: in the chapter on consumption;
- sanitation facilities: in the chapter on sanitation;
- household income and expenditure, as well as the cost of water for households: in the chapter on the capacity to pay;
- consumer behavior (past³) and expectations (future⁴): in the chapter on willingness to pay;
- expectations regarding water and/or sanitation facilities: in the chapters on access to water and the demand for sanitation.

• Organization

This point is dealt with in the 'Methodological framework' sections of Chapter 3 (The demand

³ Revealed Preference method

⁴ Contingent Valuation Method and Psychological Price method

for water) and Chapter 4 (The demand for sanitation) that set out a step-by-step methodology, schedule of operations and staff required, etc. The methodological element is most developed in the chapter on water, which contains an example of a schedule for a 'general assessment' of demand for water.

• Critical analysis of quantitative surveys

This is a very full analysis and is presented in Annex 2 under the heading: 'household surveys: for or against'. The most common arguments for and against conducting surveys are presented and examined. The main subjects are covered: objectives, budget, schedule of operations, organization and team, questionnaire, sampling procedure, data processing and communication.

Also in this annex is a survey report template, as well as a table comparing certain technical details of the survey: questionnaire size, sample size, staff required, etc.

• Sampling procedure

There is a detailed explanation on how to create a sampling procedure for quantitative surveys in Annex 3 entitled: 'The sampling procedure for a household survey'.

Qualitative surveys

Qualitative surveys (in-depth interviews and focus groups) are mentioned in several chapters that all deal with the factors that determine demand. This type of survey is most commonly used for:

- the preliminary study of a quantitative survey (reconnaissance of the terrain and identification of variables that need to be considered): mentioned in the section on the step-by-step methodology in Chapter 1, The water demand assessment: What is it? What is it for?;

- interviews with large consumers, in the sections dealing with non-domestic demand in Chapter 3 (The demand for water) and Chapter 4 (The demand for sanitation);
- in-depth study into consumer behavior and expectations (most commonly used for sanitation demand assessments): mentioned in Chapter 4, The demand for sanitation.

The economic and financial aspects of demand

- **Household income and expenditure**, and classification of households by wealth/poverty level: presented in detail in the first part of Chapter 5, which looks at the economic factors influencing consumers/capacity to pay.
- **Cost of water for households**, and where the expenditure on water fits into the family revenue: presented in detail in the first part of Chapter 5, which looks at the economic factors influencing consumers/capacity to pay.
- **Methods of analyzing consumer behavior:**
 - **Consumer behavior:** revealed preferences (past behavior), contingent valuation (expectations for the future), psychological price (future). These methods are presented in brief in the first part of Chapter 5 (economic factors/willingness to pay).
 - **Consumer profiles:** presented in detail in the second part of Chapter 5, which deals with the marketing factors influencing the consumer.
 - **Consumer satisfaction:** presented in detail in the second part of Chapter 5, which looks at the marketing factors influencing the consumer.
- **Elasticity of water consumption** in relation to revenue and in relation to the price of water:

these indicators are briefly presented in Chapter 3, in the part that deals with unit consumption.

- **Capacity to pay for an improved service (for water and/or sanitation):** this point is dealt with in the first part of Chapter 5, which looks at the economic factors influencing consumers/capacity to pay.
- **Willingness to pay for an improved service (for water and/or sanitation):** this point is discussed in the first part of Chapter 5, which deals with the economic factors influencing consumers/willingness to pay.
- **Water tariff:** this question is dealt with as such in Chapter 5, in connection with the cost of water. However, the 'social basis' of the tariff is looked at in detail in Chapter 6, in the section pertaining to using the results.
- **Marketing policy:** this is dealt with in Chapter 6, in the section on using the results.

The social aspects of demand

- **The social aspect of water** is presented in all chapters of the Guide: all the components of the demand for water (access, unit consumption, water demand, type of sanitation facility, satisfaction and expectations) can (and must) be analyzed in terms of poverty/wealth.
- **Social policy for water:** this more specific issue is dealt with, as a summary of previous analyses, in Chapter 6, in the section on using the results.

Communication of the demand assessment results

Communication of the results of the assessment: this point is dealt with in Chapter 6, in the section pertaining to using the results.





CHAPTER 1

The water demand assessment:
What is it? What is it for?

What is demand⁵ ?

Need

The concept of need refers to an objective situation, which is almost 'medico-social': how much water do people need to live? What type of sanitation service do they need in order to live in decent sanitary conditions? However, it also includes a large part that is subjective as, over and above the poverty threshold and the idea of 'basic needs'⁶ (the definition of which is often open to interpretation), there is a level of well-being that the government wishes to see the population attain.

The needs estimate does not take into account either the technical circumstances specific to the production system of the asset under consideration or its related financial aspects.

Demand

The concept of demand refers to need, but results from an expression of willingness by the population to cover its own needs. The population's expression of need is inevitably subjective as each population has its own priorities in terms of both consumption and solvency (budget priorities).

⁵ The different types of demand are presented in Annex 1.

⁶ On 28 July 2010, the United Nations General Assembly adopted a resolution recognising "the right to safe and clean drinking water and sanitation as a human right that is essential for the full enjoyment of life and all human rights".

Demand can be expressed in many different ways depending on the asset concerned and the circumstances (the main definitions are given in Annex 1). When considering only the 'solvable demand', then the estimation of demand takes into account both the technical circumstances specific to the production system of the asset under consideration and its related financial aspects.

In practice, a true evaluation of demand (conducted using best practice) is carried out based on the results of specific studies aimed at analyzing this particular aspect of household consumption: classic statistical surveys and sometimes even surveys that are far more in-depth: contingent valuation, participative approach, etc.

Consumption

The concept of consumption implicitly refers to all aforementioned concepts by attempting to reconcile both the consumers' wishes (demand expressed as part of perceived solvency for covering essential needs and even for satisfying those that are less essential) and the producers' and distributors' constraints (technical and financial aspects).

In this respect, consumption results from a resolutely realistic approach (taking certain constraints of the offer into account), but also one that is somewhat optimistic as it prioritizes the consumers' preferences and it is these that should then direct the choice of producers. It is clear,

however, that there is no totally 'objective' approach to consumption.

The example of health is caricatural: on the one hand, in Africa, health needs are very important and often not satisfied despite a clearly high demand; and on the other hand, there are a

high number of unemployed (trained) doctors. The reason for this is the low solvency levels of the population who has the need and the desire to meet this need, yet is unable to meet the associated expense.

What 'water' should be assessed?

Water for all types of use...

A demand assessment for water needs to consider all types of water used and demanded by both domestic and non-domestic consumers, whatever its origin (or source of supply), whatever its quality and whatever its subsequent use. The assessment, therefore, concerns the following 4 categories of water (some of which have common characteristics):

- **Potable water:** water that is clean for human consumption. For this to be the case, it needs to meet quality standards. Drinking water standards⁷ are usually defined in national legislation. Water distributed by a public network, managed by a public organization or private operator (conducting their activity within a delegation of public service framework) should, in principle, be potable (as stated in the national legislation).

- **Non-potable water:** water that does not satisfy the standards for drinking water (for human consumption).

- **Raw water:** water that has not undergone any treatment and that can supply a drinking water production plant or be delivered in its raw state to a (large) consumer as part of a (whole) sale, often at a discounted rate.

Included in this category is untreated water delivered directly, without treatment, for use in urban agricultural activities or for street cleaning.

- **Water produced (and/or distributed) by other sources of water supply** than those of the water company (individual connections, public standpipes or similar): household wells, private boreholes, extraction or use of water from rivers, lakes, ponds, water purchased from water sellers not supplied by the water company, etc.

⁷ The standards most commonly concern the following characteristics:

- Organoleptic qualities: transparency (/turbidity), color, odor, taste;
- Physico-chemical parameters: pH, temperature, concentration of minerals, conductivity, etc.;
- The presence of undesirable substances: nitrates, nitrites, fluorine, pesticides and related products, etc.;
- The presence of toxic substances: arsenic, cadmium, lead, chrome, hydrocarbons, etc.;
- Microbiological parameters: does not contain harmful bacteria (coliforms, streptococci, etc.).

It is, of course, also necessary to consider water used for washing laundry when this activity is conducted outside the home (often at the river), as this consumption will gradually be displaced into the home once households are connected to the water supply by individual (or shared) connection.

Wastewater

An assessment of sanitation needs to consider all types of wastewater or 'soiled' or 'dirty' water that is discharged into the natural environment in any way. 'Wastewater' is water that has been used for whatever reason; it can correspond to very different types:

- **Domestic wastewater:** this is household water and water from the WC.
 - **Household water, also called 'greywater':** this is water generated by activities such as laundry washing, personal hygiene (bathing), cooking (food preparation, washing up of utensils) and housework (washing floors).
 - **Toilet water, also called 'blackwater':** this is water used exclusively for the evacuation of excreta, i.e. urine and human fecal matter, including the materials used for personal hygiene (paper, water).
- **Non-domestic wastewater:** this is water generated by non-domestic activities, particularly

agriculture and industry, but also administrative activities (schools, hospitals, military and police camps, prisons, administrations, etc.). This water needs to be included in 'wastewater treatment' assessments, which include both domestic and non-domestic water.

- **Rainwater:** this is water from surface run-off which collects elements as it passes over an impermeable surface (house roof, ground, etc.).

Rainwater is often not included in 'wastewater treatment assessments' unless specifically requested. It is for this reason that this subject is not dealt with in this Guide.

Product or service?

Whether it be water or sanitation, it is not the product that is assessed but the service as a whole; this means taking all technical, financial and even social aspects into account:

- **Water:** quality of the product (potability), quality of distribution (sources of supply, shut-offs, pressure), financial aspects (any connection cost and means of funding, water tariff and billing frequency).
- **Sanitation:** facilities, maintenance services (for pit emptying, for example), financial aspects (cost of the works and means of funding, amount of any possible remittance for a sewerage system).

Various ways of approaching demand

The wide range of expressions used in relation to the demand for water and/or sanitation reflects the various different perceptions of the concept of demand/demand assessment/estimation of demand/analysis of demand. Misunderstandings often arise out of confusion over vocabulary (the same words can mean different things to different people); this does not concern the approach as much as the final publication of the study and the expectations of those for whom the study is intended.

The professionals who undertake these studies and analyses each often have quite different visions, objectives and practices⁸.

Interpretations of the concept of demand

For water demand assessments, there are wide variations in professionals' interpretation of demand: these differences stem from the fact that the various professionals tend to favor one aspect of demand over another.

In contrast, for sanitation, this difference is less pronounced as, in most cases, the issue is not the volume of waste but more the type of facilities to offer to households. Emphasis is given to researching those systems that are technically and financially suited to consumer expectations.

⁸ This analysis is detailed in: *Optimising the selection of demand assessment techniques for water supply and sanitation projects (Project/Task No: 207)* - Final Report - WELL / Sarah Parry-Jones, October 1999

For planning and sizing the structures

Identifying the quantities of water necessary to supply the population with satisfactory volumes is often the prerogative of engineers, who focus on identifying consumer profiles and estimating future demand in order to adapt the system to this new situation (investment for development, operation and maintenance). For engineers, water demand is first and foremost the flow in m³ of a certain quality⁹ that will feed into sizing models; qualitative requirements are secondary.

Engineers tend to favor classic statistical analyses: classic household surveys (still costly) that enable analysis of 'revealed preferences', but also the analysis of client documentation and other quantitative field observations.

For analyzing the issue of the water company's financial stability

Estimating the capacity and willingness to pay for water and/or sanitation (connection and/or consumption) based on different levels of service is often the role of economists or socio-economists. Their priority is assessing economic and financial data, both of households (for example, income and expenditure), and also that of the water company (notably subsidies, revenue received from water, etc.).

As far as survey methods are concerned, economists prefer to use 'revealed preference' and/or

⁹ Responding to specific technical and sanitary standards.

'contingent valuation' type methods (which are costly and need careful handling).

As for econometric modeling, which presents consumer behavior in the form of equations and that sometimes claims to be predictive, this may be of use in certain projects but is often very difficult for the layman to understand.

For identifying consumer practices and expectations

The most social approach, based on dealing with the poverty issue and identifying target

groups to benefit from specific activities, is often undertaken by sociologists and related professionals who seek out data on the needs and priorities of different groups, their knowledge, attitudes and practices.

The sociologist best understands the qualitative survey methods: participative methods (implemented in the community), in-depth individual interviews, community meetings, focus groups, etc.

For the sociologist, a 'water demand assessment' is an analysis of the whys and wherefores of the issue. As such, the result is not only expressed in m³.

TABLE 1. The different interpretations of the concept of demand

	SCIENTIFIC INTERPRETATION	ECONOMIC INTERPRETATION	SOCIO-POLITICAL AND CULTURAL
Representation of demand	Quantities of water required to supply a given population	Consumers' willingness to pay for a given service	Expression of a need or right to ensure social fairness
Operational goals	Optimize the sizing of the works to supply water in sufficient quantities in compliance with imposed technical and health standards (reliability, continuity of supply, etc.)	Optimize the definition of the commercial offer for services with consumers (cost of a hook-up, billing rates)	Improve the living conditions of disadvantaged populations and encourage greater participation on their part in making decisions concerning service management
Measurement focus	Technical data recorded at the installations, consumption levels and requests for future improvements in operation of the service (management, maintenance)	Economic and financial data: household incomes and expenditure, willingness to pay for the various levels of service, desired level of subsidy, etc.	Identify the priority needs of the various social groups, identify present and potential conflicts among consumer categories or groups, identify cultural practices and beliefs, normative values
Measurement tools	Generally accepted estimates based on standards for supply; assumptions based on the most feasible option: Revealed Preference Surveys (RPS)	Contingent Valuation Method (CVM): Revealed Preference Surveys (RPS)	Participatory Rapid Appraisals (PRA); community meetings and focus groups

Source: *Water, sanitation and sustainable development - The challenge of cities in developing countries - UNESCO, Veolia Water, pS-Eau, 2004*

A common platform: one approach, four principles

It is not a question of one method being better than another, but rather of reasoning in terms of results: which method is the most effective for a given objective? The answer to this question varies according to the assessment type: Master Plan, CMS study, topic-based assessment, etc. At the same time, however, it is always preferable to have a multi-disciplinary methodological approach to the assessment of demand for water and/or sanitation services. To work properly, a simple approach needs to be adopted and four principles applied.

One approach

Regardless of the assessment type and its objectives, the approach is the same. It consists of:

- **Specifying the objectives** by answering the questions: what information and data is to be collected? how will this information be used?
- **Defining the methods** to be used, assembled in a coherent methodology within a limited budget and fixed schedule: methods of data collection; methods of analysis; results communication strategy; etc.
- **Specifying the organizational system** that is to be put in place: required competencies; necessary budget; schedule of operations.

This approach is repetitious: with budget resources and time being limited, it is necessary to establish priorities, modify the objectives and adapt the methodology until a satisfactory level of coherence is obtained.

The above elements need to be assembled in a Methodological Note of around ten pages that

clearly and succinctly provides the outline and scope of the work to be carried out.

Four principles

① Understand the context:

- **the town:** its history, current economic and social issues;
- **the service's stakeholders:** the stakeholders within the water service (the water company), institutional stakeholders (local, and even national, public authorities);
- **the water demand stakeholders** (the population and economic and administrative activities): demand for the service is often very high; even if the social aspect is a large constraint, there is still huge consumption potential.

② **Adhere to the reality of the situation in the field:** the end goal is to satisfy the needs of the population, not only as a consumer group but also as a community.

③ **Adopt a multi-disciplinary approach** that integrates different methods into a coherent whole¹⁰, that is realistic (as near to the reality in the field as possible) and effective (in that it produces the anticipated results, within the given timeframe and within budget).

④ **Work from several sources** by carefully checking the quality of the data to manage uncertainty over the data used (existing and/or produced specifically for the requirements of the demand assessment). It is rare to find a source that does not contain some information that can be used.

¹⁰ At the end of assessment, any potential contradictions between data and results must be explained so that the person responsible for the assessment can retain the 'correct figure'.

By comparing¹¹ data of different origin, it is possible to test the robustness of the estimate, conduct a more in-depth analysis, look for explanations,

make better informed choices and to feel one's way (by frequently multiplying the calculations by iteration).

The different types of demand assessment

Two broad categories of assessment have been distinguished to provide greater clarity:

- **The general assessments** that cover the whole area (the town or even the country in the case of national tariff assessments, for example) and which, given the size of the area covered, can never be particularly detailed;
- **The topic-based assessments** which generally look at a more limited area but for which analyses are conducted in more detail and are more in-depth.

General assessments

Objectives

In general, the objective of a classic water demand assessment is to describe the current situation of the 'water and/or sanitation market' and to sketch the outline of its future development (in conjunction with local decision-makers). In practical terms, in a classic assessment it is necessary to:

- **Define the framework:**
 - within a certain perimeter, broken down into small geographical areas (or neighborhoods);
 - within a set timeframe; most often this is a timeframe of 20 years, or 30 for sewerage system projects. This involves: 1) calculating present consumption and demand, which are rarely known with any precision; 2) carrying out a short and medium term forecast.
- **Analyze the 4 main system components:**
 - *access to water*: number of connections and current and future number of standpipes, the households and people supplied by these facilities;
 - *the volume of m³* of drinking water most likely consumed;
 - *the capacity of (current and potential) consumers to pay* 'for an improved service' and their willingness to pay for this water, given that: households and non-domestic consumers are generally not all currently supplied with drinking water; the quality of the water service is far from satisfactory for all; the financial resources of a number of consumers are limited; the municipal and/or national authority has limited capacity to invest in water and sanitation to expand the activity and improve the service quality.
 - *the social aspect of drinking water distribution*: it is necessary to aim for 'consumer satisfaction' regardless of

¹¹ For example, household surveys and water company statistics.

the consumers' socio-economic profile. As such, the social part of the assessment needs to avoid introducing socially and economically unacceptable imbalances that make assumptions as to the financial stability of the program and the way in which the water company operates.

The practical use of a general water demand assessment

The majority of so-called 'water demand' assessments are carried out within the framework of:

- Potable Water Supply Master Plans (PWSMP), Wastewater Treatment Master Plans (WWTMP);
- Concerted Municipal Strategies (CMS);
- Identification studies;
- Feasibility studies;
- Pricing/financial studies.

TABLE 2. Specifications framework for the development of a Potable Water Supply Master Plan

<p>Phase 1. Collect, analyze and summarize existing data</p> <p><i>Objective: provide a representation that is as complete and reliable as possible of the operating conditions of the existing service, particularly:</i></p> <ul style="list-style-type: none"> – General overview of the local authority responsible for managing the drinking water service – Pumping and supply points – Supply distribution – Analysis of service operation: current consumption, analysis of current operation – Security, contingency plan, emergency plan – Phase 1 conclusions <p>Phase 2. Future needs and suitability of current infrastructure</p> <p><i>Objective: for a local authority, evaluate the evolution of needs, both on average and at drinking water supply points, and assess how this evolution will be spread across the main distribution sectors.</i></p> <ul style="list-style-type: none"> – Determine future needs – Capacity of existing infrastructure and gap analysis – Options for evolution of needs aligned to current infrastructure 	<p>Phase 3. Study potential resources</p> <p><i>Objective: evaluate those water resources able to be mobilized, taking into consideration possible water savings and the impact of their exploitation on the environment, including during critical periods (drought, etc.)</i></p> <ul style="list-style-type: none"> – Planning drinking water savings – Increase of existing pumping levels – Interconnection – New resources <p>Phase 4. Plan for drinking water supply</p> <p><i>Objectives:</i></p> <ul style="list-style-type: none"> – Propose and compare scenarios to overcome current and future shortcomings – Propose resource security in terms of health protection and diversity – Study the agreed scenario: propose scenarios; precise study of agreed scenario and conclusions <p style="text-align: right;"><i>Source: Specifications framework for the development of a Potable Water Supply Master Plan</i></p>
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TABLE 3. The framework of a CMS Study

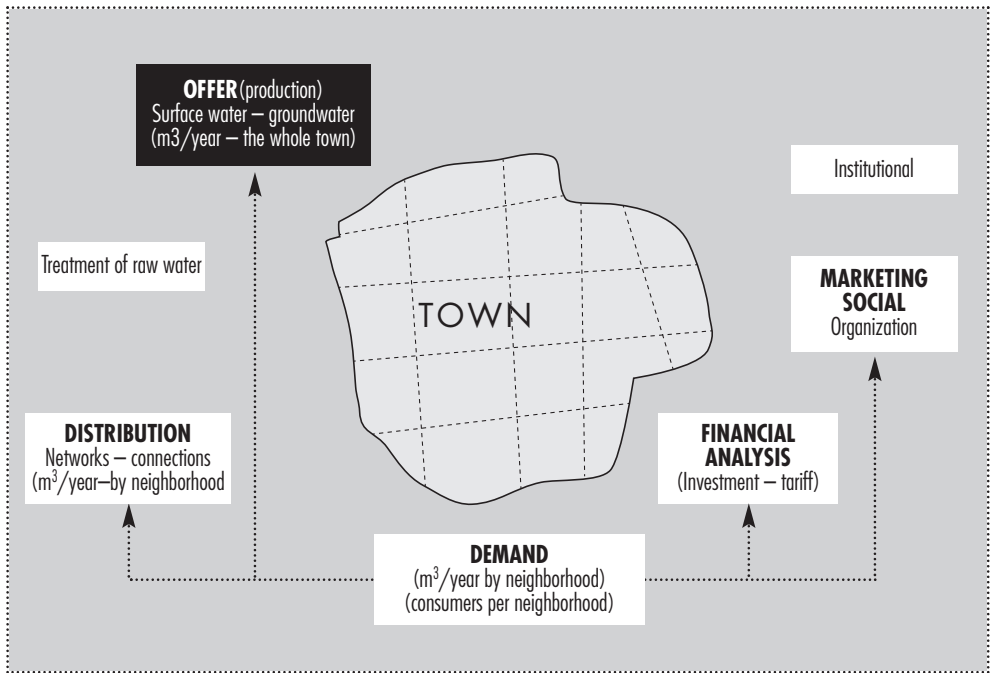
THE STRATEGIC PROCESS	MAIN STAGES OF STRATEGY DEVELOPMENT
<ul style="list-style-type: none"> • Strategy: document providing guidance and the overall vision of drinking water and sanitation services • Concerted: stems from listening to all and facilitates coordination of everyone's efforts • Intervention: leads to immediately feasible actions that enables visible and rapid improvements in access to water and sanitation • At municipal level: clarifies a common vision for the whole area covered by the town 	<ol style="list-style-type: none"> 1. Concerted and detailed diagnostic, technical diagnostic and 'stakeholder' diagnostic 2. Presentation of findings and discussion of diagnostic 3. Concerted research to find solutions on the agreed topics 4. Presentation of findings and discussion of solutions and their respective priorities 5. Development of final documents for the concerted municipal strategy
MAIN STAGES OF THE DIAGNOSTIC (PHASE 1)	
WATER	SANITATION
<ol style="list-style-type: none"> 1. Have both an overall view and view by neighborhood of the: <ul style="list-style-type: none"> - Water resources - Infrastructure, network and domestic - Actual means of access to water - Household practices - Programs and existing forms of innovation 2. Establish who the demand stakeholders are 3. Establish who the offer stakeholders are 4. Ensure expert topic-based analyses are conducted 5. Provide current rates of access to water using the agreed calculation method 	<ol style="list-style-type: none"> 1. Have both an overall view and view by neighborhood of the: <ul style="list-style-type: none"> - Inhabitants' practices - The situation of shared establishments - Economic activities' practices - Programs and existing forms of innovation 2. Establish who the demand stakeholders are 3. Establish who the offer stakeholders are 4. Ensure expert topic-based analyses are conducted 5. Provide current rates of access to sanitation using the agreed calculation method

Source: SMC-PDM-pS-Eau - Note n° 1: Repères méthodologiques d'ensemble, et pour la phase de diagnostic - Atelier de Cotonou, 17-21 February 2009

The framework of these assessments is one of long-term general planning; one in which the part dealing with forecasts plays a major role in defining future investment programs over a 20 to 30 year period. However, not all of these assessments need to consider the same amount of geographical detail (independent of any breakdown by socio-economic level, or by type of housing, or by sources of water supply or by means of sanitation):

- for the modeling of a distribution network, the more refined the breakdown of demand data by small geographical area the better (although socio-economic criteria are not really considered). For resource modeling, a more general approach will suffice.
- for pricing studies, and often for studies into consumer satisfaction and other marketing assessments, the issues lie at town level. In contrast, data on the type of consumer (connected/not

FIGURE 1. Assessment of demand for water within the framework of a Potable Water Supply Master Plan



connected to the network, but also poor/other, etc.) needs to be very detailed.

- **studies to define the national investment program** for the water and/or sanitation sector, or reviews of the tariffs charged by the national water company, go beyond the scope of one single town: they cover all towns within the country, or a certain number of towns as specified by the ordering party of the study. In this case, the assessment is more difficult to organize as, in general, this involves studying a representative sample of the urban environment, which means working over a geographically wide area.

In practical terms, a general water demand assessment is indispensable:

- **for identifying the resource required:** the hydraulics engineer needs the demand figure¹² to work out the raw water requirements for the town (groundwater and surface water) to ascertain the volume needed to satisfy demand and to calculate the investment required;
- **for sizing the raw water treatment plant(s)** and the wastewater treatment plant(s);
- **for planning the network:** the hydraulics engineer needs this data for aligning his water distribution model to each water distribution network hub, for sizing his networks and for calculating the investment required to meet demand over the forecasting period;

¹² Including losses (on the public network).

- for specifying the sources of water supply and types of sanitation facilities most adapted to consumer expectations, giving maximum consideration to the need for financial stability of the system;

- to develop and conduct a true marketing policy:

- define the actions to be undertaken with consumers to increase their satisfaction and, notably, to define the most anticipated service improvements;

- define a specific social strategy, adapted to the poorest households: what facilities, at what price, with which means of cost recovery, etc.

- to adjust the tariff:

- it is not possible to create a business plan without knowledge of the demand for water and its characteristics: domestic demand (individual connections, shared distribution points, stand-pipes), non-domestic demand by activity sector.

The turnover of the water company directly depends on the volumes of water consumed, billed and paid for, as well as the tariff, which can itself be deducted from these volumes, and the associated costs (operation, investment).

- there can be no economically stable and socially adapted tariff without a sound assessment of the consumers' financial capacities, which enables inclusion of the poverty aspect.

Conclusion

General strategy, in space and in time

Such assessments aim to facilitate the creation of a general strategy for the water and sanitation service offer (in terms of volumes, quality, availability and price, etc.) that is adapted to the economic and social reality of the town concerned. These studies are, therefore, generic. They deal with:

- the entire perimeter of the town;

- all of the population: rich and poor, regardless of the neighborhood (but distinguishing between them as part of segmentation);

- all consumers: current and potential, domestic (households) and non-domestic (industries, businesses and services, administrations, etc.);

- all types of service;

- the current situation, but also that over the next 20 years.

Most of these studies make use of the assessment methods covered in this Guide, although some more than others. Lastly, in order to be useful and used, they should be based on as wide a consultation approach as possible, not only with those professionals involved in the sector (engineers, financial managers, sales teams, etc.), but also with the town's decision-makers.

Strengths and weaknesses of general assessments

- **Master Plans** are usually long operations (they take over a year to complete) and very costly (especially where there is work to be carried out). The most frequent criticism aimed at these assessments doesn't concern the technical quality

(which is high) but rather lack of consultation with partners (local authorities and services, civil society, etc.). As result, there is an insufficient sense of ownership of these master plans, resulting in a large number of recommendations going unheeded.

- **The CMS approach** stems from this observation: emphasis is placed on consultation with all local partners¹³. As with master plans, the CMS objectives cover the entire field: access to supply, service quality, institutional (the stakeholders and the governance of the water sector). Here, the main criticism does not concern the consultation process, which is at the heart of this approach and its success, but rather the technical quality of the assessments (which is more cursory) and the shorter term vision.

Topic-based assessments

In this type of study, the expression ‘water demand assessment’ has a more limited, and indeed changes, meaning: it is not the overall market that is studied, by qualifying and, more specifically, quantifying this, but a part of this market (often more limited in space and in population) that is to be qualified.

¹³ For example, the ‘gender-based approach’ is an important part of the consultation process: “women have a contribution to make, all the more so as this involves leading a consultation on topics linked to the private sphere [...] It involves finding suitable methods of passing on their demands and messages”.

Which assessments?

There are various assessments included in this category; some are very operational, whilst others are predominantly concerned with research:

- marketing studies: overall strategy or a strategy that is more targeted towards a particular market segment;
- social policy for water and/or sanitation;
- satisfaction studies, aimed at setting (immediate) priorities aligned to consumer expectations;
- studies to determine demand, to carry out in-depth analyses of consumer behavior and their expectations (notably by testing different service offers);
- studies to locate connections or standpipes, or public latrines (to be installed), aligned to the demand of the population;
- comparative studies into the service offered by the public provider and by small private competitors; etc.

The factors that determine demand

- **Twenty years ago**, in most developing countries, water companies were poorly operated and did not provide the social services expected. An assumption was put forward to explain this endemic disease: these companies failed because they did not give enough consideration to consumer expectations (whether these were expressed or not).

Since then, a large number of ‘water demand assessment’ studies have been carried out (under the auspices of the Water Research Team of the World Bank, but also the AFD) to test this assumption. Their objectives were to try to specify how households choose their supply

source, to establish how this affects their consumption levels, and lastly to ascertain what they expect from an improved service. These studies thus aimed to specify the factors that determine the demand for an improved service.

The scope of these studies most often focused on the poorest parts of the population; those who lived in outlying neighborhoods with no individual connections to the public network and who suffered from reduced financial circumstances. One example of this is the study conducted under the auspices of pS-Eau on the low income populations of peri-urban areas of small towns¹⁴. The demand of those households studied most often concerned “distribution services via shared water points, the factors determining the choice and source of supply, as well as the individual users of these water points and their determining factors”.

- **Today**, the focus of these assessments on certain favored topics has given rise to more specialized studies, which border on research and so are a lot less generic. The range of this type of study is therefore more limited than that of general assessments, but the analyses are often more detailed, more extensive and more in-depth.

In conclusion, these studies:

- are not concerned with calculating the demand for water, i.e. calculating the number of m³ that will be consumed in any given year.

However, in the majority of cases, they consider unit consumption to be an important indicator;

- rarely aim to cover the whole area of a town, or all the communities that make up the town’s population. However, they can integrate control groups into those population groups being observed in order to compare the population studied and the ‘normal’ population.

Small scale assessments (geographical, social, etc.)

It may well be that a project to improve water and/or sanitation services is concentrated on a small geographical area: a small urban area, a neighborhood, or a group of neighborhoods (certain well-defined outlying neighborhoods, for example), generally lacking basic infrastructure. There is often a limited budget in place for the assessment. When this is the case, what can be done to ensure there is a minimum of information available with regard to the demand?

Deciding not to conduct an assessment at all is not the best solution. Working only from standards (national or international) is also not particularly satisfactory (even though these standards will come in useful over the course of a short assessment).

It is possible to carry out a small-scale assessment with an adapted methodology; this is relatively inexpensive as it brings together all the various protagonists from within the project area (managers but also the population) as part of an approach based on organized consultation.

¹⁴ The study referred to is: Alain Morel à l’Huissier, Bernard Collignon, Janique Etienne, Serge Rey, *Analyse des paramètres économiques de la distribution d’eau pour les populations à faibles revenus des quartiers périurbains et des petits centres en Afrique - Programme d’alimentation en eau potable dans les quartiers périurbains et les petits centres*, Action de recherche N°3) - CERGRENE, March 1998.

Use and limitations of topic-based assessments

Use

• **Test for changes:** the fact that the aim of many of these assessments and research studies is to conduct in-depth testing of different systems with households (or rather, some households) based on appropriate methods is undoubtedly one of their most useful aspects. It is possible to test:

– the institutional framework for the supply of water and/or sanitation services: small private operators versus large corporations (municipal, national or multinational), for example;

– one type of improved service versus another: source of water supply and/or means of sanitation;

– the price of a connection (with credit options, if appropriate) linked to the service type;

– the price of water and/or sanitation and the billing frequency; etc.

• **Devising innovative systems:** the results of some of these studies and research can also be used to devise new ways of financing connections (OBA¹⁴ assessments, for example), and new technologies (for sanitation), etc.

Limitations

One of the limitations of a number of these assessments is that their operational use is sometimes restricted: as they often only cover a small geographical area, their results are rarely applicable elsewhere. Furthermore, they are not predictive and rarely look to the future¹⁵, whereas the decision-maker/investor would expect to find some prospective ideas.

Moreover, it is not always easy to slot these assessments into the vast array of existing studies (notably those carried out by the Office for National Statis-

tics). Very often, the definitions and terminology used are different: activity, occupation, socio-professional category, source of water supply, means of sanitation, etc. In the same way, some methodologies, which would enable interesting comparisons to be drawn, are not systematically requested.

A necessity: create synergy

Rather than placing general assessments in competition with topic-based assessments, it is better to establish how they can complement each other. Their roles are very different:

• **the topic-based assessments** prioritize in-depth analyses (attitudes, motivations, decision-making processes, etc.) and causal analyses (preferences). They enable understanding and formulation of the assumptions to be verified. In a way, they can be considered as preparatory studies for general assessments, as the aim of the latter is more to quantify the phenomena than qualify them;

• **the general assessments** overall provide a more descriptive approach for immediate use, notably by all the town's water and sanitation professionals (engineers, financial managers,

¹⁵ Output Based Aid: this approach involves delegating service provision to the private sector or to NGOs, based on a contract that no longer links the payment of public aid to means (investment to be made to offer services, such as access to water supply in one area), but to results (services actually carried out, such as the number of connections realized). This is program aid rather than project aid: the donor no longer identifies or evaluates projects, but rather the processes involved in allocating, paying out, using and managing the aid within the framework of a general sector policy.

¹⁶ Some studies have occasionally improperly attributed a predictive character to their results.

sales teams, administrators). However, by quantifying the qualitative observed elsewhere, they also enable identification of the specific directions that any future water company marketing policy should take.

By linking them closely, these two assessment types are useful for creating vital synergies.

The baseline indicators

There are many different assessments available aimed at analyzing the demand for water and/or sanitation services. Regardless of whether the implementation methods for assessing demand are simple or sophisticated, all these studies need to be based on a minimum of information, without which it is very difficult to give strategic consideration to water and sanitation. The list of **essential indicators** given below forms part of this minimum information requirement.

TABLE 4. The baseline indicators

	WATER	SANITATION
All assessments		
1. Supply / Access	X	X
2. Unit consumption for water (domestic)	X	
3. Household income	X	X
4. Household expenditure for* . . .	X	X
5. Part of family income dedicated to * . . .	X	X
6. Households' capacity to pay * . . .	X	X
7. Households' willingness to pay * (domestic)	X	X
Assessments aimed at quantifying water volumes		
1. Domestic: demand / discharge	Demand	Discharge
2. Non-domestic: demand / discharge	Demand	Discharge
Pricing studies		
1. Non-domestic: expenditure on water consumption / disposal	X	X
2. Non-domestic: part of turnover dedicated to . . .	X	X
3. Non-domestic: willingness to pay for . . .	X	X
(*) Often concerns both water and sanitation (with no distinction made between the two).		





CHAPTER 2

A prerequisite:
understanding
the urban context

The population

$$\text{Domestic demand for water} = \text{Total Population} \times \text{Access (source of water supply)} \times \text{Unit consumption (Per source of water supply)}$$

The population is the primary component of the demand for domestic water. Taking this population into account can actually be more difficult than it seems if there is no recent and reliable data available on the subject – which is the case in numerous African countries – and also because the demand for water often has to be calculated by neighborhood.

Therefore, it is not only necessary to calculate the town's total population (demographic approach) but also to break this down by neighborhood (urban planning approach based on a thorough understanding of the neighborhoods' boundaries as well as the urban perimeter).

The sum for the demand for water above shows that population data constitutes one of the 3 elements required for the calculation.

For the demand for water, the aim is to obtain reliable population figures: both current and forecast over the timeframe of the project.

In order to establish the population figure, a review of the current situation first needs to be carried out (in terms of historical structure and evolution) and then a forecast needs to be made (based on the current structure and by making assumptions as to any future growth).

In general, conducting a water or sanitation demand assessment should include a visit to the

Office for National Statistics¹⁷ in order to bring together all existing data and then proceed with a detailed examination of the data available, whether this be: historical or current data, but also recent population forecasts; published or unpublished data.

The initial situation

Structure of the population

What data to look for?

In order to gain a better understanding of the population, it is necessary to find the answers to 3 questions:

- **How many people are there and where are they?** This means ascertaining the number per geographical area or neighborhood. This data enables population density to be analyzed, for urban (neighborhood development) as for rural (pressure on land for agriculture and livestock breeding) areas.
- **Who are they?** This means having an understanding of the main socio-demographic charac-

¹⁷ General Directorate or Regional Directorate

teristics of the households, the population and the housing. If possible, this information should be broken down by geographical area to support the abovementioned analysis of the numbers. Some of the usual variables considered are: migratory status, level of education, economic activity (type of activity, occupation, etc.), and even income (if the data is available). For housing, the characteristics of the dwelling need to be carefully analyzed: type and condition of housing, source of water supply, type of sanitation, main facilities and equipment.

• **How are they organized?** In other words, what different social groups make up the community's population and what are the main differences between communities: land ownership, organization of production, etc.

Information sources

There are numerous sources of information to be consulted:

- first and foremost, **the latest General Population and Housing Census**, as this is the only really comprehensive source of statistics. This data is to be obtained from the Office for National Statistics;
- **the latest National Agricultural Census**;
- **recently conducted Household surveys**: Household Budget/Consumption survey; Poverty Monitoring survey; Multiple Indicator Surveys (MIS); Demographic and Health Surveys (DHS); etc.
- then, any socio-economic studies that have been conducted in the town itself or in the region or given geographical area(s) by study or local development organizations, such as an NGO or private company, or a research body (in the socio-medical domain, for example).

Unfortunately, the majority of national surveys won't have included the name of the town studied in their sample. This is why it is often necessary to make estimations. All the data needs to be made coherent and then summarized. If possible, i.e. where the data exists, the summary should include not only the town in its entirety, but also the town's main geographical areas.

Population growth

Population growth is studied on two levels:

- net growth: if possible, an attempt should be made to differentiate between geographical areas based on the intensity of population growth;
- the factors that influence population growth: meaning that natural growth (fecundity/birth, mortality) and migratory growth are both analyzed from the available data; it is possible to provide an estimate of these figures if necessary.

Aspects linked to the health of the population (morbidity, mortality) are looked at in an attempt to verify whether certain 'waterborne diseases' are more present than in other areas; large public health programs usually deal with this issue.

Here again, there are multiple information sources. A summary of the data needs to be made. This not only enables those factors influencing growth to be specified, but also provides a more detailed picture of the sanitation situation within the town and the level reached through demographic transition (mainly viewed in terms of the decline in fecundity rates).

Population forecasts

Principles

The population forecast method should be based on a threefold approach:

- **Demographic**, including demographic 'inertia'; this means the continuation of demographic transition as a result of fecundity rates continuing to fall and increased life expectancy.
- **Economic**, considering the extent to which the hoped for investment will materialize. For example, if a large part of the investment is made in regions other than that of the town and/or in other towns, there is a risk that migratory flows may be redirected towards these new employment centers.
- **Urban**, integrating the urban policy for future land use. In addition, through housing programs (public or private) and corresponding legislation, the public authorities can influence the way in which the people settle in the town. Lastly, the authorities can better focus their infrastructure programs, such as that for urban transport.

In fact, the economic growth and urban development of the town and its region both need to be examined and taken into consideration when selecting assumptions on factors influencing population growth.

Forecasting methods

If possible, which means if adequate data is available, the building-block approach should be used to calculate forecasts, in preference to extrapolating the net growth rates from the batch.

The building-block approach

To use this method, a complete set of data is required: on fecundity, mortality and migration rates. The method consists of applying the data to the population structure by population gender and age (groups of five years) from the forecast start date, then proposing evolution models to ascertain the population for a given year. This work can be carried out with the help of specialized software such as Demproj/Spectrum (a copy of which can be downloaded free from the Internet).

This approach is reserved more for demography specialists, as handling the concept and data is not simple. The baseline data is often found in the population census (organized by gender and age); the fecundity rate data is often contained in the latest DHS; as for mortality rates, it is usually necessary to make do with the under-five mortality rate¹⁸ (provided in the latest DHS) which enables selection of a model¹⁹. As far as migration is concerned, there is rarely any information on this; choices are made following discussion with the urban planner.

Using a population growth formula

– *Geometric growth*. This is valid for large towns which have been populated for a long time. Past

¹⁸ Infant mortality is defined as the number of deaths before the first birthday (0 years). Child mortality corresponds to the period covering the four subsequent years (1-4 years). The under-five mortality rate covers the two previous periods, i.e. the first 5 years of life (0-4 years).

¹⁹ When several DHS have been conducted in the country, it is possible to trace the historical evolution of fecundity and under-five mortality rates; this information is used to define models for future evolution. For mortality, if there is no complete table of mortality rates available, it is necessary to refer to a model that corresponds to the evolution of the under-five mortality rate.

growth over a given period is carried over by applying the average growth rate of this preceding period (of the same duration) to the current population figures.

➔ **For example**, if the population has grown by 40% over the last 20 years, a rate of 40% is applied to the current population figures to ascertain the population figures for 20 years time.

– *Exponential growth*. This is suitable for towns that are growing very quickly. The average annual growth rate observed over a period in the past (often the latest data available) is used; it is assumed that population growth will continue at the same pace:

$$P_t = P_0 \times (1 + r)^t$$

where:

P_0 is the starting population

P_t is the forecast population, in time t

r is the average annual growth rate

t is the length of the forecasting period (in years)

Attention: Using this classic formula implicitly assumes exponential evolution of the population. For a town whose boundaries are fixed, such growth over a long period is highly unlikely due to the limited space available. In contrast, however, such growth is possible for a built-up area whose outer limits (to be considered in assessments of demand for water and/or sanitation) have been extended over the years.

– *Logistic growth*. This is suitable for towns whose growth will continue to stagnate, after once having been high then experiencing an appreciable slowdown. Here, the increase in population over time (t) is compared to the increase required to reach saturation point. The minimum (MIN) population size is defined, as is its saturation size

(MAX), then the points observed are adjusted using the function:

$$\text{Log} \frac{P_t - \text{MIN}}{\text{MAX} - P_t} = a + bx$$

where: x is time

The final MIN and MAX thresholds are obtained by trial and error: they are those that provide the best linear adjustment.

➔ **Example**. The population of the town of Kongoussi in Burkina Faso stood at around 26,000 in 2006. Its population grew rapidly between 1985 and 1995, then this pace slowed considerably between 1995 and 2006: it grew from a population of 6,578 in 1985 to 17,893 in 1996, then to 25,172 in 2006.

It seems inappropriate to use an exponential function to model this growth. However, if a logistic function is used, the adjustment is almost perfect²⁰. It is also possible to trace the evolution before 1985 (retrospective forecast) and after 2006 (forecast).

Precautions to be taken

Forecasting considers the current population living within a given perimeter, usually defined as the boundaries of the current municipal administration's authority. Population growth, however, often means that part of the population settles outside this perimeter. It is therefore essential to gain a good understanding of this particular aspect, with the help of an urban planner, in order to define the perimeter of the 'town of tomorrow' and to provide this information to managers for validation. The question being: what is the demand for water or the demand for sanitation, within which perimeter?

²⁰ For this adjustment, the best results were obtained using MIN=0 and MAX=28,000 (population saturation is equal to 28,000 inhabitants).

FIGURE 2. Population of Kongoussi (Burkina Faso): exponential tendency curve, calculation based on observed figures

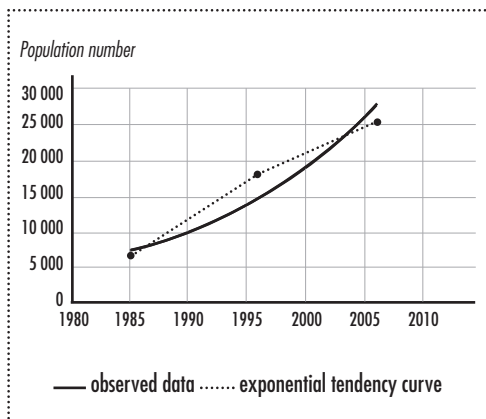
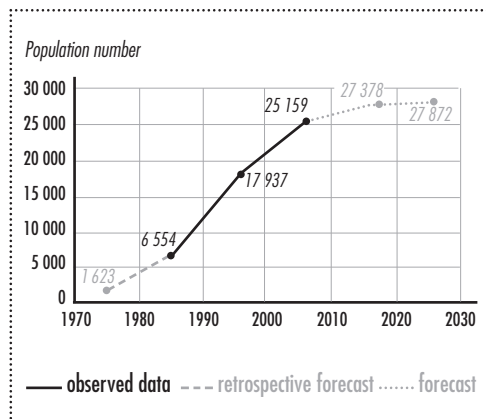


FIGURE 3. Population of Kongoussi (Burkina Faso): retrospective forecast and forecast



Selecting the development scenarios

Consultation with managers

The 'starting point' for forecasting is the diagnostic of the current situation. In principle, if the study has been rigorously conducted and if the conclusions are based on analysis of duly established and indisputable facts, this diagnostic should not lead to drawn out discussion.

In contrast, demand forecasts are based on assumptions which are, by definition, uncertain. Their possible accuracy is not down to luck or the existence of any imminent law that enables predictions to be made without major risk of error. These assumptions should reflect the willingness of managers to see the situation progress in a given direction as part of a long-term vision for their town.

Consultation between those responsible for the study and local managers (municipality and/or water or sanitation company), and even the civil society, is therefore essential. This is because it is these managers who ultimately set the assumptions; the role of the person responsible for the study being to discuss the degree of likelihood of these assumptions, test their feasibility and point out any technical and financial repercussions.

Short-term / Medium-term / Long-term

When conducting a '20-year forecast', the person responsible for the study should be aware that he needs to follow two very different approaches:

- **in the short-term**, i.e. over five years: the forecast really is a 'forecast' as, unless something

21 For example, the unexpected establishment of a factory, or the arrival of a migratory wave due to unforeseen external events, etc.

totally unexpected happens²¹, nearly all the major changes have already been identified (due to the project implementation timescales). This period is also when urgent work is begun as part of the first phase of a major works program, etc.;

- **in the medium-term**, i.e. between 5 and 10 years: the forecast remains a 'forecast' as this period corresponds to the realization of on-going projects or projects that are certain to be carried out;
- **in the longer term** (from 10 to 20 years), the forecast in fact becomes a simulation: it tests various assumptions to assist the decision-makers in their choice (major investment), as the future largely depends on their decisions.

Three sets of assumptions

In general, the socio-economist puts forward 3 demo-economic scenarios based on 3 sets of assumptions:

- **High**: where the population grows more quickly due, not to the effects of lower mortality rates (as fecundity rates fall rapidly), but to the acceleration of the rural exodus caused by economic development. Investment needs are exacerbated by the growing number of households.
- **Low**: where the population grows more gradually due to a slowdown in the rural exodus caused by weak economic development. As the

investment needs are reduced, there is greater possibility for improving the quality of water and sanitation services.

- **Average**: this corresponds to the most likely scenario.

This work to identify the average assumption enables the results of the forecasting to be defined more clearly as they can be placed within value ranges to measure the extent of the issues. Moreover, it is simple to modify certain assumptions and to proceed with a contingency analysis (which is held in esteem by a number of donors).

Results

The work of the demographer should result in the production of tangible population figures (per small geographical area or neighborhood), accompanied by explanatory notes on the:

- current situation;
- future situation, year by year: but particularly in 10 years time, then at the end of the project (often 20 years).

All data should be presented in a table, in a pre-defined format agreed with the person responsible for calculating the demand for water or sanitation, so that it is immediately compatible with the forecast model of the demand for water

or sanitation.

Organizing the assessment

Parties involved

There needs to be either a demographer in place (to be recruited as part of the demand assessment), working under the supervision of a socio-economist, or the project's socio-economist (if he knows enough about demography). The demographer and/or the team should:

- have access to population forecasting software (by components);
- have experience of making population forecasts, if possible in conjunction with an urban planner (to specify the way in which the total population can be broken down by neighborhood);
- be able to work quickly without getting lost in technical detail of little practical interest.

Length of the demographic study

Two weeks spread over two months (as close

Urban development

coordination with the urban planner is vital for calculating population size by neighborhood). This analysis enables the following studies to be developed and completed: population, housing and, more generally, the community's living conditions. It also provides relevant information that can help inform the program for improving conditions of water and sanitation supply: what activities are involved, where the population concerned is located, etc.

When calculating the demand for water or sanitation, the objective is as follows:

- **Domestic:** to allocate the future population to each neighborhood in line with urban development (increase in residential areas, increase in population densities) and to have an idea as to the qualitative evolution of the neighborhoods (such as changes in the type of residential

occupancy).

- **Non-domestic:** to take non-residential urban development into account to validate the evolution of the demand for water or sanitation.

Summary of documentation

There are several different documents required for carrying out a study:

- Urban Development Master Plan (UDMP);
- Local Development Plan for the town, if there is one;
- Programs on improvement and/or urban development and housing (for example, those

programs concerning the development of certain neighborhoods) and on infrastructure;

- Maps and town plans, aerial photographs and satellite images (it is necessary to always check Google Earth© to test reliability: the clarity of the image and the age of the image, etc.);
- Geographic Information System (GIS) of the urban planning department.

The summary of this documentation should particularly focus on the following:

- Analysis of the details of the urban function of the town as part of the development of the surrounding region;
- The urban rebalancing strategy potentially used in the town;

- The identification of new reception centers and future areas of construction based on the current land use map and the planned map (as part of a local urban planning map, for example);
- The identification of future areas of economic activity and agricultural areas, if appropriate.

Land use

Land use (residential by housing type, industrial, commercial, services, open and agricultural spaces, recreation areas, cultural areas, etc.) is a central topic in the analysis of the urban fabric.

The current situation, past development and

FIGURE 4. Satellite image of part of the town of Koudougou (Burkina Faso)



especially the prospects need to be studied, in particular to better identify spatial development possibilities in different areas of the town. Some of these contain large quantities of space which creates a high demographic dynamic, whereas other areas have probably reached the saturation threshold.

Consideration of the urban development strategy needs to result in scenarios being proposed that are easily acceptable to all the different parties involved: municipality, water and/or sanitation company, the supervisory ministry, ministry of housing, etc.

Specifically, land use should be dealt with:

- in a cartographic manner: production of maps;
- in a quantitative manner: number of hectares per land use type²² and by small geographical area – neighborhood or other – and population densities by residential occupancy sub-type. Work will be conducted with the urban planner to identify the anticipated saturation level for each neighborhood, as well the probable date upon which this saturation will be reached;
- to produce results relating to the present situation, then the future situation (within the timeframe of the project).

²² The types of land use should be detailed, although not overly (to avoid drowning in detail). 4 or 5 types of residential land use and the same number for non-residential will suffice:

- Residential, by distinguishing several sub-types. For example: detached house (high standing), apartment building (standing), (social)/low-rent apartment building, densely populated, sparsely populated. A density also needs to be associated to each type.
- Non-residential: administrative and commercial, industrial, touristic, open/agricultural spaces, vacant.

Population densities by geographical area

Gross density / net density

The concept of population density or the number of inhabitants per hectare of a given geographical area can correspond to different definitions, depending on whether the total surface area of the zone is taken into account or only the residential surface area:

- **gross density** takes the total surface area of the zone into account;
- **net density**, or 'residential' density, only takes the residential surface area of the zone into account. As such, it provides more detail on the type of housing.

➔ **For example:** In a town, the Xinawa neighborhood has a total surface area of 26 hectares (ha), and a population of 3,900. This neighborhood includes an area of housing that occupies 9 ha, an area containing administrative buildings (10 ha), a commercial area (5 ha) and vacant lots (2 ha):

- the gross density is 150 inhabitants per hectare;
- the net density, or residential density, is 433 inhabitants per hectare.

Current / future density

Population densities are dealt with differently, depending on whether it is the current situation or the forecasts that are being calculated:

- **current situation:** if the population per small area is known (through the general population and housing census), as well as the surface area of the zone (provided by the land use map drawn up by the urban planner), then calculating the population densities is straightforward. If,

however, the population per small area is unknown, then the density is a standard that corresponds to the type of residential housing and enables calculation of the population per small area;

- **future situation:** the population density is an assumption (given by the urban planner). For a given date, the population per small area is obtained by multiplying this by the corresponding residential surface area.

Results

The work of the urban planner should result in the production of definitive maps and tables of statistics (per small geographical areas) which are accompanied by explanatory notes:

- numbered maps at 1/1,000 or 1/5,000 (scale to be determined with the head of the project);
- Excel spreadsheets that correspond to the maps;
- a short report (of a maximum of thirty pages) giving the current situation and the rationale behind those options retained for future evolution.

This analysis should enable the further development and completion of studies on population, housing and, more generally, standards of living in the town. It also provides relevant information that can help inform the program for improving conditions of water and sanitation supply: what activities are involved, where the population concerned is located, etc.

This information will then be entered into a

Geographic Information System (GIS) in order to conduct a geo-statistical analysis and to compare the information with other data (map of the water network, etc.).

Organizing the urban study

Parties involved

There needs to be an urban planner (recruited as part of the demand assessment), working under the supervision of a socio-economist. The urban planner and/or the team should:

- have suitable materials (plotter) and software (for drawing such as AUTOCAD, and/or preferably GIS) available and, of course, know how to use them;
- be able to easily manipulate the statistical data and Excel, in particular;
- be very familiar with the use of aerial photos and satellite images.

Length of the urban study

An urban study should last a maximum of two months.





CHAPTER 3

The demand for water

Methodological framework

The information below is mainly placed within the framework of a 'general assessment' of demand for water, as defined in the previous chapter.

The figures presented on the following pages illustrate the different elements that should be included in such an assessment, given that the same 'general' approach can be implemented with a simplified and quicker methodology.

Baseline indicators

All water demand assessments should use a minimum of information, without which strategic planning is very difficult. The list of 'essential indicators' given below forms part of this minimum information requirement:

• All assessments

1. Supply/Access to water;
2. Unit consumption (domestic);
3. Household income;
4. Household expenditure on water;
5. Part of family revenue dedicated to water;
6. Households' capacity to pay for water;
7. Households' willingness to pay for water (domestic).

• Assessments aimed at quantifying the demand for water

In studies where the main objective is to quantify the demand for water (how many m³?), a further two indicators must be added:

8. Domestic demand;
9. Non-domestic demand.

• Pricing studies

For the most complete pricing studies, a further three indicators need to be included (relating to non-domestic demand):

10. Expenditure on non-domestic water;
11. Part of turnover dedicated to non-domestic water;
12. Willingness to pay for (non-domestic) water.

This list gives rise to two remarks:

– For certain indicators relating to demand for domestic water (expenditure on water, position of water in the family budget) households often don't know how to distinguish between the cost of water and that of sanitation. The indicators calculated need to be precisely defined, regardless of whether only sanitation is retained or water and sanitation together.

– For indicators relating to non-domestic demand, the information required is often very difficult to obtain due to reticence on the part of the organizations questioned. It is for this reason that these indicators are only prioritized in pricing studies.

TABLE 5. Baseline indicators for all water demand assessments

INDICATOR	USE
ALL ASSESSMENTS	
1. Supply / Access (Current, Future)	
Breakdown (in %) based on source of water supply: <ul style="list-style-type: none"> – Households and Population – Non-domestic consumers 	Evaluation of the situation and forecasts in relation to the MDGs. Growth criterion for all other variables studied. Enables distinction of very different categories of facilities and need: <ul style="list-style-type: none"> – Households: connected to the network / not connected to the network; – Non-domestic consumers: connected to the network / other source of water supply.
2. Unit consumption (domestic) per source of water supply (liters/person/day)	
Calculated in 2 timeframes: <ul style="list-style-type: none"> – Consumption per day: Households total water consumption*, not including resale (in liters) over a period / Number of days in the period. – Unit consumption (per day and per person): consumption per day / number of people in the household. <p><i>*Regardless of source of supply and use of water</i></p>	Gives a measurement of health risk, which is higher the lower the consumption. Enables distinction of very different household categories of facilities and need: connected / Not connected to the network. Enables future water demand (m ³ required) to be calculated with more precision.
3. Household income (CFA Francs/month/household)	
This is a difficult subject to raise during a household survey; a more precise picture is often built up from household expenditure. This data is vital for all social-based planning for water.	<ol style="list-style-type: none"> 1. Capacity to pay for water: calculated by applying standards. 2. Quintiles: calculated <ul style="list-style-type: none"> – Income per Unit of Consumption (includes the composition of the household: number of people and age¹); – Filmer and Pritchett² Method.
4. Household expenditure on water (CFA Francs/month)	
If expenditure is not given for an actual month, recalculate the expenditure per month. To be collected for: <ul style="list-style-type: none"> – Households; – Non-domestic consumers. 	Enables calculation of: <ul style="list-style-type: none"> – Unit cost of water (in CFA Francs / m³): which enables comparison of the water price actually charged in the town (and possibly even per neighborhood) based on the different sources of supply; – % of family budget dedicated to water (Indicator n° 5).

¹ To calculate the number of units of consumption in the household, each member of the household is 'weighted' according to their age (see table 16, Chapter 5, p.124.

² See Chapter 5, p. 125

► **TABLE 5.** - Baseline indicators for all water demand assessments (continued)

INDICATOR	USE
5. Part of family revenue dedicated to the purchase of water (domestic) (in %)	
<p>Household expenditure on water over the course of one month / Household's monthly income</p>	<p>Enables an immediate social evaluation of the importance of water in the family revenue.</p> <p>This importance is considered too high if the % is over (for water + sanitation):</p> <ul style="list-style-type: none"> - 3 % of average household revenue (all households); - 5 % of revenue for households in the 1st quintile.
6. Households' capacity to pay for water	
<ul style="list-style-type: none"> - Connection / Facility (CFA Francs) - Consumption (CFA Francs / month) 	<p>Calculated by applying standards:</p> <ul style="list-style-type: none"> - Water / Water + Sanitation? - 3% - 4% - 5%? - On average / 1st quintile?
7. Households' willingness to pay for water	
<ul style="list-style-type: none"> - Connection / Facility (CFA Francs) - Consumption (CFA Francs / month) 	<p>Comparing the capacity to pay and willingness to pay enables choices to be made and results in adapted proposals on:</p> <ul style="list-style-type: none"> - Amounts; - Financing methods: connection (credit), billing (billing frequency).
Assessments aimed at quantifying the demand for water	
8. Demand for domestic water (Current/Future)	
<ul style="list-style-type: none"> - Individual connections to the public network / Other source of water supply (number) - Consumption / Demand (m³) 	<p>Enables planning, by geographical area and by year, of:</p> <ul style="list-style-type: none"> - the development of the network and types of (technically and socially) adapted facilities; - the water resources to be mobilized.

► **TABLE 5.** Baseline indicators for all water demand assessments (continued)

INDICATOR	USE
9. Demand for non-domestic water (Current/Future)	
<ul style="list-style-type: none"> – Individual connections to the public network / Other means of water supply (number) – Consumption / Demand (m³) 	<p>Enables planning, by geographical area and by year, of:</p> <ul style="list-style-type: none"> – the type of facilities to be planned; – the water resources to be mobilized.
Pricing studies	
10. Non-domestic: Expenditure on water (CFA Francs/month)	
<p>(This concerns all non-domestic consumers with or without an economic activity).</p> <p>If expenditure is not given for an actual month, recalculate the expenditure per month.</p>	<p>Enables calculation of the unit cost of water (in CFA Francs / m³). This means the water price actually charged in the town for the different sources of supply: network connections / private borehole/etc. can be compared.</p>
11. Non-domestic: Part of turnover dedicated to water (in %)	
<p>(This only concerns those non-domestic consumers with an economic activity).</p> <p>Non-domestic consumer's expenditure on water over the course of one month.</p> <p>Turnover of the given organization (non-domestic consumer).</p>	<p>Enables an immediate economic evaluation of the importance of water and sanitation in the revenue of the given organization (non-domestic consumer).</p>
12. Non-domestic: Willingness to pay for water	
<p>(This only concerns those non-domestic consumers with an economic activity)</p> <ul style="list-style-type: none"> – Connection / Facility (CFA Francs) – Consumption (CFA Francs / month) 	<p>Comparing the capacity to pay and willingness to pay enables choices to be made and results in adapted proposals on:</p> <ul style="list-style-type: none"> – Amounts; – Financing methods: connection (credit), billing (billing frequency).

Step-by-step methodology: the different stages

Demand at the non-domestic consumer's²³

In the figure below²⁴, two different models are presented for the 2 large groups of consumer, one for domestic demand (households) and the other for non-domestic demand (activities). The operations (numbered on the diagram) are as follows:

• General data

1. Definition of the perimeter of the study, present and future (town perimeter in 20 years): this will have an impact on both domestic and non-domestic demand.
2. Sales statistics: analysis of the water company's client files to extract information on the current situation (and that of historical evolution, if necessary):
 - Access to (domestic) water and the elements of calculation;
 - Domestic consumption (so, if appropriate, units of consumption);
 - Local non-domestic consumption²⁵;
 - Large consumers and their consumption;
 - Average consumers and their consumption.
3. Population and urban planning: current and future situation, per neighborhood.

²³ Demand 'at the consumer's' corresponds to demand at the spot that separates the private property (the occupant's responsibility) from the public (the water company's responsibility). If the occupant is a registered consumer with a meter, this corresponds to demand at the meter.

²⁴ Source: L'analyse des besoins: la demande en eau [Needs Analysis: the demand for water] - Exposé presented to the Ecole Supérieure de Commerce de Paris (ESCP) as part of a specialized Masters degree on "Management of International Projects" - G. Roger, February 2005.

• Domestic demand, per neighborhood

4. Household survey²⁶. This survey can be preceded by:
 - a qualitative investigation: in-depth interviews and/or focus groups;
 - a survey conducted at standpipes and other shared water distribution points.
5. The cost of water: calculated from the household surveys, consistent with the sales statistics;
6. Access to supply²⁷, per neighborhood: current (from the household surveys, consistent with the sales statistics), and future (choice made in consultation with the decision-makers);
7. Unit consumption per neighborhood: current (from the household surveys, consistent with the sales statistics), and future (choice made in consultation with the decision-makers);
8. Domestic demand (per neighborhood), current and future: calculation based on elements 1, 2, 3, 6 and 7.

• Non-domestic demand, per neighborhood.

9. Local demand, current and future, per neighborhood: along with total domestic demand and consistent with sales statistics;
10. Large consumers²⁸, along with sales statistics;
11. Large consumers' survey: current and future demand by neighborhood;

²⁵ For the definition, please see Chapter 3, 'Local' consumption.

²⁶ This is a quantitative survey, often called 'statistical'. For this survey many different methods can be used: Revealed Preference Surveys, Contingent Evaluation Method, Psychological price, etc. (please see the comparative table of these methods in Annex 4).

²⁷ Breakdown of the population based on source of supply, regardless of the origin of the water.

²⁸ For the definition, please see Chapter 3, Large consumers.

FIGURE 5. Model of a complete assessment of demand for water – PART 1: at the consumer's

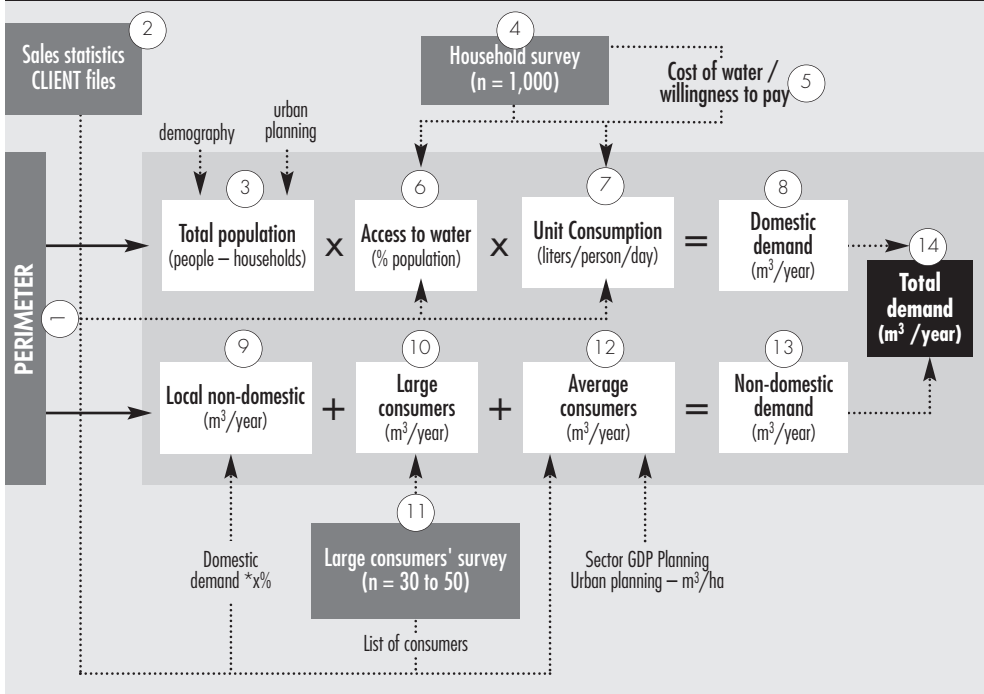
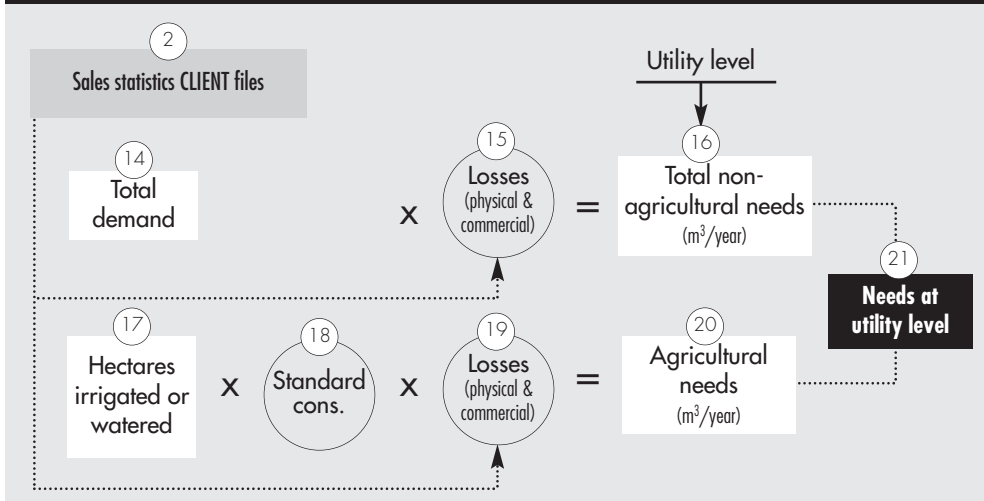


FIGURE 6. Model of a 'general' assessment of demand for water – PART 2: from demand to need, at utility level



12. Average consumers²⁹, by neighborhood: along with urban development forecasts and macro-economic statistics (growth in sector GDP);
13. Non-domestic demand (by neighborhood): calculation based on elements 1 and 2, 9 to 12.
14. **Total demand (domestic + non-domestic)**, by neighborhood = sum of elements 8 and 13.

From demand to production

For the engineer responsible for water production, the demand calculated above (from the consumer's property) should be converted into water production.

During this conversion, demand is transformed into needs as the major factor in this transformation – the yield of the public network, including losses on the network – is independent of the consumers.

The yield of the network

The yield of the network corresponds to the part (measured in %) of production which is effectively distributed to consumers (whether these pay or not). Those volumes not reaching the consumers are considered to be losses, either 'technical' (water lost due to the poor state of the network) or 'commercial' (water distributed but not accounted for mainly due to under-metering, fraud, etc.).

Methodological model

In the figures above³⁰, two different models are proposed for 2 large consumer groups, one for

non-agricultural demand (domestic and non-domestic) and the other for agricultural demand. The operations (numbered on the figure) are as follows:

Non-agricultural needs, by neighborhood

14. Losses on the normal network³¹: along with sales statistics and production statistics;
15. Total non-agricultural needs, at utility level: calculation based on elements 14 and 15;
16. Non-agricultural needs, at utility level: calculation based on elements 14 and 15.

Agricultural needs, by neighborhood

17. Hectares irrigated: coherent with the urban planning study;
18. Standards of water consumption for agriculture (in a town: mostly truck farming);
19. Losses on the agricultural network (if the farms are linked to the public network and not if they have their own private borehole): along with the statistics for sales and production, if appropriate;
20. Total agricultural needs: calculation based on elements 17 and 19.
21. **TOTAL needs, at utility level**: the sum of elements 16 and 20.

Difficulties

The yield of the network is an indicator of great strategic importance for monitoring how well the water company is operating; it is often difficult to ascertain, however, unless the water company has specific information systems that routinely calculate this.

³¹ For the current situation, both the physical and commercial losses are considered. For forecasts, however, only the technical losses are taken into account.

²⁹ For the definition, please see Chapter 3, Non-domestic demand..

³⁰ Source: L'analyse des besoins: la demande en eau – op. cit.

Calculation of this indicator does not stem from the demand assessment. It is usually conducted from measurements taken on the public network (and from estimates for other sources of water supply) and from calculations made by the water company's engineers.

Its definition changes according to whether it is the current or future situation that is being examined:

- **For the current situation:** Production - Billing = physical and commercial losses. So the yield integrates these two aspects.
- **For the future:** all volumes consumed are included, not only those that are billed. Indeed, the efficiency of client management is not taken into account despite the fact that this is of vital importance for calculating the sustainability of the service.

Schedule of operations

Position of the problem

An assessment of demand for water is, as intimated by the sequence of operations presented in the figures on the preceding pages, a relatively long and costly operation.

The factors of time and budget are essential components of a demand assessment, as without financial resources and without a minimum of time, it is almost impossible to do anything of note. Working under poor conditions produces poor information; this can be dangerous for managers who risk making decisions that are not adapted to reality (technical, economic and social).

Prior to constructing an adapted methodology and a budget and schedule of operations, the following two questions need to be answered clearly and precisely:

- Is there a requirement³² for a household survey and a survey of large consumers?
- For what geographical level is data on the demand required: the entire town, some large areas, the neighborhoods, the sectors of relief, etc.?

It is important to remember that implementation of the assessment is not uniform:

- The phase of describing the current situation, which means establishing a diagnostic with all the baseline data, can take up to 80% of the total assessment time.
- The forecasting and simulation phase takes a maximum of 20% of the time; this includes discussions with managers.

General assessments

Long duration: 4 to 6 months

The average length of a water demand assessment is between 4 and 6 months.

Such an assessment includes a large household statistical survey (with a sample of between 300 and 1,000 households³³) and a semi-quantitative survey with 30 large consumers, plus several small topic-based investigations (for example, on standpipes and/or truck farmers starting up inside the urban perimeter).

³² Arguments for and against conducting household surveys are covered in Annex 2.

³³ The final size of this sample largely depends on the budget available for this activity, but also on the survey objectives (to obtain significant results at what geographical level).

In addition, it is also possible to include a qualitative investigation (conducted in preparation for the large household surveys) based on in-depth interviews and/or focus groups, as well as a survey conducted at standpipes and other shared water distribution points.

This type of assessment is conducted by a large team with a wide range of competencies: as a minimum, a socio-economist, a demographer and an urban planner, with perhaps a sociologist for the qualitative approaches³⁴, not to mention a team of around a dozen interviewers and some monitors.

To organize the work, two essential deadlines always need to be respected:

- The end of the preparation phase for the household surveys, after a maximum period of 6 weeks;
- The end of the household surveys at a maximum of 14 weeks after the start of the assessment; this second deadline takes into account a maximum two month period for the phases relating to collecting, processing and analyzing the survey data.

The advantage of ‘long’ assessments is considerable: thanks to the surveys, a large part of the existing information (and notably the standards everyone uses) can be updated.

Average duration: 2 to 3 months

There is often some doubt over the usefulness of the surveys (with households and large consumers), all the more so as they involve a high cost. It is for this reason that some assessments are requested with no survey.

Indeed, this is the same type of long assessment, with the same analyses, but with no large survey. However, it is sometimes desirable to conduct short investigations, but quickly and so with small

groups (which should not be called ‘samples’ so as not to create ambiguity over how representative these investigations are).

The advantage of ‘average length’ assessments is their shorter duration and lower budget. They provide a response to the question doubtlessly posed by a number of managers in small towns: what type of study can be conducted to obtain a minimum amount of quality information in less time and with a more reduced budget?

The whole challenge of this approach lies in stretching this assessment as far as possible with fewer resources. Prior reflection and consultation with the managers needs to be all the more refined and lead to the adoption of only a small number of clearly defined priorities.

Reduced duration: 1 month

It is often the case that a public authority (municipal or national), or other organization (water company, donor, or even an NGO) wants to know the demand for water in a town but only has a little time and a very limited budget. The organization is prepared to finance the assessment, but one that is small in size and low in cost.

The average duration of a reduced assessment should not be less than one month.

Such an assessment is necessarily entirely separate from any large-size assessment. It mainly consists of:

- summarizing existing work, often older, for which there is no guarantee of either reliability or quality;
- processing the water company’s client files; this should be as in-depth as possible in order to extract information on consumers (and thereby access to supply: household connections, standpipes) and on the type of consumption (domestic - i.e. units of consumption – and non-domestic);

34 This is fundamental when dealing with sanitation.

- having systematic recourse to estimates, conducted using unreliable source information if no other information is available;
- organizing a number of consultation meetings with homogenous groups of those people and organizations concerned.

The risk of serious error. This risk is inherent in the exercise, regardless of the qualities and competencies of the professional in charge of the assessment, as it is the source information (unreliable) and the timeframe (which leaves little time for exploration and analysis) which are at issue.

Is it necessary to run such a risk? This doubtless depends largely on the size of the town: the smaller and more socially unified the town, the better this approach is likely to work; for larger and more socially diverse towns, this approach is less advisable.

The advantage of this type of assessment is its speed and low cost.

Topic-based assessments

Long duration

In the case of research, the investigation usually lasts a long, sometimes very long, time. Often conducted by small teams and not tied to a schedule involving major investment or the start of work to improve the infrastructure, such assessments can often last a year or more.

In the case of 'action research', in which the study is closely tied to the realization of a service improvement program (notably for sanitation) in a given area, the research can last several years. It is often the case that the research is undertaken whilst the program is in progress and ends at the same time.

One way of breaking down this approach consists of proceeding in a repetitive manner, neighborhood by neighborhood, with the same small-sized investigation. Each 'small' investigation is immediately followed by improvement work on the service. By proceeding in this way, it is possible to cover all the large areas by dividing them into uniform sub-areas, making the approach easier: it is an effective way of managing the same small teams, not only for the social study but also for the work.

Short duration

How can a service improvement program be defined quickly and inexpensively? The answer is obviously to conduct a brief investigation that can satisfactorily replace an investigation that is larger, longer and more expensive.

Extremely brief, this type of investigation is often confused with the project mobilization phase, during which visits are paid to managers and some interviews conducted with the population to specify their expectations, or rather to quickly validate the legitimacy of the fundamental options included in the project.

Can this approach still be called a 'water demand assessment'? Doubtless, the expression 'scoping of a project in start-up phase' would be more appropriate.

FIGURE 7. Schedule for a 'general assessment' of demand for water

RESOURCE	TASKS
	0. PREPARATION
Socio-economist + statistician	01 Selection of sub-contractors
	1. URBAN DEVELOPMENT
Demographer + urban planner	02 Analysis of documentation & file preparation
Urban planner	03 Land use: verification in the field
Urban planner	04 Data capture
Urban planner	05 Current & future land use tables
Urban planner	06 Current & future land use tables
Urban planner	07 Report (including final maps & plans)
	2. POPULATION
Demographer	08 Analysis of documentation
Demographer	09 Overall population forecasts
Demographer + Urban planner	10 Population forecasts by neighborhood
	3. HOUSEHOLD SURVEY
	Preparation
Statistician + socio-econ. + survey stat.	11 Questionnaire: design, test, finalization, printing
Statistician + socio-econ. + survey stat.	12 Instruction Manual for interviewers
Statistician + survey stat.	13 Sampling procedure
Statistician + survey stat.	14 Recruitment & training of interviewers
	Data collection in the field
Survey stat.	15 Collection & monitoring in the field
	Data processing and analysis of results
Survey stat.	16 Monitoring questionnaires (in the office) & coding
Survey stat.	17 Data capture
Statistician + survey stat.	18 Data cleansing of files
Statistician	19 Tabulation, analysis & report

FIGURE 7

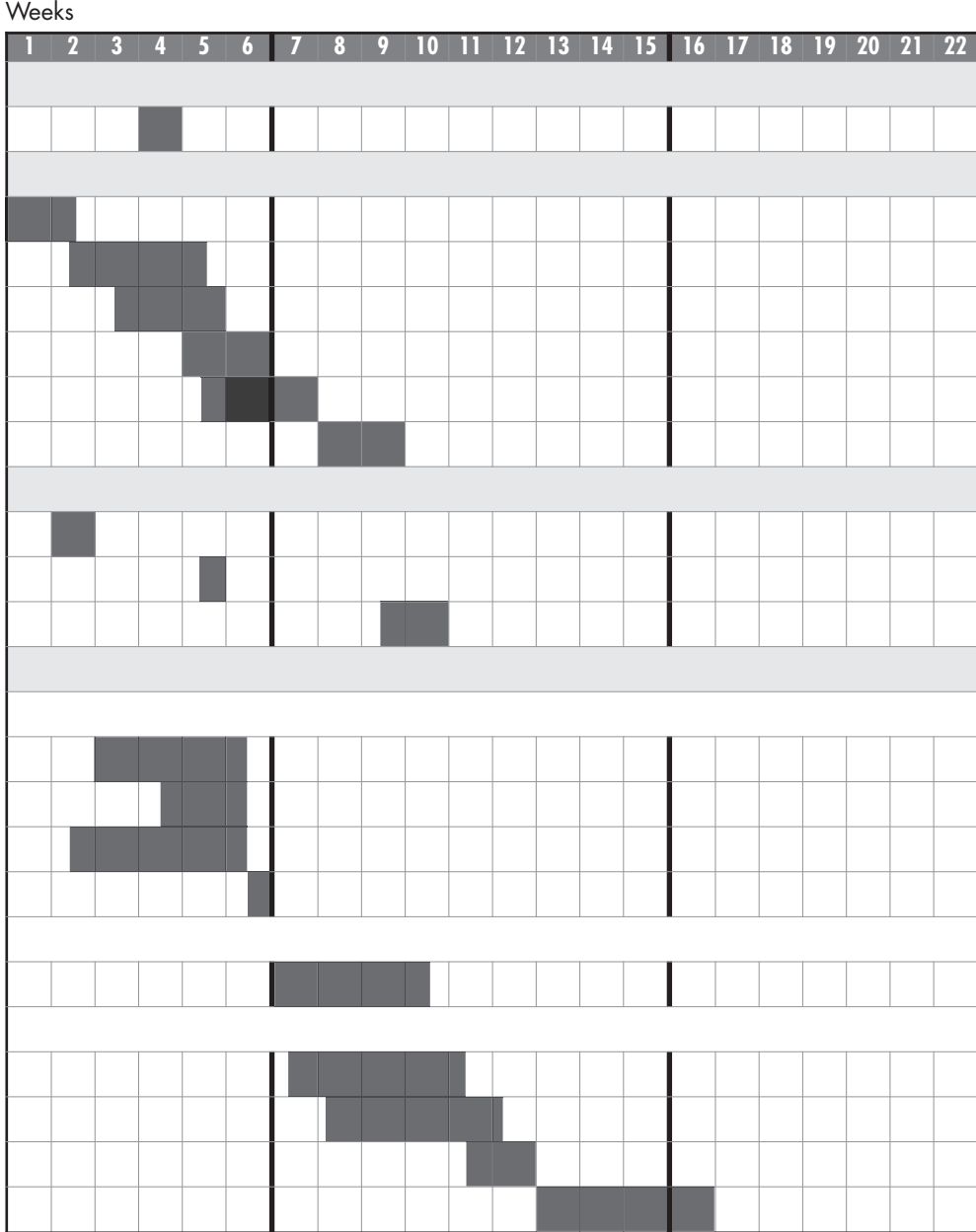


FIGURE 7. Schedule for a 'general assessment' of demand for water

INTERVENANTS	TASKS
	4. WATER COMPANY CLIENTS
Statistician + IT expert+ socio-econ.	20 Analysis of client data
Statistician + IT expert+ socio-econ.	21 Integration of results into demand assessment
	5. NON-DOMESTIC CONSUMERS SURVEY
Statistician + IT expert+ socio-econ.	22 List of large consumers
Socio-econ.+ engineer+ sociologist	23 Interview guide: design
Sociologist + qualitative interviewer	24 Interviews
Sociologist + qualitative interviewer	25 Counting & analysis
	6. ECONOMIC DEVELOPMENT
Socio-econ. + statistician	26 Documentary study
Socio-econ. + statistician	27 Interviews on sectoral growth
Socio-econ. + statistician	28 Economic forecasts
	7. DEMAND FOR WATER
Socio-econ. + statistician	29 Current situation
Socio-econ. + statistician	30 Forecasts
Socio-econ. + statistician	31 Presentation to authorities: municipality, water co., etc.
Socio-econ. + statistician	32 Review of forecasts
Socio-econ. + statistician	33 Report

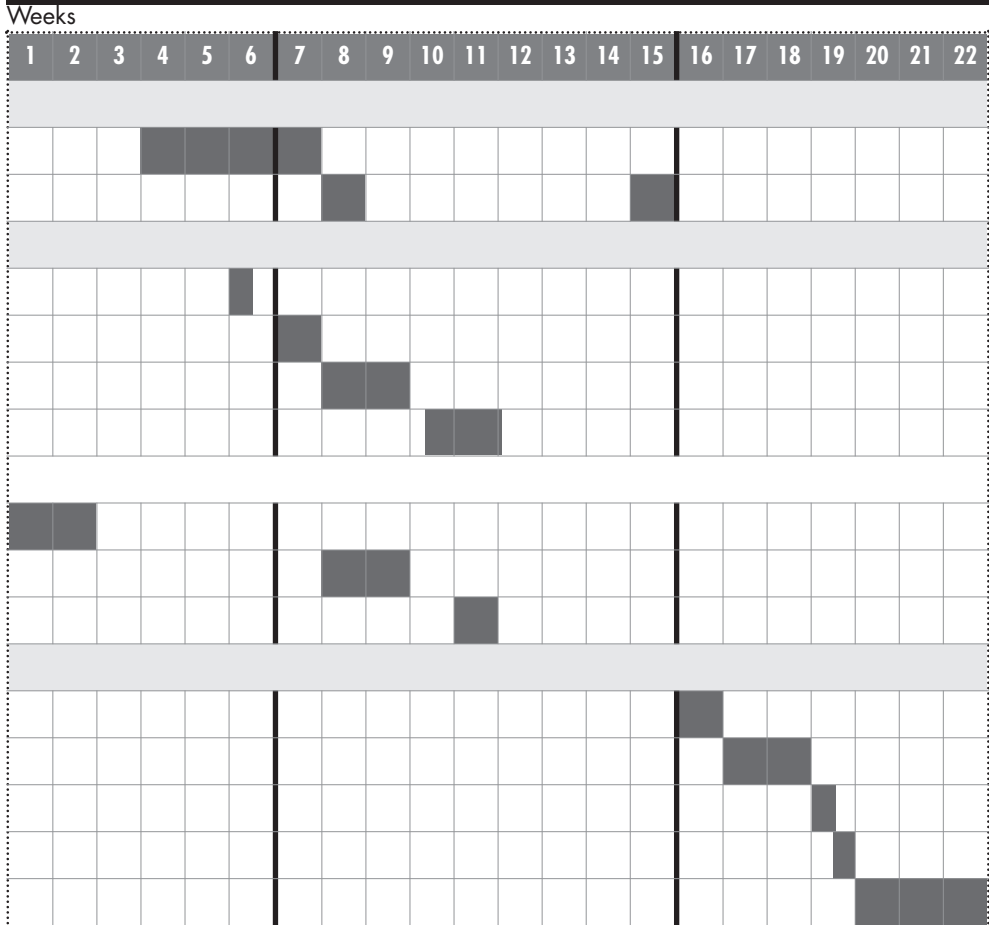
Recommendation

Regardless of the type of assessment to be conducted, how to choose between one of long and short duration?

Of course, assessments that are as complete as possible are recommended, as these guarantee

quality, reliability and durability. Therefore, it is advisable to conduct assessments that are relatively long and not compromised by thinking it is possible to carry out low level assessments: each time the experience has been reviewed

FIGURE 7



(with the review often financed by a donor), conclusions have shown that the results don't meet expectations, not only of quantity, but particularly of quality where they become virtually useless.

To clarify this choice, it is necessary to take a step back and assess the real scale of the issue faced by the demand assessment: what does such a cost and such a timeframe matter when the future of the town over the next 20 years is at stake?

Staff required

The composition of the team will vary considerably depending on the type of assessment to be conducted.

The central role of the socio-economist

In all cases, there is one professional profile that should take center stage in a water demand assessment: that of the socio-economist, who needs to have two very different qualities:

- the rigor of a statistician or planner, who can manipulate the figures with dexterity, but not excessively, not only for observing phenomena and handling data files, but also for making forecasts;
- the empathy of a human science specialist or social worker to enable him to more easily consider the social aspect of the phenomena and to bear this in mind for his observations and forecasting assumptions.

In many assessments, the socio-economist replaces several specialists, notably the survey statistician (in the design, monitoring, processing and analysis of the household survey), the sociologist (by conducting qualitative interviews or even focus groups³⁵), perhaps the analytical statistician (by himself sorting through the water company's client files), and even the demographer (by carrying out the population study).

³⁵ However, whilst he may attend a focus group, it is not recommended that he leads the meeting: it is in his interest to remain in the background.

A team aligned to the duration of the assessment

Long assessments (lasting 4 to 6 months)

As shown in the table on the following page, a larger team needs to be mobilized over periods of different length.

This team can consist of over 20 people:

- a socio-economist;
- a demographer;
- an urban planner;
- a survey statistician;
- a survey team (for the quantitative household survey), comprised of interviewers and monitors: either recruited as part of the assessment framework or sub-contracted out to a specialized consulting firm. The number of interviewers depends on the sample size:
 - . 300 households: 4 interviewers and 1 monitor;
 - . 1,000 households: 12 interviewers and 4 monitors, plus one supervisor.
- a sociologist, for the exploratory phase (prior to the household survey) which is based on in-depth interviews and focus groups;
- sociologists or young engineers (or qualitative interviewers) for the large consumers' survey;
- a computer expert, specializing in databases (or a statistician or analyst) able to exploit the client database.

Average assessments (lasting 2 to 3 months)

The same specialists are required, but without the team for the household survey (as there is no such survey planned).

Short assessments (lasting 1 month)

Due to lack of time, it is often only possible to mobilize one person, perhaps two, in order to gather together all necessary documentation as quickly as possible and to share the meetings (there

will be a high number of administrations and organizations, as well as many people to be visited). It is necessary to find two profiles: that of a socio-economist and that of an urban planner (with a good working knowledge of GIS).

TABLE 6. Staff required for conducting a 'general assessment' of demand for water

COMPETENCE REQUIRED	TASKS	NUMBER	LENGTH OF INTERVENTION
Socio-economist	<ol style="list-style-type: none"> 1. Coordination and supervision of all operations: <ul style="list-style-type: none"> – Population and urban development; – Household survey; – Large Consumers' Survey; – Data processing of the water company's client files; – Analysis of economic development (town, region, national). 2. Regular consultation / cooperation with managers: municipality, water and/or sanitation company. 3. Summary of other consultants' work: <ul style="list-style-type: none"> – Design of the forecasting model(s); – Current situation of the demand for water and/or sanitation, by small geographical areas (/neighborhoods): calculation; – Presentation of the diagnostic to managers (and, if appropriate, the civil society). 4. Forecasts of the demand for water and/or sanitation, by small geographical areas/ neighborhoods (alongside the work of the urban planner): <ul style="list-style-type: none"> – Consultation with managers (and perhaps the civil society) regarding the forecasting assumptions (access to supply, units of consumption, the cost of connection and consumption); – Forecasts and simulations. 5. Final report: <ul style="list-style-type: none"> – Drafting; – Presentation to managers (and, if appropriate, the civil society). 	1	<p>3 to 6 months:</p> <ul style="list-style-type: none"> – The total duration depends on the role effectively carried out by the socio-economist: – 6 months: if he undertakes the household survey himself, identifies the population segments, leads part of the qualitative investigation and compiles all financial documentation – 3 full months, but spread out over 6 months: if he undertakes the role of coordinator at the same time as working on all the design phases.

► TABLE 6.

COMPETENCE REQUIRED	TASKS	NUMBER	LENGTH OF INTERVENTION
Demographer	<ol style="list-style-type: none"> Demographic analysis: current situation and forecast: <ul style="list-style-type: none"> – The whole town; – By small geographical area (or neighborhoods). Verifying there is coherence with urban forecasting (residential surface areas and densities). 	1	3 weeks
Urban planner (with working knowledge of GIS)	<ol style="list-style-type: none"> Urban development study – land use, present and future: <ul style="list-style-type: none"> – The whole town; – By small geographical area (or neighborhoods). Verifying there is coherence with demographic forecasts. 	1 + 1 draftsman (CAD/GIS)	2 months
Sociologist	<p>Qualitative household survey (10 in-depth interviews and/or focus groups) prior to the quantitative household survey:</p> <ul style="list-style-type: none"> – Transcription; – Processing and analysis. 		Depends on the timeframes (2 weeks maximum, all inclusive) and on the budget
Young engineers or qualitative interviewers (sociologists)	<p>Large consumers' survey (average output: 2 to 3 interviews per day, including written debrief):</p> <ul style="list-style-type: none"> – Processing: quantitative and qualitative; – Conclusions in a Report of 15 to 30 pages. 	2 or 3	Depends on the number of interviews: 30 are recommended ¹
Survey statistician	<ol style="list-style-type: none"> Design of the quantitative household survey: questionnaires (including test) and interviewer handbook, sampling procedure, training (of interviewers and monitors). Supervision of: data collection in the field; codification / control in the office; data capture; data cleansing of the files captured. Processing and analysis of the survey: data entry form, with filters and jump filters; tabulation; multivariate analyses, modeling. Report: drafting the report (50 to 80 pages, not including the annexes of all statistical tables); slide show presentation. 	1	3 to 4 months

¹ The number of large consumers depends on the nature of non-domestic consumption: if, in the town studied, 90% of consumption is by 15 large consumers, 15 interviews will suffice. In the same way, if there is only modest weighting of non-domestic consumption in total consumption, there should also be a modest number of interviews (fewer than 20). 30 should be considered an average, with 50 as a maximum.

▶ TABLE 6.

COMPETENCE REQUIRED	TASKS	NUMBER	LENGTH OF INTERVENTION
Interviewers (quantitative)	<p>Household survey:</p> <ul style="list-style-type: none"> – Training: 3 days, of which 50% includes practical experience in the field; – Data collection in the field: 12 to 18 days; – Average expected output: 8 questionnaires²/day/interviewer (including editing the questionnaires before handing them into the monitor); – Work: 6 days a week. 	Depends on the sample size	4 weeks (including training)
Monitors (quantitative)	<p>Household survey (1 monitor for 3 to 5 interviewers):</p> <ul style="list-style-type: none"> – Training: 5 days, of which 50% includes practical experience in the field; – Data collection in the field: 12 to 18 days; – Output: all completed questionnaires are verified every day (and any comments are passed on to the interviewers the following day); – Subsequent verification: 2 days; – Work: 6 to 7 days a week (to make up for any delays without impacting on the planned schedule). 	Depends on the sample size	5 weeks (including training and catch-ups at the end of the survey)
Coding administrator³	<p>Household survey:</p> <ul style="list-style-type: none"> – Training: as for the interviewers; – Codification (including consultation with the interviewers to obtain rectifications and additional information): 80 questionnaires a day; – Start and End of codification: 2 days after the start of data collection 2 days after the end). 	Depends on the sample size (number of questionnaires)	5 weeks (including training)
Data capture administrator³	<p>Household survey:</p> <ul style="list-style-type: none"> – Training: as for the interviewers and coding administrator, with additional training on data capture; – Data capture (including consultation with coding administrators to obtain rectifications and additional information): 100 questionnaires a day; – Start and End of codification: 3 days after the start of data collection (3 days after the end). 	Depends on the sample size (number of questionnaires)	5 weeks (including training)
Computer expert (Database and/or GIS) or Statistician	<p>Analyze the water company's client database:</p> <ul style="list-style-type: none"> – Data extraction; – Tabulations; – Analyses, alongside the socio-economist: 10-page report, not including annexes. 	1	2 to 3 weeks

² In the case of an 'in-depth' assessment, with fewer than 10 open questions: around 160 variables, simplified Contingent Valuation Method type questions, but with mandatory observation of income and expenditure (equating to at least 20 minutes of this data collection time).

³ In many assessments, the codification and data capture functions are one and the same operation. Here, they have been separated as the codification function provides a good means of control prior to data capture.

Access to supply: sources of water supply

$$\text{Domestic demand for water} = \text{Total Population} \times \text{Access (source of water supply)} \times \text{Unit consumption (Per source of water supply)}$$

Also known as ‘access to water’, this is one of the most important indicators in an assessment of demand for water, especially for calculating domestic water demand. Access is the second component of domestic water demand. Indeed, household consumption can vary widely according to whether or not it is supplied by a

household connection. In addition, however, the cost of investment for distributing drinking water to the population is not the same if all households are already connected, or if a large number is supplied with water (of high or low quality) by other methods.

Definition

Access to water is an indicator that gives the proportion of the population supplied with water (potable or non-potable) by any given method:

$$\text{Access} = \frac{\text{Population supplied with water}}{\text{Total population}} \text{ (in \%)}$$

Therefore, by definition, does all the population have access to water? Not all are supplied in the same way, however, and the quality of the water used is also not the same for all (some use potable water, some use non-potable water).

In order to be as rigorous as possible, this definition needs to respect simple rules of consistency:

- Geographic: the scope of the assessment must be the same for both the numerator and denominator population;
- Within the indicator, i.e. between the numerator and the denominator, the definition of the population must be the same (resident population or total population).

In practical terms, an analysis of access is based on dividing up the population by supply method; some methods supply drinking water (individual house connection, for example) and others supply non-potable water (for instance, backwaters).

Historical evolution

Analysis of the historical evolution of access to water is carried out in 3 stages:

- **Study the documentation:**
 - Potable water supply and/or sanitation Master Plans;
 - Urban Development Master Plan;
 - Ad hoc study(ies), general for the whole town or partial, undertaken as part of project set-up, for example;
 - Population census and social studies (demographic, health, socio-economic, etc.).
- **Summarize the data** to present the evolution of access in the town in chronological order; this is not always easy as the terminology used often differs from one source to another.
- Conduct an estimate of **the initial situation**.

Current situation

There are several approaches possible for ascertaining the access to water:

Existing data

Recourse to recent and quality data is obviously recommended, as long as this exists and is relevant to the geographical area for which the water demand is to be calculated. The sources of information most often used are mainly: the General Population and Housing Census; the Demographic and Health Surveys; the Household Budget and Consumption Survey (sometimes referred to as 'Household Living

Standards Survey'); CWIQ36; MICS37; Poverty Monitoring surveys; if appropriate, local surveys conducted as part of the Urban Master Plan or by an NGO.

In practice, a distinction needs to be made between the general population census and the surveys. The census covers the whole country: it is therefore possible to obtain data not only for the whole town, but also for the neighborhoods (provided that the data is requested from the Institute of Statistics). In contrast, the survey data most often deals with geographical areas that do not correspond to the perimeter of the water demand assessment: urban/rural at national, regional, sometimes capital city/secondary center level, etc.

Lastly, this data is often out of date; the census takes place every 10 years (at best) and the surveys every 5 years at the most. For these reasons, the survey data is often of limited use but always needs to be examined.

In conclusion, the existing data always needs to be examined with care, even if it is not particularly recent: **the disadvantage** is often the poor use of terminology which means it is rarely possible to enter into any detail; **the advantage** is that this indicator is immediately available, without recourse to another information source or any type of calculation.

36 Core Welfare Indicators Questionnaire.

37 Multiple Indicator Cluster Surveys, generally organized under the auspices of UNICEF.

Direct observation, in the field

Quantitative household survey

As part of a water demand assessment, a quantitative³⁸ household survey enables the access to water to be quantified, not only for the whole town, but also by geographical area or neighborhood. This survey should be conducted using a rigorous methodology, which means it:

- is conducted with a representative sample of the population, so that the observed variables can be estimated with satisfactory precision. The sample should have been constructed according to precise statistical rules: adequate sampling frame, sampling method, etc.;
- uses clear, detailed, precise and rigorous definitions. For example, what is a shared household connection, what is a shared connection (for an apartment building or street, etc.), what is a neighbor vendor, etc. What is to be done where several supply methods provide water for the same use, etc?;
- enables identification of the water supply source (potable and/or non-potable) for each of the main uses: eating and drinking, washing up, personal hygiene (/bathing), toilets (/WC), laundry, and others to be specified (watering the garden or vegetable patch, drinking water for animals, even washing the car, etc.).

In a quantitative survey, access can be identified by simply going through the survey file that provides a breakdown of households (and/or the population) by water supply method and by use, but also by geographical area.

38 This expression is the opposite of 'qualitative survey' which corresponds to surveys usually conducted with small sample sizes (statistically non-representative). 'Quantitative surveys' are sometimes called 'statistical', 'qualitative surveys' are often referred to as 'in-depth'.

One of the advantages of a household survey³⁹ is that it generates both the numerator and the denominator of the indicator; there is therefore absolute coherence between the indicator's components. Of course, the quality of the indicator depends on the quality of the sampling procedure, the quality of data collection in the field and the quality of data processing (codification of the data captured, data cleansing⁴⁰ of the files).

In-depth' survey or 'brief' survey

The expression 'quantitative household survey' can correspond to very different situations, which should not only meet specific objectives, but also constraints, particularly of time and budget.

To make the correct choice, a simple rule needs to be borne in mind: the cost of a survey depends on:

Size (/complexity) of the questionnaire
x sample size.

This gives the following alternatives:

- an 'in-depth' survey with a questionnaire that is developed containing a lot of questions (so

39 The survey also permits calculation of the number of people per connection by asking 2 additional questions:

– Is the connection shared with other households? A clear definition should be provided for two closely related cases: the household supplied by shared connection (sharing the bill received by the registered household) and the household supplied by a neighbor vendor (application of a monthly fee for regular customers or even sometimes 'sold by the bucket').

– If the connection is shared, then with how many households, including the number of people, is this connection shared?

This information also enables precise calculation of the actual consumption of the household questioned from the bill the registered household receives.

40 Operation of 'cleansing the files after data capture' to correct any anomalies and inconsistencies found in some questionnaires.

with an interview length in the field of around an hour): carried out with a relatively limited sample (usually 300 to 1,000 households). In this case, there are a high number of topics dealt with in the questionnaire, but the statistical importance of the results by geographical area is limited (depending on the number of areas for which results are required);

- a 'brief' survey with a basic questionnaire containing very few questions (so with a short or very short interview and simple and quick data processing procedures): carried out with a large or very large sample⁴¹. In this case, there are an extremely limited number of topics covered⁴², but the statistical importance of the results by geographical area is high (even if the number of areas for which results are required is high: for example, not only neighborhoods, but also sub-neighborhoods or even sectors).

This type of 'inventory survey' is closer to an exhaustive census than to classic surveys: these are the types of census by sampling, with a very high sampling fraction. However, it is recommended when access to water and/or sanitation needs to be established precisely and at a refined geographical level. For example, to quickly and precisely review access to water it is ideal (for the five yearly review of a concession contract that includes access objectives by neighborhood or for comparing the current situation to the MDGs).

41 In a town of 100,000 inhabitants comprised of 15,000 households, a brief survey with 5,000 households will give excellent statistical precision. Such a survey with 5,000 households can be conducted in 7 days with 12 interviewers (with an average output of 8 surveys per hour of work).

42 Fewer than 10 variables and only containing simple questions which are easy to answer.

Estimation, without going into the field

In general, the population with access to water is estimated by applying an average number of people supplied by the facilities to the number of 'domestic', individual (connections) or shared (standpipe, kiosk, etc.) drinking water supply facilities.

$$\text{Access} = \frac{\text{number of facilities} \times \text{number of people supplied per facility}}{\text{Total population}} \text{ in } \%$$

This method is tricky to apply as there are many problems that can be encountered and that need to be handled with a lot of caution:

Number of connections

The number of connections is provided by the water company from its client database. By analyzing this figure in more detail, however, it is often possible to notice confusion surrounding the definition of a connection and so:

- The terminology used to define the client category often poorly distinguishes between the concepts of 'domestic' and 'non-domestic': small non-domestic consumers (businesses or services) are often included in the domestic category, which leads to over-estimates of domestic access to water. Yet, it is essential to separate the domestic and non-domestic consumers.
- The concept of active or inactive connections (for whatever reason) is not always specified in the tables giving the number of connections. A clear decision has to be made, however, on two points:
 - Should a connection that has been cut off due to non-payment of bills be included in the

access rate or not, even if this is a long-standing⁴³ situation?

- Should an existing connection, but one without water, be included in the access rate?

Indeed, in certain towns, the number of inactive connections can be very high.

- Shared connections (for apartment buildings and often housing estates, etc.) are counted as one unit and many client databases don't contain vital additional information, such as the number of households concerned (or the number of people supplied). If this information is not available from the water company, it will be necessary to make field visits to collect it.

- The residency status of the person to whom the connection is registered is not always included in the client database: often it is impossible to distinguish between a 'resident' household and a 'visiting' household or 'second home'. However, the reference population included in the indicator's denominator generally comes from the population census; this mostly equates to the resident population, with visitors and second homes being omitted.

Number of people per connection

Of vital importance for calculating the population with access to drinking water, the number of people per connection is most often obtained from older field observations that, over the years, have become the 'standard' in the country. However, these standards are often used with no particular care or (even summary) verification in the field.

This gives rise to errors, most often over-estimates. Moreover, the average number can vary considerably from one neighborhood to another within the same town; these differences can, on average, be higher than one person per

Examples of active/inactive connection figures in client files

➔ **Example in Kinshasa**⁴⁴, in 2005. "REGIDESO has 36% of its connections listed as inactive in its client files, which corresponds to those connections theoretically cut off for non-payment, delays in payment or connections in areas with severe water shortages. The number of inactive connections has continued to increase over the last 5 years due to the effects of the economic crisis and the deterioration in service conditions, whereas the number of active connections has fallen.

It is recognized that some of these inactive connections continue to be used in one way or another. Field visits conducted during surveys have confirmed this practice. These illegal connections need to be added to the total of inactive connections".

➔ **Example in Lomé**⁴⁵, in 2007. "Based on the most recent figures from Togolaise des Eaux (TdE: Togolese Water Company), the number of private connections (which encompasses domestic clients and others) today stands at over 42,000, of which nearly 31,000 connections are functional, meaning that there is a sizeable proportion of connections that are inactive (25%).

The survey confirms this proportion by questioning nearly 8% of households who have had their connection terminated, i.e. 22% of active consumers. This breakdown is coherent with that indicated in the latest activity report".

43 Very few operators remove long-term inactive consumers from their files. As a result, many client databases contain a sizeable number of inactive consumers.

44 Source: *Schéma directeur d'alimentation en eau potable*, Kinshasa, R.D. Congo: Expertise démographique et socio-économique, BCEOM, 2005

45 Source: *Programme d'amélioration de l'alimentation en eau potable de la ville de Lomé, Etude d'identification et de faisabilité*, Cabinet Merlin, 2007

connection. It is, therefore, very approximate, even dangerous, to use the same figure for the whole town.

However, the managers rarely appreciate the repercussions this error, which they consider to be 'small', can cause. Thus, replacing a standard that is often too high with a more reliable field observation can reduce the access rate quite dramatically.

For example, going from 11 people per connection to 9 people reduces the access rate by 19%, so for a town of 100,000 inhabitants with 7,000 connections, this will give a difference in access of 15,000 people and an access rate that falls from 77% to 63%.

Number of standpipes

The number of standpipes is provided by the water company from their client database.

As for individual connections, the concepts of active and inactive standpipes (inactive for whatever reason) are not always specified in the tables giving the number of standpipes. A clear decision needs to be made on this point, however:

Should an existing standpipe that does not function be included in the access rate?

Indeed, in certain towns, the number of inactive standpipes can reach very high levels.

Number of people per standpipe

Of great importance for calculating the population with access to water, the number of people per standpipe is rarely obtained from field observations; however it could have been calculated in the past from the observed access to water⁴⁶. In general, a 'standard' is applied, without knowing whether the number used is valid; the

standard can vary from between 150 and 500 people supplied per standpipe⁴⁷.

However, the number can be verified by taking the total consumption at standpipes (supplied by the water company) in the town and dividing this by the average consumption of a person obtaining his water from a standpipe. The usual assumption is a standard of 20 liters of water a day⁴⁸, or 25 to 30 liters when including the sizeable losses observed at standpipes and/or 'parasitic consumption' such as car washing and other non-domestic consumption.

Alternative sources of water supply

The 'alternative sources of water supply' not listed by the water company are ignored with this method: it is not possible to identify the population supplied by these different 'alternative sources'.

An essential control: coherence between numerator and denominator

Both the population served and the reference total population need to be of the same type, which means they both need to be resident populations and live in the same geographical area. The population needs to have been estimated with rigor, which is not easy if the last

46 The household surveys give access to water as a percentage of the population for the whole town. It is therefore possible to calculate the total population supplied by standpipe in the town. As the number of standpipes is known (from data provided by the water company), it is possible to calculate the average number of people supplied by a standpipe.

47 The figure of 1,000 people per standpipe, which is often used, seems excessive. When it is used, it is due to there being an insufficient number of standpipes, too far away from each other.

48 The volumes of water consumption per person per day vary according to the context. The volumes indicated correspond to an urban context with few or no alternative resources. In some small towns or neighborhoods where households often have access to several different sources of water, the volumes consumed at the standpipe may be considerably lower.

TABLE 7. Sources of water supply in the urban centers of Gabon, in 2003

	LIBREVILLE	PORT-GENIL	FRANCEVILLE	LAMBARÉNÉ	FOUGAMOU	URBAN GABON
<i>Use: eating and drinking</i>						<i>Unit: % of households</i>
Detailed supply source						
SEEG ¹ connection in the house	36.3	36.8	29.5	18.2	11.6	31.1
SEEG connection in the yard	22.7	32.7	37.5	24.9	23.6	24.8
SEEG connection at the neighbor's ²	0.7	0.8	1.2	1.5	0.4	0.8
Neighbor vendor	31.1	24.5	11.3	16.9	5.2	24.9
SEEG standpipe	7.3	4.9	19.1	34.2	31.2	13.3
Wells in the yard	0.8	-	-	0.3	2.4	0.8
Wells outside the compound	0.7	-	-	1.8	0.4	0.7
Spring, lake, river	0.0	-	0.7	1.2	13.2	1.8
Other	0.4	0.3	0.7	1.0	12.0	1.8
Total	100	100	100	100	100	100
SEEG access, based on 4 different definitions						
House + yard	59.0	69.5	67.0	43.1	35.2	55.9
House + yard + neighbor	59.7	70.3	68.2	44.6	35.6	56.7
House + yard + neighbor + neighbor vendor	90.8	94.8	79.5	61.5	40.8	81.6
House + yard + neighbor vendor + standpipe	98.1	99.7	98.6	95.7	72.0	94.9
NOTES						
¹ SEEG = Société d'Eau et d'Énergie du Gabon (Gabonese Water and Energy Company)						
² Connection to the neighbor:						
– 'Connection at the neighbor's': the water received by the household is 'piped' because it reaches the house through a pipe connected to the house next door. These households 'share their bill with other households';						
– 'Neighbor vendor': the water coming from a SEEG connection is not 'piped' as containers are used to transport the water to the neighbor's house. These households 'pay a fixed sum to a neighbor vendor'.						

Source: Enquête sur la consommation d'eau et d'électricité des ménages au Gabon (Survey into Households' Consumption of Water and Electricity in Gabon) - ECONEM 2004, Hoche Consultants, G. Roger, March 2006.

census was undertaken a long time ago (see Chapter 2).

Advantage of estimation

The main advantage of this method based on estimates made without field visits is that it is the only alternative when there is no recent household survey to consult: when there is no time or budget available for carrying out a survey, it is necessary to proceed by estimation.

In conclusion: a necessity made coherent

It is recommended that several information sources are consulted; to compare these and seek to explain any differences in the figures coming from different sources. Such research can often provide a lot of information, particularly on the validity of the data used and on the existence of certain phenomena that may have been overlooked.

In any event, the method recommended is the carrying out of household surveys as only these provide information that comes from recent and direct field contact. However, this doesn't remove the need for coherence, which often means making certain adjustments and also enables the quality of the client database to be improved.

► **The example on the previous page, relating to the situation in Gabon** in 5 of the country's towns in 2003, shows how much the figures can change when the definition is modified; the main issue in this particular case lies in understanding exactly what is being discussed. The table gives rise to the following comments:

Access to supply by the SEEG, calculated by including the standpipes, gives a maximum rate that enables the net deficit in access to public drinking water to be measured. These rates are very high in the 3 large towns: 99.7% in Port-Gentil, 98.6% in

Franceville and 98.1% in Libreville. They are only slightly lower in Lambaréné (95.7%), although appreciably lower in Fougamou where a quarter of households is neither directly nor indirectly supplied by the SEEG.

An objective observer would note that the interesting fact about this data is the role (different from one town to another) played by neighbor vendors (in the large towns) and by standpipes (in the small towns).

Access to drinking water is a MDG

'Improved' access

Governments and donors have been paying a lot of attention to access to drinking water for many years: the objective 'water and sanitation for all' set at the beginning of the 1980s, then reaffirmed 10 years later during the third International Water Decade, has been superseded by the Millennium Development Goals, which, between now and 2015, aim to reduce by half the proportion of people without sustainable access to drinking water or sanitation services (target 7C. of the MDG 7: ensure environmental sustainability).

There are several precise definitions for the expression **potable water**⁴⁹:

49 The expression 'clean water' is sometimes used in its place. The World Bank gives the following definition of access to clean water: "The number of people able to obtain clean water in sufficient quantities and without excessive difficulty, as a percentage of the total population. 'Without excessive difficulty' means:

- In urban areas: that there is a standpipe or public tap located within a radius of 200m of the dwelling.
- In rural areas: that family members don't have to spend too much of their time each day fetching water.
- Water is clean or unclean depending on the levels of bacteria it contains.
- A sufficient quantity of water is one that meets metabolic, hygienic and domestic needs; usually around twenty liters per person per day".

- The proportion of the population using an improved water source is the percentage of the population using one of the following sources of drinking water supply:

- running water at home: piped household water connection located inside the user’s dwelling, plot or yard;
- public tap or standpipe;
- tube wells or borehole;
- protected wells;
- protected spring;
- rainwater.

It is assumed that, if a user has access to ‘an improved water source’, then this source is located no further than 1,000 meters away and provides at least 20 liters of drinking water per person per day.

- Other sources of supply are not considered to be ‘improved’:
 - unprotected dug well;
 - unprotected spring;
 - cart with small tank/drum;
 - tanker truck;
 - surface water (river, dam, pond, lake, stream, canal, irrigation channels);
 - bottled water (classification based on concerns

over the quantity of water, not the quality).

The ‘drinking water ladder’

During the ‘International Year of Sanitation’ in 2008, a new way of analyzing access to water was proposed based on a ‘drinking water ladder’. This ladder, presented in the table below, gives a more detailed view of the tendency for using improved water sources.

The category ‘improved water sources’ includes sources that, by nature of their construction or through active intervention, are protected from outside contamination, particularly fecal matter. These include piped water in a dwelling, plot or yard and other improved sources.

Drinking water coverage should, from now on, be presented as a three-step ladder that includes the proportion of the population using:

- Unimproved drinking water sources;
- Improved drinking water sources other than piped water;
- Water piped into a dwelling, plot or yard (running water at home).

However, no objective has been set relating to the respective proportions of the population to

TABLE 4. The drinking water ladder, adopted in 2008

IMPROVED WATER SOURCES		UNIMPROVED WATER SOURCES
Piped water on premises	Other improved water sources	
Piped household water connection located inside the user’s dwelling, plot or yard.	Public taps or standpipes, tube wells or boreholes, protected dug wells, protected springs and rainwater collection.	Unprotected dug well, unprotected spring, cart with small tank/drum, tanker truck and surface water (river, dam, lake, pond, stream, canal, irrigation channels), bottled water.

Source: Progress on Drinking-water and Sanitation, UNICEF and the World Health Organization, 2008

be supplied with drinking water by household connections and standpipes.

Access to water is a political issue

The fact that access to water and sanitation facilities has become a MDG has transformed the technical indicators into a political issue, which means uncertainty can persist over the quality of the data published; the relevance of certain estimation methods can also be questioned, as they often lead to systematic over-estimates.

The national political responsibility may lead some countries to:

- Use definitions adapted to the national situation which may differ from international definitions;
- Set more ambitious objectives than those recommended by international bodies.

The issues involved in defining certain situations precisely⁵⁰ and of implementing those definitions adopted in the field, should cause the person leading the water demand assessment to proceed with caution when making conclusions based on his analyses (field observation or estimate based on existing data). This is because the primary objective of gaining an understanding of access to water is to plan improvements: supply more households with facilities that are better suited to their needs and financial situation.

Future Evolution

Principle

More than any other indicator, access to water depends on the willingness of the public authorities to equip the town's population⁵¹; it is up to

these authorities to set the objectives for different timeframes. This constitutes the heart of what a water policy should be. The role of the socio-economist should be to assist the managers with their strategy, not replace them.

For access to water, is there a 'trend' of improvement or deterioration in access? The historical evolution of access to water will give an idea of what may happen in the future, as long as the water policy implemented thus far does not change. If there is a trend, this will naturally be one of deterioration as a result of population growth: to maintain the quality of access to water, this access must develop at the same pace as population growth, otherwise the situation will deteriorate.

The evolution can be quantitative (the number of network connections grows faster than the population) or qualitative (for example, the number of households supplied with water through a standpipe falls, but this results in certain households transferring to a household connection which increases the corresponding units of consumption).

Factors determining households' choice of a source of supply

Prior to making an investment decision on equipment and facilities, the public authorities need to be aware of households' opinions and expecta-

⁵⁰ For example, it is often difficult to distinguish between a shared connection and a neighbor vendor when in the field; many households prefer to state that they share the bill, rather than say they sell the water on (for a sizeable profit).

⁵¹ This willingness needs to be accompanied by appropriate pricing measures: the connection cost needs to be socially (and, to an extent, economically) adapted to the financial means of the majority, the water tariff should act both as an incentive for the poorest and as a deterrent to prevent wastage in the home.

tions so they can adapt the offer of improved services to demand.

The factors that determine or influence a household's demand for 'improved' water supply are relatively complex, as it is not only the household income that needs to be considered. There are three factors involved:

- *the households' socio-economic characteristics*: income, occupation, assets owned, as well as the size and composition of the household, the gender and level of education of the head of the household;
- *the availability, reliability*, the cost and the convenience (time spent fetching water) of existing sources of supply compared to those sources proposed;
- *the attitude of households* to the authorities' policy in the water and sanitation sector and to the water company.

Consideration of these factors, or at least a certain number of them, is a guarantee of success for service improvement programs: promotion of piped connections, increase in the number of standpipes, pricing modifications, change of billing frequency, social water policy, etc.

Forecasting assumptions

The assumptions that are ultimately used need to consider:

- *The national policy* that defines quantified targets and, if appropriate, the exact type of facilities that it intends to promote. This policy can, of course, be based on the MDGs, but can also be a lot more ambitious. The national policy can also be adapted by housing area (urban or rural), as well as by the size of the town (corresponding to different levels of service expected and so to different levels of investment by the state).

- *The local authority policy* that defines its own objectives for access to drinking water, for example by promoting a given source of water supply at a given price.

- *Planned pricing developments*: the cost of a connection for those households not already hooked up to the network and the cost of water used (fixed charges, consumption bracket).

- *The volumes of water available*, as a rapid change in access to water can lead to a boom in demand for water; the demand of newly connected households rises sharply from 20 liters per person per day to over 60. The satisfaction of a previously unsatisfied demand due to water scarcity (shut-offs, lack of pressure) also needs to be added to this increase.

There are many distinct phases to the forecasting period:

- *In the short-term*, up to 5 years, an assumption needs to be selected that is consistent with the national strategy. Where no national or local objective exists, the simplest solution is to adopt the Millennium Development Goals, provided that these have not already been reached or exceeded.

- *Between 7 to 10 years*, a period which usually corresponds to the timeframe for realizing on-going or planned projects and these projects need to be considered in the figures: the % of additional households connected to the network, number of additional people supplied by standpipe, kiosk, public tap, etc.

- *Over 10 years*, the forecast becomes a simple simulation that calculates the outcomes of the managers' given choice (even if these outcomes are major in terms of investment).

Domestic unit consumption

$$\text{Domestic demand for water} = \text{Total Population} \times \text{Access (source of water supply)} \times \text{Unit consumption (Per source of water supply)}$$

Definition

Unit consumption of domestic (potable) water is one of the most important strategic indicators in an assessment of demand for domestic water. Unit consumption makes up the third component of the demand for domestic water.

Indeed, the consumption of a household can vary widely depending on whether or not it is supplied with water through a household connection. Also, the water resource necessary to meet household demand if they are all connected to the network is a lot higher than that required if a large part of the population is supplied via standpipes.

Position of the problem

Definition

Unit consumption of water is the average daily consumption of a member of the household over a given period. It is expressed as:

liters per person per day

→ Below are 2 examples:

- **Connection to the public network:** a connected household of 7 people receives a bill for 30m³ from the town's water company that corresponds to two months of consumption: this consumption

equates to 500 liters per day, and so to a unit consumption of 71 liters/person/day.

- **Standpipe:** a household of 7 people obtaining water from a standpipe and washing their laundry in the river consumes 1,200 liters per week (figure determined from a household survey): this consumption equates to 171 liters per day and so to unit consumption of 24 liters/person/day.

Of course, this consumption can vary widely from one season to another, particularly in towns where there are insufficient resources during the dry season.

Inaccuracy is frequent

Many documents giving quantities consumed list these as 'consumption per person per day' with no further precision. These figures are questionable as they can correspond to very different situations:

- **The production of water per person⁵², i.e.:**

domestic consumption + non-domestic consumption
+ losses on the network

- **Total water consumption, i.e.:**

domestic consumption + non-domestic

⁵² i.e. 'leaving the treatment plant' or leaving the borehole.

TABLE 9. From production to the Unit Consumption of water

	L/PERS./DAY	% ²	L/PERS./DAY
Units of production	300 ¹		
Network yield i.e. . . . % Losses		45 % 55 %	
Total Consumption: Dom. + Non-dom.			135
% Non-domestic Consumption in Total Consumption		25 %	
Domestic Unit Consumption			101

¹ i.e. 22,500 m³/day for a town of 75,000 inhabitants.

² Assumptions (values often noted in Africa).

➔ **For example:** Published unit consumption is 300 liters per person per day. Where there are ‘units of production’ in a town where the yield of the network stands at 45% and where non-domestic consumption represents 25% of total consumption, then domestic unit consumption equates to 101 liters per person per day. Therefore 101 = 300: it all depends on what is being discussed.

- the Potable Water and/or Sanitation Master Plan;
- studies conducted for projects in certain neighborhoods: standpipe installation, network development in a given neighborhood, feasibility study for a water or sewage treatment plant, etc.;
- etc.

It is often possible to find partial information, such as unit consumption for a given source of supply (network connection – in the house and/or yard, standpipes, etc.), or for a specific type of housing in the town studied (detached house, leasehold, social housing, prestige housing, isolated house, house converted into flats, etc.), or for a given geographical area. This information is precious, especially where no other data is available: rational assumptions for the whole town will be based on this information.

Historical evolution

Analysis of the historical evolution of unit consumption can usually be dealt with quite quickly as sources of information are rare or non-existent. Indeed, only specialized studies can provide this type of information and these are few and far between:

Current consumption

There are several possible approaches for identifying the unit consumption of water:

Existing data

It is, of course, recommended that recent and quality data be used where this exists and relates to the geographical area for which the demand for water is to be calculated.

Usually, the only figures available are those from the water and/or sanitation company, which only deal with consumption per meter reading area and not unit consumption. It is always possible to calculate unit consumption but this is far from simple as the boundaries of the meter reading areas are rarely the same as those of the areas established by the administration, urban planning services or those set up for carrying out the population census⁵³. It is therefore necessary to:

- make the area boundaries consistent;
- for each area, calculate the current population and the volumes of water consumed.

Direct observation

This direct observation is carried out from a household survey conducted within the framework of a water demand assessment.

• For households connected to the public network, there are two cases to be examined:

- The connection is equipped with a meter (that works): ask to see the last bill (or 2 or 3 most recent bills), copy down the number of m³ from the bill and the dates the meter was read; then, where there is a shared connection or neighbor vendor, calculate the household consumption by subtracting the volumes sold on. With these

elements, it is possible to calculate daily consumption by dividing the volume read by the number of days between the two meter readings.

- The connection is not equipped with a meter, so there is usually fixed rate billing⁵⁴: consumption is renowned for being unknown. However, if the tap is not in the house but in the yard, try to count the buckets and bowls carried from the tap to the house each day and estimate consumption in this way (there is, however, a high risk of underestimating consumption owing to the short distance between the tap and the house).

• For households not connected to the public network (including those households supplied by a neighbor vendor), proceed by estimating consumption for each main use⁵⁵, per week (as certain activities only take place twice a week): for each, identify the type of container used, the number of containers used per trip (where such a trip is necessary) and per person, the number of trips per day, the frequency of trips per week. With these elements it is easy to calculate weekly consumption and so daily consumption.

To calculate consumption per person per day, divide the daily consumption by the number of people concerned (information collected at the start of the interview with the question: 'how many people live in this dwelling?'). Please see the examples on the following page.

⁵³ This division into areas, called 'census cartography' consists of dividing the national territory into small geographical areas that contain an equal number of inhabitants.

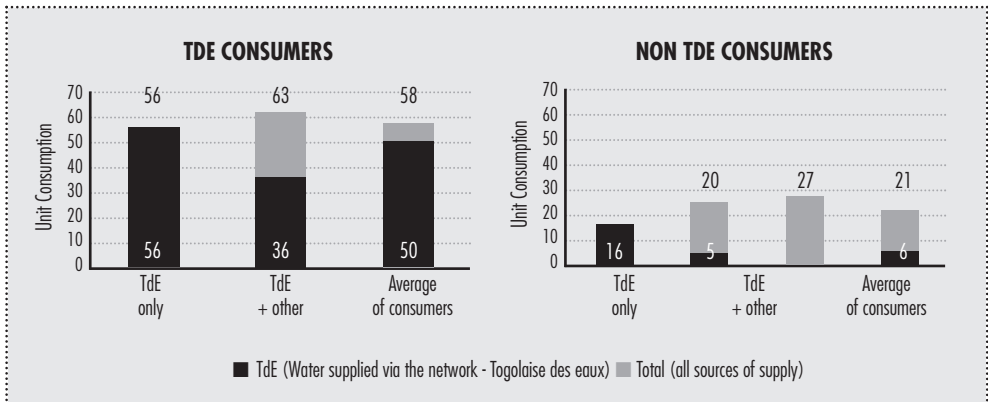
⁵⁴ Possible to calculate based on past consumption, 'from the time when the meter functioned correctly'.

⁵⁵ In general, 5 uses are considered: eating and drinking, washing up, personal hygiene, laundry washing, latrine use and possibly 'other' for watering the garden or for animals, etc. However, the sole purpose of this distinction is to facilitate the calculation of total consumption without omitting anything: for example, thanks to this approach, the interviewer is systematically led to asking a question on the amount of water consumed for washing laundry. The breakdown of water consumption by use is usually too approximate to be exploited.

► **Two examples:** Lomé in Togo in 2007 and urban Gabon in 2003. Notes on the two examples (see Figure 8 and Table 10): this data shows the extent to which unit consumption can vary

depending on the source of water supply, but also on the size of the town (Gabon, 2003), or where there is recourse to more than one supply source (Lomé, 2007).

FIGURE 8. Households' unit consumption by source of water supply - Lomé (Togo), 2007



Source: Programme d'amélioration de l'alimentation en eau potable de la Ville de Lomé - Etude d'identification et de faisabilité - op. cit.

TABLE 10. Unit Consumption by source of water supply, by town (Gabon, 2003)

	LIBREVILLE	PORT-GENTIL	FRANCEVILLE	LAMBARÉNÉ	FOUGAMOU	URBAN GABON
	<i>Unit: liters / person / day</i>					
Source of water supply (main source)						
SEEG ¹ connection in the house	144	130	120	117	91	138
SEEG connection in the yard	104	82	74	83	66	93
SEEG connection (house or yards)	130	107	94	98	74	111
Neighbor vendor	50	52	45	40	48	50
Standpipe	39	53	47	38	44	40
Other	47	44	54	47	40	44

¹ SEEG: Société d'eau et d'énergie du Gabon (Gabonese Water and Energy Company)

Source: Enquête sur la consommation d'eau et d'électricité des ménages au Gabon - ECONEM 2004, Hoche Consultants, G. Roger, mars 2006.

Estimation

In order to be able to estimate unit consumption it is necessary to have statistical data on consumption and on the corresponding population supplied; this information can be provided by the water company.

<p>Unit consumption (based on source of supply)</p>	<p>=</p>	<p style="text-align: center;">Water consumption (in liters/person/day)</p> <p style="text-align: center;">..... (in liters/person/day)</p> <p style="text-align: center;">Population supplied by this source</p>
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- For the population connected to the network, consumption equates to those volumes listed, regardless of whether or not they were billed for by the water company (commercial losses⁵⁶). As for the population served, please refer to part 2 of Chapter 3: The demand for water that deals with access to water.
- For the population supplied through a standpipe, public tap or kiosk, the water company is only able to provide the volumes distributed by these sources of supply (these volumes equate to both consumption and wastage at the standpipes, which is often very high). Unfortunately, the corresponding population supplied by these sources is often unknown, thus preventing calculation of unit consumption (unless a specific study on counting this is put in place).

The specific, yet frequent, case of lack of meters warrants particular attention:

- if there are no connections equipped with meters: the volumes distributed are unknown. As a result, it is impossible to calculate unit consumption;
- if some connections are equipped with a meter, whilst others aren't, an assumption can be

⁵⁶ I.e. water used but not billed for: blocked connections or undercounting of the meter, but also fraudulent consumption (illegal connections, for example), poor estimates of consumption by users paying a fixed amount.

made: households with no meter have the same unit consumption as those with a meter.

Verification of values identified

There are scales of magnitude for unit consumption, below or above which the data and calculations should automatically be verified:

- Households connected to the network: quantities lower than 30 liters/person/day or higher than 200 liters should be considered as abnormally low or high. These values, of course, depend on the socio-economic level of the consumer⁵⁷: it may be that average household consumption for those living in large detached houses exceeds 200 liters per day, but this would need to be verified. In the same way, even if those households in disadvantaged neighborhoods have low consumption rates, it is difficult to imagine them consuming less than an average of 30 liters per day.
- Households supplied by a standpipe, public tap or kiosk, etc.: in urban areas, quantities lower than 15 liters/person/day or higher than 40 liters should be considered as abnormally

⁵⁷ The location of the tap within a plot strongly influences the level of consumption: if the tap is in the yard, consumption per person is at least 30% lower than when the tap is in the house.

low or high – even if households use a means of transport for bringing the water home from the standpipe.

These simple checks mean that errors can be avoided when calculating the demand for water. During this verification phase, the socio-economist may discover an unexpected explanation caused by an important local particularity.

From consumption to demand

In a town, consumption is often limited by poor service quality, as much for piped connections as for standpipes: shut offs, water available for only short periods of the day and lack of water pressure when it is available, all result in households being unable to consume as much water as they would like. As a result, consumption is less than demand and will remain so until the service quality is improved.

Unsatisfied demand is the difference in current consumption and actual demand, as expressed by the households (at the current price). This figure can only be established via a household survey that deals with this subject, either directly or indirectly (which is rarely the case).

- **Directly:** consumers need to be asked about their future behavior, **‘when the situation will have changed, when there is no longer a limit on consumption, when all the water required will be available 24 hours a day, 7 days a week, etc.’**. The interviewer therefore asks the interviewees to specify the additional quantities they would like to consume (over and above current consumption).

We can only recommend asking the question, as poor service quality makes it impossible for numerous households connected to the network to consume the desired quantities. The interviewer needs to take care here as households often find this question difficult to answer and make unrealistic statements; the interviewer needs to be able to immediately take stock of the situation and restructure the question by giving further explanations.

- **Indirectly,** by comparing (if possible) consumption between different types of household; those benefitting from good service quality and those suffering from poor service quality.

► **For example, in Kinshasa in 2005⁵⁸,** a strong correlation was observed between the consumption levels of a household with a connection and the operating conditions of this connection.

When the service is not continuous and there is low pressure, monthly consumption stands at 28m³ instead of 31m³ when there is a continuous service.

When the service is good in quality and continuity, volumes produced stand at 34.4m³/month, which is a difference of 5m³ compared to connections where consumption is limited due to water quality or continuity and pressure issues.

Here the impact on consumption of a ‘restricted’ household can be seen, which is lower than that which could be consumed were there satisfactory service conditions in place.

It is therefore possible to set the ‘actual’ demand at 35m³ per month (excluding resale), i.e. around 80 liters per day per person occupying the plot of land.

It is important to remember, however, that a number of households affected by lack of water at times when they need it can find sufficient amounts in storage: this enables them to have water available at any time of the day or night.

⁵⁸ Source: Schéma directeur d’alimentation en eau potable, Kinshasa, R.D. Congo, op. cit.

They receive water when it is available and store it in reservoirs (often below ground to make up for lack of pressure), then they use this water (by pumping it into a reservoir situated higher up) when the network no longer provides any. This practice is effective but it:

- is costly, not only in terms of the investment cost but also the operating cost (amortization and maintenance of the pumps and electricity);
- doesn't guarantee good water quality unless it is stored properly;
- can lead to wastage if the household disposes of the remaining water stored when running water returns.

Future evolution

Determining factors

What are the factors that best determine the evolution of unit consumption levels?

Service quality

Improvements to service quality can have a considerable influence on unit consumption: moving to a continuous 24 hour, 7 day a week service is a way of meeting unsatisfied demand; moving from water of poor quality (taste, smell, color) to better quality water can also induce users to increase their demand.

The source of the water supply

At individual level, it is clear that a household who exchanges use of a standpipe for a piped connection significantly increases its consumption, even when this household has a low income.

At collective level, the arrival of new households with low incomes and low rates of water consumption into a group of connected households can lead to a reduction in average unit consumption. However, this fall, purely mathematical, often only reflects an increase in access to water by piped connection and not a change in behavior of those households connected to the public network.

► For example: in a town...

The % of households connected to the public network was 50% in 2000. However, after efforts made by the municipality, this % should rise to 75% in 2015, due to an active policy of social connections linked to extension of the network to outlying neighborhoods.

The average unit consumption of connected households in 2000 was 65 liters per person per day. In 2015, the average unit consumption of connected households will be different as a result of incorporating households with much lower incomes and thus lower consumption rates. By posing the assumption that...

- The unit consumption of 'old' connected households (representing 50% of the population) remains the same: 65 liters per person per day;
- The 'new' connected households (representing 20% of the population) have much lower consumption: e.g. 40 liters per person per day;

... average consumption (of the total) of households connected will change from 65 liters in 2000 to 57 liters in 2015, without the consumption behavior of the connected households having changed.

The price of water

The price of water has a definite influence on consumption, but this is more for those poorer households. Indeed, from a certain socio-economic level upwards, there is no real reason for a household's consumption that is already high to increase further.

Everything depends on the sanitation facilities contained in the dwelling:

- where there is a shower with piped water and toilets with piped water, then consumption is a lot higher;
- if there is a garden that is regularly watered, then consumption is a lot higher;
- if the plot is used for livestock breeding, then consumption can be much higher⁵⁹.

To take an increase in the price of water into account, the concept of elasticity is often used; this measures how consumption responds to a variation in price ('price elasticity of demand'): price elasticity of demand is the relationship between the percentage of variation in demand for an item and the percentage of variation in the price of this item.

The result is often negative as, when the price increases, demand falls and vice versa. For example, where the average value of elasticity is -0.2⁶⁰, a 10% increase in the water price will lead to a 2.0% reduction in unit consumption.

The price of water, frequency of billing and amount billed: with the same consumption and the same tariff, the more frequently the water company bills households, the lower the bill and vice versa. However, for households, the most important factor is the amount they have to pay when they receive the bill, every month, every two months, every three months, etc.

Billing frequency has a large impact on the poorest households: living from hand to mouth, they are often not able to keep aside the money that they should – and often can – save for the water bill without spending it for 1, 2 or 3 months. Such a household can, in fact, pay 100 CFA Francs per day for water, yet be incapable

of paying 3,000 CFA Francs each month, and a fortiori 6,000 CFA Francs every two months. It is, therefore, vital to take billing frequency into account in water price simulations as the number of unpaid bills, and so temporary or permanent cut-offs, at least partially depend on this⁶¹. This water price aspect needs to be systematically tested during the household surveys.

The socio-economic level of households

The socio-economic level of households can greatly influence consumption: when their standard of living increases, households are in a better position to equip their dwelling, notably with sanitation facilities:

- Shower: washing without piped water that consumes a few liters (15 liters maximum) is exchanged for a shower with piped water (that can use up to 30 liters or more);
- Toilets (WC): the situation changes from using virtually no water in the latrines, less than one liter of water in improved latrines, to using over 10 liters per visit to a toilet with a flushing system that uses piped water.

The concept of elasticity is often used when considering the increase in households' standard of living; this elasticity shows how consumption responds to a variation in the households' living standards ('income elasticity of demand'):

59 For livestock breeding, the following consumption ratios can be used: 80 to 100 liters per day for a cow, 20 liters for a calf; 20 liters for a mother sow, 10 liters for a porker, 5 liters for a piglet; 0.2 liters for a hen, 0.15 for a chick, 0.45 for a turkey, etc.

60 This value is within the value range usually observed in sub-Saharan Africa.

61 This frequency is a determining factor for microcredit, where it is possible to make weekly repayments; water companies could take inspiration from this experience and these practices.

income elasticity of demand is the relationship between the percentage of variation in demand for an item and the percentage of variation in income.

This result is often positive as, when income increases, demand increases at the same rate. For example, where the average value of elasticity is 0.35⁶², a 10% increase in income will lead to an increase in unit consumption of 3.5%.

Awareness-raising activities for reducing consumption

In cases of severe water shortages, the water company, in agreement with the local authority, may decide to implement water saving activities to reduce the consumption of those households connected to the network. As for health and hygiene education programs, these activities can bring about significant results if they are repeated over a long enough period.

It is also possible to introduce a 'marketing multiplier' to identify the likely effects of a proper sales policy introduced by the water company to increase sales to households or, alternatively, to reduce demand.

For example, taking a multiplier of 1.5 (policy aimed at increasing demand) and applying this to income elasticity of demand increases this income elasticity from 0.35 to 0.53 (0.35×1.5). In contrast, a policy of controlling demand gives a negative coefficient, for example -1.5, which changes the price elasticity of demand.

Needs: unit consumption and health risk

There are many figures in circulation that claim to provide 'standards' for unit consumption; however, these figures are often contradictory. The Table

(p. 86) specifies the different levels of health risk in an open and rational manner.

There is a range that can be clearly identified from this table:

– 20 liters per person per day is the level below which there is a high or very high health risk (this figure more or less equates to anticipated average consumption at a standpipe);

– 50 liters per person per day corresponds to a situation that is barely acceptable but a lot less problematic.

These value ranges are essential for setting objectives for future demand for water in a town, paying particular attention to the most disadvantaged neighborhoods.

Unit consumption standards

These consumption standards largely depend on the source of the water supply:

For households connected to the public network

It is difficult to use anything but a range of values as the initial situation varies from one town to another and even from one neighborhood to another, within the same town.

- There is no minimum as many households in some towns consume very little, often fewer than 50 liters per person per day. However, it is difficult to imagine this situation staying the same over the next 10 to 20 years, all the more so since the determining factors for demand can be brought into play: for example, the water price, availability of water (times, quantities), etc.
- The maximum, to be imposed regardless of expectations, should be set at around 150 liters

⁶² This value is within the value range usually observed in Sub-Saharan Africa.

on average⁶³. Anything above this amount should be considered as wastage in the home.

Prior to setting a standard, it is useful to know the breakdown of connected households by location of the connection on the plot (in the house or yard): consumption for households with a connection inside the house is at least 30% higher than that of households where the pipe is in the yard.

For households connected to the public network

It is difficult to use anything but a range of values as the initial situation varies from one town to

63 It is clear that this average conceals disparities relating to the type of dwelling: consumption is higher in an individual house than in an apartment building.

another and even from one neighborhood to another, within the same town.

- There is no minimum as many households in some towns consume very little, often fewer than 50 liters per person per day. However, it is difficult to imagine this situation staying the same over the next 10 to 20 years, all the more so since the determining factors for demand can be brought into play: for example, the water price, availability of water (times, quantities), etc.
- The maximum, to be imposed regardless of expectations, should be set at around 150 liters on average . Anything above this amount should be considered as wastage in the home.

Prior to setting a standard, it is useful to know the

TABLE 11 . Unit consumption of water, needs and health risk met

SERVICE LEVEL	ACCESS MEASURE	NEEDS MET	LEVEL OF HEALTH CONCERN
No access: < 5l./pers./day	> 1.000m. or 30 minutes total collection time	Consumption cannot be assured. Hygiene – not possible (unless practiced at source). ¹	Very high
Basic access: ≤ 20l./pers./d.	Between 100m and 1000m. or between 5 and 30 minutes total collection time.	Consumption should be assured: – Handwashing and basic food hygiene possible; – Laundry/bathing difficult to assure unless carried out at source.	High
Intermediate access: 50l./pers./d. on average	Water delivered through one tap on-plot, or within 100m, or 5 minutes total collection time.	Consumption and hygiene are assured: – All basic personal and food hygiene assured; – Laundry and bathing should also be assured.	Low
Optimal access: 100l./pers./d. and +	Water supplied through multiple taps continuously.	Consumption: all needs met. Hygiene: all needs should be met.	Very low
The intermittent supply of water usually reduces consumption and increases the health risk.			

Source: Domestic Water Quantity, Service, Level and Health - WHO/SDE/WSH/03.02 - Guy Howard et Jamie Bartram, 2003

breakdown of connected households by location of the connection on the plot (in the house or yard): consumption for households with a connection inside the house is at least 30% higher than that of households where the pipe is in the yard.

For households supplied by standpipe

It is almost impossible for unit consumption of water at standpipes to be increased. Of course, it is possible to reduce the distance between the household's dwelling and the standpipe, but this has little impact on unit consumption, as the fact the water must be transported is a major constraint that leads households to economize.

The standard proposed for the urban context is

30 liters per person per day

i.e. 23 liters of actual consumption and 7 liters of wastage around the standpipes⁶⁴.

Remember that, in urban areas, standpipes should be considered as a temporary source of water supply (as, in time, there should be a tendency towards individual household connections, which are more practical and offer better guarantees for health).

Forecasting assumptions

As for access to water, unit consumption depends on the willingness of the public authorities to develop the water service for the town's

population; it is up to these authorities to set the different objectives and timeframes.

The role of the person in charge of the assessment should be to assist the decision-makers in their planning as part of an organized consultation process, not replace them. Indeed, it is these decision-makers who are charged with developing and leading the town's water policy, which should normally strive for significant progress to be made in the quality of the service (particularly in terms of quantity and continuity).

It is clear that the assumptions retained need to take into consideration:

- The national policy, which may have set quantified objectives per means of access: a national average, which is sometimes adjusted according to type of housing area (urban or rural), but also according to the size of the town or village (this corresponds to different levels of expected service and so to different levels of state investment);

► **For example**, in Burkina Faso⁶⁵, the National Program for Water Supply and Sanitation has defined the following objectives which are to be achieved by 2015 in urban areas:

- Household connection: 57 liters per person per day;
- Standpipe: 37 liters per person per day.

- Planned price increases;

- Volumes of water available, as a significant increase in the service quality based on an improved water offer can lead to a real explosion in demand from those households with a connection.

64 The intensity of wastage largely depends on the way in which the standpipe is managed: if it is under private management, then the attendant tends to eliminate those volumes that he cannot bill; wastage is therefore very low. Where the water is distributed free-of-charge and no-one is responsible for daily management of the standpipe (notably, opening and closing the tap and technical maintenance), however, then wastage can be very high.

65 Source: *Programme national d'approvisionnement en eau Potable et d'assainissement à l'horizon 2015 (National Program for Potable Water Supply and Sanitation up to 2015)*, PN-AEPA 2015, Document de programme, Ministère de l'Agriculture, de l'Hydraulique et des Ressources halieutiques, November 2006.

Total domestic demand

The total demand for domestic water is the most important component of a water demand assessment as it nearly always represents 2/3 of the total demand (domestic and non-domestic). The basic equation is as follows:

$$\text{Domestic demand for water} = \text{Total Population} \times \text{Access (source of water supply)} \times \text{Unit consumption (Per source of water supply)}$$

Demand at the consumer's

Once all components of domestic demand have been studied, the elements are in place for calculating the domestic demand. However, this means the demand located at the consumer's, directly outside his dwelling.

To facilitate the calculation of total demand, it is advisable to examine all of the demand components using separate spreadsheets: one for the population; one for access to water; one for unit consumption. Each spreadsheet is linked to a central sheet where calculation of the total domestic demand is carried out.

The calculation needs to be conducted by considering all the geographical areas included in the assessment, as well as each year between the forecast start and end dates:

- around a maximum of ten geographical areas, as it is difficult to obtain reliable information on access, and especially unit consumption, at a more refined level⁶⁶.
- about twenty years, from the first year of the forecast (which corresponds to the current situa-

tion) to the year the forecast ends (which corresponds to the end of the project).

Demand at utility level

Demand is translated into need through the yield of the public network. This aspect is dealt with in part 6 of this chapter, which is dedicated to total demand.

⁶⁶ Although it is unlikely, it is not impossible to have sufficient information at a refined geographical level. The following are required for this:

- the General Population and Housing Census that was conducted a maximum of 1 to 2 years prior to the water demand assessment;
- the consumption of households with an individual connection and by stand-pipe, identified at the same time.

Consequently, access, the average number of people per connection and unit consumption can be calculated.

Indeed, the census provides a good opportunity for mapping access to water and means of sanitation, as long as the data by small geographical area (known as 'Enumeration Areas' or 'Census Tracts') is communicated shortly after the census has been carried out in the field.

Non-domestic demand

Non-domestic water is that which is used by consumers other than individual households; these can be commercial or industrial, or administrative and/or not-for-profit consumers (whereby the latter is often referred to as 'institutional demand').

Remember that a water demand assessment looks at:

- All water consumed, currently and in the future, not only that coming from the public network, but also other sources of supply. Indeed, the demand assessment should enable a comprehensive appraisal of the water resources required to meet total demand (whether currently satisfied or not), and particularly of the current state and future development of the groundwater table(s) used, as well as rivers.
- The town perimeter at the end of the project. These elements, examined in Chapter 2, are taken up again for the non-domestic water demand assessment: perimeter (present and future), population (current and future), land use (current and future), with the emphasis on non-residential types of land use.

Position of the problem

The consumption of non-domestic water evolves according to 5 different models:

1. **One part, called 'local'**, is closely linked to the presence of people in a given geographical

area: it equates to modest-sized activities that are commercial (such as shops or local services, workshops or crafts, small industries) or administrative (such as children's play areas and primary schools, dispensaries and first aid centers, local administrative services).

Its evolution is directly linked to domestic consumption in the area and the corresponding quantities can therefore be subtracted from the non-domestic consumption figures. To estimate the corresponding future demand, it is possible to apply a certain percentage to domestic consumption: most often between 10% and 20%.

2. **There is also a part that is closely linked to the town's administrative functions**, both national and local: this equates to the largest administrations (notably, parks and gardens, the prison, police and army camps, etc.), to religious institutions and NGOs, etc. The evolution of this consumption is tied to the development of the administrative, cultural and political functions of the town: it is relatively difficult to predict.

3. **Another part is closely linked to the town's industrial, commercial and service functions**: this corresponds to the main industries, commercial buildings, markets, commercial port, etc., not including local activities or large building sites. The evolution of this consumption is linked to the water price, as well as to local and national economic development; but also to the businesses' specific strategies, such as the investment policies of large companies who already have a production unit in the town, and/or to

the willingness of new companies to settle in the town, etc.

4. One part often equates to agricultural activities that may exist within the town's perimeter, for example, truck gardening activities. The majority of truck gardeners get the water they use directly from the groundwater table via private boreholes⁶⁷.

5. Yet another part is closely linked to the town's population growth (considered in total): this more or less equates to large consumers, such as secondary and high schools, polytechnics, universities, hospitals, etc. The evolution of this consumption is tied to population growth, as well as advances in schooling and health.

Identifying the different types of non-domestic consumers

In practical terms, who are the different types of non-domestic consumers and how can they be identified?

Non-domestic consumers connected to the network

If the consumer is connected to the public network, they will feature in the water company's consumer files (with one or more connections). As a result, the name of this consumer (with more or less the correct spelling) is easily established. Sometimes, the connections are given a code to denote the 'use of the building'.

⁶⁷ Most of the time, they don't pay a fee to local authorities for this water because there is no clear regulation requiring them to do so. de le faire.

The majority of water companies don't properly name the actual activities; this prevents identification of the non-domestic consumer's field of economic activity. It is therefore necessary to base identification on the pricing category, which more or less fulfills the same function. The pricing terminology is often very imprecise, as it was created to apply a tariff not to identify the consumer. The terminology often has two major shortcomings:

- **The distinction between domestic consumer and non-domestic consumer** (where the consumer is not identified by its name, for example) is often difficult, all the more so as this has pricing implications. This distinction is vital, however. This distinction is all the more complicated when the use of the connection is mixed, i.e. if the consumer uses the water for both family and professional use. How are such connections to be classified? Including them in the domestic category leads to over-estimates of access and unit consumption; excluding them has the opposite effect.
- **Identifying the type of economic activity of the non-domestic consumer** is often very difficult (if nothing is known about this consumer). Yet analysis by sector is important for forecasting the non-domestic demand of 'average consumers'.

Non-domestic consumers not connected to the network

If an organization is not connected to the public network, it will not feature in the water company's consumer files. It needs to be clearly identified, and then examined to ascertain its source of water supply, its consumption and the type of sanitation facilities it uses.

Water extracted from private boreholes is mainly used in the food industry and, also perhaps, for

irrigating truck gardens. This water can represent a sizeable part of total non-domestic consumption; however, the quantities are often underestimated as a large number of boreholes are not included⁶⁸.

Knowledge of this consumption is very important for sanitation assessments, for which a quantitative and qualitative understanding of the total wastewater discharge is essential.

Conclusion

Once this information has been established, a list of non-domestic consumers is compiled and then arranged in descending order of consumption to identify: the largest consumers; those so-called 'local' consumers, who can be defined as the smallest consumers; the average consumers who constitute an intermediate category. This is important as the dynamics of consumption growth are very different for a large consumer compared to those for a small consumer.

⁶⁸ Authorization from the administration is often required before constructing a borehole; the administration needs to have detailed knowledge of data processing techniques. Furthermore, the owners of these boreholes often have to pay a pumping tax, i.e. a few CFA Francs per m³ extracted. In fact, the administration considers these as fairly negligible, although they don't have precise figures relating to consumption.

Large consumers

Definition

Large consumers are dealt with separately as their consumption levels are so high and the proportion of this consumption in total non-domestic consumption is also high: often over 60% for the 30 largest consumers. They often represent over 75% of industrial consumption, over 50% of administrative and municipal consumption, but a very small percentage of commercial consumption.

It is also possible to define those who consume more than a given amount of m³ per month as 'large consumers'. This means setting a lower limit that will vary from one town to the next (for example, 2,000m³ per month). Indeed, this criterion needs to be handled carefully as the lists produced by the water company concern the meters and not more general consumption units. As such, certain meters, considered in isolation, may show low consumption yet belong to a group that constitutes a large consumer: the army, police, university, etc.

These consumers have consumption behaviors that are very different to those of households, as the issues are not at all the same.

TABLE 12. Types of consumer: distinctive issues

LARGE CONSUMERS	DOMESTIC CLIENTS (HOUSEHOLDS)
Individual issues, sensitive for the water company	Individual issues, negligible for the water company
Low number of users (a few hundred or thousand), enabling case by case handling and requiring refined statistical monitoring	Large number of users, requiring simple regulations and a minimum of different handling methods
High water price elasticity: Stakeholders in 'management behavior' ¹	Very low water price elasticity

1. Except, perhaps, for the majority of administrations.

These consumers are unique, each in its sector and in the town. It is for this reason that the assessment to be undertaken should not rely on consideration of national sector development: it needs to be individualized.

Direct field observation

Objectives

The objective of the assessment is to produce information on non-domestic consumption that does not currently exist, for example:

- the sources of water supply other than the public network (often called 'alternative'), the quantities consumed and related costs;
- the needs of the large consumers, in quantities (volumes) and service quality;
- future developments in their activity in the town over the course of the next few years.

List of large consumers

The list of large consumers is established from the water company's list of non-domestic consumers, ranked in descending order of consumption rates, from the largest to the smallest. The first thirty consumers are taken from this list, to which any large consumers not listed can be added if necessary.

Survey method

The survey method needs to be semi-quantitative as, on the one hand, there are a small number of large consumers to be questioned and, on the other hand, the subjects dealt with come out of a qualitative approach. Given the issues and low number of units observed, the in-depth interviews need to be conducted by someone at quite a high level, familiar with the approach: preferably an engineer open to questions that

are not strictly technical, and/or a sociologist aware of the technical and financial aspects of water. Therefore, a closed questionnaire is not used as for statistical surveys, but rather a very open interview guide.

The main problem with these interviews, beyond the fact that it is difficult to obtain an appointment, stems from the fact that:

- the information required comes from different people within the company: the general director, the technical director and the finance director;
- there can be large-scale fraud: illegal connections, undeclared boreholes (and/or those for which production is seriously under declared); careless disposal of untreated or insufficiently treated wastewater, etc.

Interview guide

The interview guide contains the list of topics to be raised and is created in conjunction with all parties involved: institutional partners, but also the consumers. It is developed from information collected during several exploratory interviews carried out beforehand by the project's socio-economist. Of course, it is not fixed: it can evolve over the course of the interviews to further develop certain specific questions.

The interview guide covers the various aspects of water consumption, notably:

- *the characteristics of the organization*: activity and process, surface area (plot, buildings) of the unit, seasonal variations in the activity, staff employed, etc., sector development prospects;
- *source(s) of water supply*, water storage, quantities consumed (broken down by source of supply);
- *cost of water*, from the network and other sources (for example, the operating cost of borehole(s) and amortization);

- *volumes of wastewater discharged*, wastewater treatment method, quality of the wastewater discharged;
- *opinion of the current situation* (/satisfaction);
- *expectations for the future*: volumes distributed (unsatisfied demand?), shut-offs, pressure, quality specifications, etc.;
- *the organization's development prospects*, in the town and elsewhere in the country (or even abroad, depending on the policy of the organization's parent company, if it has one);
- *water consumption prospects*: changes in process (short-term, long-term, etc.).

Processing

The questionnaires can either be processed manually or by computer using the appropriate software.

Calculating the demand for water

Calculations are made from the large consumers' survey data, which includes, in part, (past and present) consumption taken from the client database.

Current situation

The current situation is established from the data collected during the survey, remembering to take the all the water consumed into account.

Forecasting

- **In the short-term** (from 5 to 7 years), from the statements of those organizations met, as these statements are usually clear;
- **In the longer term**, the organizations' statements become more vague and uncertain. It is necessary to:

- consider the main projects for setting up industrial, commercial and administrative sites;
- cross-reference the information that these provide with the national and local sectoral economic prospects;
- prevent the organization's water consumption increasing indefinitely, as the development of its activity is limited by land boundaries due to the configuration of the buildings and the size of the plot on which the organization is situated.

Local consumption

Definition

Local consumption corresponds to those small consumers using less than 5 to 10m³ per day.

The very definition of local consumption is twofold. It is:

- Domestic as, generated by the presence of the population, it is domestic 'at its core'. Therefore, this local non-domestic consumption can be ascertained by applying a standard percentage to domestic consumption of around 10% to 20%.
- Non-domestic as it is listed as such (even though at least one part will often be included in the client file for domestic consumption).

Verifying the probability of the standard

It is always a good idea to check the probability of the result of the calculation by examining the water company's client list (from which the large consumers have been identified and isolated):

- Rank them in consumption size in ascending order, from the smallest to the largest consumer;

– Add the consumption together from the top down, then check the level on the list that corresponds to the volume of water calculated using the standard of 15% of domestic consumption: if this level corresponds to a consumer who apparently has a level of consumption too high to be considered ‘small’, then the standard of 15% is too high and will need to be reduced.

Average consumers

The ‘average consumers’ are defined almost as a category by default, in the sense that they are the consumers who remain once the large and small consumers have been removed from the list (also studied in the ‘local’ category).

‘Administrative’ consumption

The administrative ‘average consumers’ essentially correspond to the average size social services (health and education) and national and local administrative services. Indeed, the hospital and the town’s largest education establishments (university, secondary schools, high schools), as well as the police or military camp, usually figure among the large consumers.

Social sectors

The water consumption of health and education establishments is closely linked to the number of pupils attending the schools and the number of patients in the healthcare centers. The number of pupils (and staff) is required for each education establishment, as well as the number of beds per healthcare center.

- **The current situation needs** to be analyzed in order to establish the local standards (or averages): by dividing their consumption over a given year by the number of their pupils or patients, average consumption can be ascertained per pupil⁶⁹ and per patient (or rather per bed). These averages enable the management quality of the establishment concerned to be evaluated: if the calculated unit consumption is a lot higher than the standards, there is likely to be wastage within the establishment.

The most commonly used standards are:

- *in schools*: around 45 liters per pupil (day pupil) per day, based on between 180 and 200 teaching days;

- *in hospitals*: from 300 liters to 600 liters per bed per day (over 365 days), depending on the size and standard of facilities in the establishment.

- **The forecast** can then be established without difficulty:

- by forecasting the number of pupils in the schools, taking projects to build new establishments into account, as well as population growth and improvements in schooling, notably in secondary education;

- by forecasting the number of hospital beds, based on the health policy;

- by using the published standards that should be met (rising where there is a water shortage or falling where there is wastage) within a few years (between 5 and 10 years).

Other administrative services

- **The current situation** corresponds to figures provided by the water company.

⁶⁹ To be calculated based on the number of days the schools are open, i.e. between 180 and 200 (this figure varies from country to country).

The case of gardens and other open spaces should not be treated separately, not even that of markets where consumption is often high; in addition, fire hydrants, where these exist, should also be taken into consideration. However, it is a good idea to analyze the corresponding consumption to check if there is any wastage, i.e. if those quantities consumed are reasonable or not for the areas watered.

- **For the forecast**, the number of the establishments' clients (staff and especially visitors) is not known. There are two approaches open to the socio-economist:

- Analyze urban development forecasts, which enable the socio-economist to consider any increase in surface area reserved for administrative buildings, and so increases in corresponding consumption. In this case, a standard of consumption per hectare (often established during an analysis of the current situation) is used.

- Review any policies to combat wastage (rehabilitation of public buildings, staff information campaigns, etc.) and so reduce consumption.

Industrial, commercial and service consumption

The industrial, commercial and service 'average consumers' essentially correspond to industries and to medium-sized commercial and service establishments.

Current situation

The current situation is considered as known: this comes from figures provided by the water company, supplemented as much as possible by information coming from those establishments not supplied by the public network.

Once this figure has been identified, a distinction needs to be made between the main types of economic activity; certain types consume a lot more water than others and certain sectors will experience faster growth than others.

Forecast

For the forecast, the problem is twofold, as certain activities are already up and running, whereas others aren't as yet but should emerge over the next 20 to 30 years.

For those activities currently in existence, macro-economic forecasts are used. The growth rate of GDP per sector⁷⁰ also enables consumption forecasts to be made broken down by type of activity.

To calculate growth rates, it is necessary to use the national macro-economic forecasts per sector which are usually established by the Office for National Statistics or by the Forecasting Directorate of the Ministry of Finance. These forecasts look at the next 5 or 10 years; the trends should, therefore, be extended by considering the suggestions made by the forecasts' authors (whom it is advisable to consult).

For activities to be created in the future, i.e. those which will move to the town over the next few years, the urban development forecasts should be used as this enables any increase in surface areas reserved for industrial, commercial or service use to be taken into account and thus the corresponding consumption. In this case, the standards of consumption per hectare are used (often coming from an analysis of the current situation, as a distinction must be made between different types of activity, notably between dry and wet industries).

⁷⁰ National (and not regional) data is usually used as this is often the only data available.

The socio-economist can ensure consistency and potentially amend the results by adding together the 2 sets of data above and by comparing the forecasts obtained using the 2 approaches.

Agricultural consumption

The agricultural 'average consumers' essentially correspond to medium-sized truck gardeners.

Current situation

In most cases, it is difficult, if not impossible, to ascertain the current situation as the water used doesn't usually come from the public drinking water network: it is pumped directly from the groundwater table or from a nearby river; it can also come from a treatment plant that delivers recycled water. The approach consists of:

- calculating the standard for consumption per hectare: a brief survey of truck gardeners and other farmers who carry out irrigation within the

town's perimeter is recommended to identify their number and, above all, to estimate consumption. A direct estimate may be difficult; however, a mini-survey can be conducted to establish the standard for consumption per hectare;

- using figures from the urban planner on the type of 'agricultural' land use to ascertain the surface area currently given over to agricultural activities.

Forecast

The forecast consists of:

- using the urban development forecasts that provide the number of hectares used for agriculture over different forecasting timescales;
- assuming that the current standard for water consumption per hectare will fall over time due to the dual effect of cultural practices' improvement programs and of the price of water for irrigation.

Total demand: Domestic + Non-domestic

The basic equation for calculating demand for water is as follows:

$$\text{Total demand for water} = \text{domestic demand} + \text{non-domestic demand}$$

Domestic demand is the most important component of a water demand assessment as, in the majority of cases, it represents 2/3 of total demand, with non-domestic demand making up the other 1/3.

Demand at the consumer's

Once both components of demand have been analyzed, the necessary elements will be in place for calculating the total demand. However, this corresponds to demand at the consumer's, just outside the dwelling (where the water meter is located).

In order to facilitate calculation of total demand, it is advisable to analyze each component of this demand using separate spreadsheets (grouped into two separate files, if necessary). To ensure easier and quicker calculations, the set of assumptions needs to be clearly separated from the data.

– *Four spreadsheets for domestic demand*: one for the population; one for access to water; one for unit consumption; one for the domestic sub-total.

– *Four spreadsheets for non-domestic demand*: one for local non-domestic demand; one for large consumers; one for average consumers; one for the non-domestic sub-total.

– *One for total demand*.

Each spreadsheet is linked to the sub-total spreadsheet, which in turn is linked to the summary spreadsheet used for calculating the total demand.

Results: general cases

The calculation needs to be set up in such a way as to ensure that all geographical areas used in the study and each year between the forecast start and end dates are taken into account. This will:

- include around a maximum of ten geographical areas, as it is difficult to find reliable information on access and, particularly, unit consumption at a more refined level⁷¹;
- cover the twenty years that separate the year the forecast begins (which equates to the current situation) and the year the forecast ends (which equates to the end of the project).

⁷¹ Although unlikely, it is not impossible to find adequate information at a refined geographical level.

Results: the specific case of pricing studies

For pricing studies, there needs to be a break-down of demand aligned to the particular requirements of the study:

- **Cost of connection:** the results mainly come from the survey on capacity to pay/willingness to pay (see Chapter 5, part 1, pp. 128-138 for more information). However, it is important not to exclude the price of water itself from this approach as it is the total amount of the bill that is important for households, i.e. the total comprised of the cost of the connection (paid for monthly on credit) and of the water tariff for household consumption: this amount needs to be aligned to the financial means of the household;
- **Water tariff:** the results, i.e. demand expressed in m³, need to be broken down by consumer category (domestic/non-domestic) and by consumption groups, of which there should be a sufficiently refined number to enable different consumption bracket groupings to be tested.

Demand at utility level

It is not the socio-economist's responsibility to transform the demand for water at the property (or 'at the meter') into production.

Identifying the network yield is a technique that varies depending on the state of the network and its management. The increase in yield over the years is the responsibility of the engineers charged with defining appropriate maintenance and investment programs: improvements stem from the water company's strategy, based on obligations of service quality imposed by the supervisory authorities.

However, the person in charge of the assessment may make calculations using the values provided to him by the engineers.

Demand at utility level, usually called 'water production' is calculated in the following way:

$$\text{Water production} = \frac{\text{Demand at the property}^{72} \text{ (in m}^3\text{)}}{\text{Network yield (in \%)}}$$

72 Not including volumes provided by alternative supply sources, i.e. individual connections, standpipes





CHAPTER 4

The demand for sanitation

Definition

PS-Eau responds to this question by highlighting that sanitation includes:

- **distancing household water** (bathing, washing up, cleaning floors) and wastewater (excreta⁷⁴) from dwellings, reducing pollution, then treating the water before returning it to the environment;
- **improving hygiene conditions**; these largely depend on the inhabitants' habits and practices;
- **promoting related behaviors**, such as hand-washing and maintenance of facilities, preserving the environment and habitat.

This definition enables more precise identification of the main topics to be covered by an assessment of demand for sanitation.

Need for sanitation

The extent to which poor sanitary conditions (i.e. the careless discharge of wastewater into the environment) can impact on the population's health has been recognized for many years now. The proximity of wastewater can lead to

73 Source: *L'assainissement dans les pays en développement: ne rien faire, c'est laisser faire ! Les acteurs français s'engagent, (Sanitation in Developing Countries: doing nothing is not intervening! French stakeholders are engaged)* ARENE, pS-Eau, SIAAP, November 2006.

74 Also called 'blackwater', as opposed to household water (also called 'greywater').

fecal-oral transmitted diseases (diarrhea, typhoid, hepatitis, cholera), or carrier diseases (malaria, filariasis, dengue fever). Other illnesses are also linked to poor basic sanitation, particularly to faulty or non-existent latrines: schistosomiasis, nematodes or other worms.

Sanitation promotion documents also show that pollution of groundwater tables and waterways by wastewater and industrial discharges not only threatens the supply of drinking water, but also causes sometimes irreparable damage to the environment. As a result, due to lack of protection of catchment areas and lack of sanitation, for example, household wells in some urban neighborhoods, and even other sources of drinking water supply, can often be polluted by this wastewater discharge.

Particularities of demand for sanitation

- **For water** households express their needs clearly and are able to translate this, without ambiguity, into demand as water constitutes a vital product that they cannot do without (or they will die).
- **For sanitation**, however, households are not really aware of its importance, even though their standards of living often suffer due to lack of satisfactory sanitary conditions. This is because both private interests (the family's health, not always considered important by households because comfort in the home is often more of a motivating factor, cultural reticence, etc.) and

public interests (saving the environment and therefore public health) are at stake. It is for this reason that people don't attach the same level of priority to sanitation as to water; there is no demand for sanitation or, where this exists, it is not expressed with the same clarity.

Indeed, constructing on-site sanitation or sewerage systems shouldn't be limited to the installation of facilities: this intervention usually requires an awareness and change in behavior, particularly relating to hygiene matters. As a result, for proposed improvements in sanitation to be largely accepted, there are a number of socio-economic factors that need to be duly consid-

ered during project planning and implementation. This involves consultation with, and the participation of, the population during the different key stages of the sanitation program.

Compared to what happens with water, the behavior of consumers is reversed: it is often the offer of sanitation facilities that drives demand which, without this offer, would otherwise not be expressed. Field experience has shown that there is often a potential demand that only comes to light when appropriate support, communication, financial and technical approaches are put in place.

Methodological framework

Objectives

Overall objective

The overall objective of the assessment is to promote the success of programs that aim to put sustainable sanitation systems in place in the town; systems that are sociologically, economically and ecologically integrated.

Specific objectives

- **To size, as part of a general assessment:**
 - the wastewater collection networks and the treatment plant(s) where there is a conventional or small-piped sewerage system;

- treatment plants for pit sludge where there is on-site sanitation.

- **For domestic sanitation:**

- identify the breakdown of housing per type of sanitation facility in the town, or in a specific geographical area;
- identify the most requested types of facilities: thereby giving the choice to the user and promoting the households' choice as an incentive. Then, the most affordable price possible for the households should be specified (a subsidized price if necessary, but without bankrupting the local authority);
- define the outlines of a marketing program, aimed not only at promoting the installation of improved sanitation facilities, but also at chang-

ing households' behavior as regards hygiene practices (thanks to the implementation of mass and/or local awareness-raising programs, such as IEC⁷⁵).

- **For non-domestic sanitation:**

- ascertain the situation for non-domestic sanitation: existing facilities on the one hand, and the quantities and quality of wastewater discharged into the environment on the other;
- identify non-domestic needs, whether this be schools or healthcare facilities, not forgetting industry and other activities that may cause pollution through the careless discharge of potentially polluted wastewater.

The baseline indicators

All assessments of demand for sanitation need to use a minimum of information, without which it is difficult to conduct strategic planning. The list of 'essential' indicators given below forms part of this minimum information platform:

All assessments

1. Access: sanitation facilities (domestic / non-domestic);
2. Household expenditure on sanitation (domestic);
3. Household income;
4. Amount of family revenue dedicated to sanitation (domestic);
5. Households' capacity to pay for sanitation (domestic);
6. Households' willingness to pay for sanitation (domestic).

Assessments aimed at quantifying the wastewater discharged

For assessments which are mainly concerned with quantifying the volumes of wastewater discharged (how many m³d), 2 additional indicators need to be added:

7. Discharge: domestic volumes;
8. Discharge: non-domestic volumes.

Pricing studies

9. Non-domestic: expenditure on sanitation;
10. Non-domestic: amount of turnover dedicated to sanitation;
11. Non-domestic: willingness to pay for sanitation.

This list gives rise to two remarks:

- For certain indicators related to demand for domestic sanitation (expenditure on sanitation, amount dedicated to sanitation in the family budget), households often are unable to distinguish between the cost of water and the cost of sanitation. The indicators calculated therefore need to be clearly defined to establish whether only sanitation is to be considered, or water and sanitation together;
- For indicators pertaining to non-domestic demand, the required information is often very hard to obtain due to reticence on the part of the organizations questioned. It is for this reason that these indicators are only prioritized during a pricing study.

TABLE 13. Baseline indicators for all assessments of demand for sanitation

INDICATOR	USE
ALL ASSESSMENTS	
1. Supply / Access (Current/Future)	
Breakdown (in %) based on wastewater evacuation method: – Domestic: Households and Population – Non-domestic: per sector of activity	Evaluation of the situation and forecasts in relation to the MDGs. Criterion for cross-referencing all other variables studied. Enables the distinction of very different categories in equipment and needs: – Households: connected to the sewerage system / not connected to the sewerage system; – Non-domestic organizations: connected to the sewerage system / alternative means of sanitation.
2. Household expenditure on domestic sanitation (CFA Francs / month)	
If expenditure is not given for exactly a month, recalculate the expense per month.	Enables: – Calculation of the unit cost of sanitation (in CFA Francs / m ³ water); – Comparison of the cost of sanitation for the different types of sanitation facility.
3. Household income (CFA Francs / month / household)	
It is difficult to deal with this subject in household surveys; it is often able to better identify this from household expenditure. This data is essential for any social-type strategic planning on sanitation.	Capacity to pay for water: calculated by applying standards. Quintiles (calculated): – revenue per Unit of Consumption (taking into account the composition of the household: number of people and age ¹); – Filmer and Pritchett ² Method.
4. Proportion of family revenue dedicated to domestic sanitation (in %)	
– Household expenditure over one month / Monthly household revenue	Enables an immediate economic evaluation of the weighting of water and sanitation in the household's revenue.
5. Households' capacity to pay for domestic sanitation: Connection/Installation, Discharge (volumes of water)	
– Connection / Installation (CFA Francs) – Service (CFA Francs / month)	Calculated by applying standards: – Water / Water + Sanitation? – 3% - 4% - 5%? – On average / 1 st quintile?

1 To calculate the number of units of consumption in the household, each member of the household is "weighted" according to their age (see Table 16, Chapter 5, p.130).

2 See Chapter 5.

TABLE 13.

INDICATOR	USE
6. Households' willingness to pay for domestic sanitation: Connection/Installation, Discharge (volumes of water)	
<ul style="list-style-type: none"> – Connection / Installation (CFA Francs) – Service (CFA Francs / month) 	Comparing the capacity to pay and willingness to pay enables choices to be made and results in adapted proposals on: <ul style="list-style-type: none"> – Amounts; – Financing methods: connection (credit), billing (billing frequency).
ASSESSMENTS AIMED AT QUANTIFYING DISCHARGE	
7. Discharge: domestic volumes (m³): current, future	
	Enables planning, by geographical area and by year of: <ul style="list-style-type: none"> – The types of (technically and socially) adapted facilities; – The collection and final treatment of wastewater: treatment.
8. Discharge: non-domestic volumes (m³): current, future	
Volumes specified in quantity and quality	Enables planning, by geographical area and by year of: <ul style="list-style-type: none"> – The types of (technically and socially) adapted facilities; – The collection and final treatment of wastewater: treatment.
PRICING STUDIES	
9. Non-domestic: Expenditure on sanitation (CFA Francs/ month)	
If expenditure is not given for exactly a month, recalculate the expenditure per month.	Enables: <ul style="list-style-type: none"> – Calculation of the unit cost of sanitation (in CFA Francs/m³ treated water); – Comparison of the cost of sanitation for different types of sanitation facility.
10. Non-domestic: Proportion of turnover dedicated to sanitation (in %) (Only concerns those organizations with an economic activity)	
The given organization's expenditure over one month / Organization's turnover	Enables an immediate economic evaluation of the weighting of sanitation in the revenue of the organization.
11. Non-domestic: willingness to pay for sanitation (Connection/Other facilities/Fee/Operation)	
Information to be collected: <ul style="list-style-type: none"> – Connection / Other facilities (CFA Francs) – Fee, where there is a sewerage system CFA FRANCS/month) – Operation and maintenance of facilities, on-site treatment (CFA Francs / month) 	Enables: <ul style="list-style-type: none"> – Potential choices to be made; – Adapted proposals, taking the local economic situation into account.

Detailed methodology

Area of study

The subject of sanitation can be dealt with as part of an assessment, the level of detail of which will depend on whether this is conducted as an additional part of a water demand assessment or whether it is the central topic of an assessment of demand for sanitation (the part relating to water then becomes a simple addendum to this).

The scope of an assessment of demand for sanitation can concern very different groups:

- **The whole town**, considered in its entirety: the assessment is therefore aimed more at the sewerage system and so at the network and at the treatment plant (sizing and location). On-site sanitation is not overlooked, however, as it is a means of treating wastewater in areas not equipped with a conventional or small-piped sewerage system;
- **One part of the town** and/or the population: The assessment can be carried out
 - in one or several neighborhoods (in outlying neighborhoods, for example);
 - on certain types of individual facilities (for example, what type of facility do households want and based on what financing methods?);
 - with certain groups or sub-groups of the population and on households' hygiene habits and practices;
 - with certain non-domestic users of all sizes: education establishments, healthcare facilities (dispensaries, clinic, hospital), public markets, stations (bus, railway, etc.), as well as administrative buildings and production activities (small or large, high or low levels of pollution).

Environmental assessment and socio-cultural survey

In order to define what parameters need to be taken into account, it is vital to know (regardless of the specific objective of the study):

- **The framework of the program to be implemented:**
 - the institutional and organizational framework for sanitation;
 - the topology of the town (type of soil and presence of any slopes, so as to define those areas suited to sewerage systems or on-site sanitation) and the surrounding area (the type of construction materials available nearby).
- **The socio-economic conditions** in which the different communities and all the households within them evolve:
 - types of existing housing and corresponding densities of built up areas;
 - water consumption, domestic and/or non-domestic;
 - types of facility used;
 - types of facility desired;
 - capacity and willingness to pay.
- **The factors likely to promote change within the population**, such as people's hygiene practices.

In practice, the methodology applied will depend on the specific objectives to be met: an overall vision aimed at prioritizing promotion of the sewerage system (network, treatment plants) or a vision aimed more towards promoting on-site sanitation (including sludge treatment plants, if appropriate). Whatever the vision, there will be several common factors.

The demand for sanitation, step-by-step

In practical terms, an assessment of demand for sanitation includes the following parts:

General data

1. Definition of the assessment objectives.
2. Methodological composition: area (scope of the assessment); environmental assessment and socio-cultural survey.
3. Sales statistics: analysis of the water and sanitation company's client files.
4. Population and urban development: current and future situation, by neighborhood.

Domestic demand, neighborhood by neighborhood

5. Definition of the technical and financial aspects of the sanitation offer to be presented to households for them to make their choice (catalog of facilities to be tested).
6. Household survey.
7. Domestic demand (by neighborhood): calculated from elements 1, 2, 3 and 6:
 - *Current*: existing sanitation facilities in the town; water consumption, wastewater discharge;
 - *Future*: identify the types of installation most requested (domestic); demand for water, wastewater discharge.

Non-domestic demand, neighborhood by neighborhood:

8. List of (current or potential) organizations that use water: large consumers (/polluters), along with sales statistics; other non-domestic consumers.

9. Large consumers' / industrial or commercial polluters' survey;
10. Survey with other consumers: education establishments and healthcare facilities; markets and stations (bus and/or railway); offices, businesses and services; other administrative structures: military / police camps, prison.
11. Non-domestic demand (by neighborhood), current and future: calculated from elements 1, 2, 3, 10 and 11.
12. **Total demand** (domestic + non-domestic), neighborhood by neighborhood: the sum of elements 7 and 11.

Schedule of operations

Position of the problem

An assessment of demand for sanitation is, as intimated by the sequence of operations presented in the list above, a relatively long and costly operation.

The factors of time and budget are essential components of a demand assessment, as without financial resources and without a minimum of time, it is almost impossible to do anything of note. Working under poor conditions produces poor information; this can be dangerous for managers who risk making decisions that are not adapted to the (technical, economic and social) realities of the situation.

Length of intervention

An assessment of demand for sanitation takes between 4 and 6 months, as such an assessment:

- includes a series of surveys which, alone, enable a diagnostic of the current situation and provide households' with a realistic offer of sanitation facilities. Out of these surveys, the household survey is the most cumbersome (with a sample of between 300 and 1,000 households). Next is the large consumers'/polluters' survey for which it can be difficult to obtain the information required. However, it is also important not to overlook surveys with other non-domestic consumers;
- is carried out by the same size team as that required for a water demand assessment and one that brings together closely related competencies. However, the role played by specialists in qualitative approaches (sociologist or other) is a lot more important.

When organizing the work, 3 deadlines need to be respected:

- *The end of the phase for identifying the sanitation offer to be presented to households*, at the end of a period of no longer than 6 weeks (this period can be longer, however, if the decision is taken to identify a real 'demand' from in-depth interviews or focus group type consultation meetings). This phase, which is strategic for the assessment, cannot easily be shortened without the risk of compromising the quality of the approach;
- *The end of the phase for preparing the household survey*, at the end of a maximum two week period following identification of the offer (most of the preparation will have taken place during the offer identification phase);
- *The end of the household survey* at the end of a maximum period of 16 weeks following the start of the assessment.

Staff required

The majority of sanitation demand assessments need to use several teams; teams that are a lot closer to the field than those required for an assessment of demand for water. This is due to the fact that:

- social specialists play a major role: they should take up at least as much space as the engineers and technicians. 'Social engineering' is often mentioned when discussing this approach as one of the main roles of the teams is to raise awareness, instill in the population the desire to change and assist in the development of their mindset;
- the role of the sociologist is central as the qualitative (and often participative) approaches dominate, even though the observations do need to be quantified at some point.

However, it is advisable that the team contains the following competencies: a sociologist; a socio-economist, or a survey statistician; an urban planner; a demographer; a team of (quantitative) interviewers; several young sociologists for non-domestic surveys.

The specific case of Wastewater Treatment Master Plans (WTMP): the household approach for the demand assessment is more superficial, which in no way excludes the use of a Contingent Valuation Method type approach: in the surveys, the interviews are too short to enable a meaningful, in-depth conversation. It is for this reason that, prior to implementing the quantitative approach, the subject should be broached via a small, more qualitative study, even if only to develop the catalog of facilities to be tested.

A WTMP type study can be conducted in the same way as a water demand assessment, with similar teams (wherein the sociologist takes on a far more major role).

Domestic demand

Access⁷⁶

Current situation: the town's sanitation facilities

The will to plan for improved facilities in the town should be based on a diagnostic of the current situation. To establish this diagnostic, it is advisable to:

- Clearly distinguish, in 2 different questions, between household wastewater⁷⁷ and blackwater (excreta) so there is no ambiguity in the answers. This is a very important recommendation as, in a number of surveys, the distinction is not clearly made (it is implicit) and the results obtained are then often difficult to understand.

Many households have two different strategies for evacuating wastewater, however, and it is important to identify these.

- In the case of a 'general' assessment, which aims to establish a reliable, yet not detailed, inventory: use precise and realistic terminology for the main types of facility that can be found in the town – supplemented as much as possible by photos and/or drawings to remove any ambiguity – as often neither the interviewers nor those interviewed have a very precise idea of the different types of sanitation facilities possible.

This recommendation is very important for understanding the statistics stemming from the surveys.

⁷⁶ The word 'access' used here corresponds to the same concept as that used for water supply: 'access' to a type of sanitation facility.

⁷⁷ The distinction is sometimes made between water used for bathing and water for cooking, housework and washing laundry.

For example, the expression 'septic tank' as used by the households interviewed often doesn't correspond to the exact technical concept: household tend to call all pits 'septic tanks' regardless of type. As a result, in a number of cases, this answer can correspond to a basic pit that has little in common with a real septic tank (instead it is more of a 'cesspool' or 'soakaway' or 'sinkhole').

If this point is not checked prior to the survey, in the terminology used in the questionnaire and in the interviewer instructions, there is a risk that the statistical results will classify very different facilities within the same category and thus a large part of their interest and value will be lost.

There should be fewer than ten different types of facility, so as not to get lost in secondary detail. In contrast, there must always be a category of 'other (please specify)' which will be used for all cases not covered by the existing terms: in this situation, the interviewer ticks the 'other' table, carefully notes down the term used by the person being interviewed and writes a brief description of the facility. This simple method prevents both the questionnaire from becoming bogged down in detail and information being from lost.

In the case of a geographically and/or socially targeted assessment, where the aim is to identify facilities in more detail, there are two different ways of proceeding: either by using the same method as for a briefer study, but with more detailed terminology; or by going directly into detail for each of the 2 or 3 types of wastewater produced (toilets, bathing, cooking-housework-laundry): geographic location (in the building/

in the yard/in the concession/etc.); detailed description of the equipment; wastewater evacuation method, with more detail when a 'pit' is used; etc.

Sustainable access to basic sanitation is a MDG

Detailed knowledge of the current sanitation situation in the town is not only very useful for the sanitation strategist, but also for the country's highest authorities. Indeed, sanitation (and water) has been the subject of much government and donor attention: at the World Summit on Sustainable Development in Johannesburg in September 2002, the international community added to the Millennium Development Goals the commitment to reduce by half, by 2015 at the latest, the proportion of the population with no access to basic sanitation services (target 7C. of the MDG 7: ensure environmental sustainability).

The expression 'basic sanitation services' corresponds to the following specific definitions.

Classic definition

The proportion of the population using improved sanitation facilities is the percentage of the population using the following types of facility:

- Flush toilets/latrines to a piped sewer system, septic tank or pit latrine;
- Ventilated Improved Pit (VIP) latrine;
- Pit latrine with slab;
- Composting toilet.

The other types of facilities are not considered 'improved':

- Pit latrines without a slab or platform;
- Hanging latrines;
- Bucket latrines;
- Open defecation (including the disposal of human feces with solid waste).

The sanitation ladder

A new method of analyzing sanitation practices was proposed, during the 'International Year of Sanitation' in 2008, based on a 'sanitation ladder'. This ladder, shown in the table 14 on the following page, gives more detail on options for using improved, shared and unimproved sanitation facilities, and on practicing open defecation.

Henceforth, sanitation coverage should be presented as a four-step ladder that includes the proportion of the population:

- practicing open defecation;
- using an unimproved sanitation facility;
- using a shared sanitation facility;
- using an improved sanitation facility.

Identifying the types of facility most requested

Consideration of consumer expectations for sanitation is a determining factor as the responses can be most unexpected. There are numerous examples of this:

- In Mexico, in the Yucatan peninsula, pit latrines were recommended as they seemed the technical solution best adapted to the realities of the local social situation. However, the women would have preferred flush latrines as they considered these more modern and practical;
- In Dakar, during the realization of a PAQPUD⁷⁸, the managers observed that the ventilated improved pit latrines (VIP) were not as successful as expected.

It is therefore necessary to offer consumers the choice of several solutions that are related in terms of technology and cost; and to provide them with information upfront to help them want to make the best choice.

⁷⁸ Programme d'assainissement dans les quartiers périurbains de Dakar. (Sanitation Program in the Peri-Urban Neighborhoods of Dakar)

TABLE 14. The sanitation ladder, adopted in 2008

Open defecation	Defecation in fields, forests, bushes, bodies of water or other open spaces, or disposal of human feces with solid waste.
Unimproved sanitation facilities	Facilities that do not ensure hygienic separation of human excreta from human contact. This category includes pit latrines without a slab or platform, hanging latrines and bucket latrines.
Shared sanitation facilities	Sanitation facilities of an otherwise acceptable type shared between two or more households. Shared facilities include public toilets.
Improved sanitation facilities	Facilities that ensure hygienic separation of human excreta from human contact. This category includes: <ul style="list-style-type: none"> – Flush or pour-flush toilet/latrine to: a piped sewer system, septic tank, pit latrine; – Ventilated Improved Pit (VIP) latrine; – Pit latrine with slab; – Composting toilet.

Source: *Progress on Drinking Water and Sanitation - UNICEF and the World Health Organization, 2008*

This part of the assessment consists of several phases.

Phase 1: prepare the offer to be presented to the consumers

The assessment team should prepare a detailed catalog of technological options that will be offered to households. This catalog should form the basis of the sanitation offer.

For example, the studies and research recently conducted in Senegal as part of a PAQPUD on appropriate sanitation technologies, adapted to households' financial means, gave rise to the following list:

– *Shared sewerage system*: Simplified sewers, system without solid waste, low gradient systems, connection to an apartment block system;

– *Individual on-site sanitation*: Simple or double ventilated pit latrines, simple or double pour flush latrines, septic tanks, wash basin with soakaway, shower with soakaway, cesspits, grease traps.

Phase 2: the survey

The most preferred methods⁷⁹ are often the most participative methods which give those interviewed more scope to talk about ethnologically sensitive subjects, especially as they are likely to have a poor understanding of the technical solutions planned for them. The method selected depends upon the objectives of the assessment.

Regardless of the method used, the starting point is always an analysis of the historical situation (which households have been equipped with

⁷⁹ The most commonly used methods are described in Annex 4.

which facilities and why), followed by a study on the future situation (what improvements can be made to the existing situation, under which conditions, and with which support mechanisms).

The participative approach is particularly used for those studies that target specific geographical and/or social areas, by combining the shared and the individual. There are two possible methods:

- **Contingent Valuation Method**, which, although costly due to the large sample sized studied, enables baseline information to be obtained quickly (particularly in terms of consumer preferences for any given type of facility) over a wide geographical area;
- **The community-based approach**, based on in-depth interviews and focus groups⁸⁰. In this case, the collection of technical and financial information and awareness-raising/IEC activities are often combined.

Once a household has clearly expressed their demand, a technician needs to conduct an on-site visit to check whether this demand is technically feasible.

Future evolution

Principle

The breakdown of the population by type of sanitation facility not only depends on people's expectations, but also on the willingness of the public authorities to provide facilities to the town's population⁸¹; it is the role of the public authorities to set objectives with different timescales. This brings us to the heart of what should constitute a sanitation policy. The role of the person charged with the assessment is to

support, and not replace, the managers in their strategic thinking; this notably through helping to clarify the situation by providing these managers with the survey results listing the most sought-after facilities.

Is it possible to identify a 'trend' of evolution leading to an improvement or deterioration of the situation? Historical evolution can provide an idea of what may happen in the future if the current sanitation policy is not adapted. If there is a trend, this will naturally lean towards deterioration as a result of population growth: to maintain quality of access to facilities, this access needs to be developed at the same rate as that of population growth; otherwise the situation will deteriorate.

Evolution will usually be both quantitative (number of improved facilities) and qualitative (transition from one type of facility to another).

Forecasting assumptions

The assumptions used should consider:

- **The national policy** that defines the quantified objectives and, if appropriate, the exact nature of the facilities it intends to promote. Whilst this policy can, of course, be based on the MDG, it can also be far more ambitious⁸². The national policy

80 Separate focus groups are often organized for men and women to enable both groups to express themselves more freely.

81 This willingness needs to be supported by appropriate pricing measures: the connection cost must be socially (and, to an extent, economically) adapted to the financial means of the majority and the service tariff should act as an incentive for the poorest.

82 For example, in Burkina Faso, the Programme National d'Approvisionnement en Eau Potable et d'Assainissement (*the National Program for the Supply of Drinking Water and Sanitation*) defined the following objectives:
 – in urban areas (covering all the ONEA area): increase the rate of access to suitable sanitation from 14% in 2005 to 57% in 2015;
 – in rural areas: increase the rate from 10% in 2005 to 54% in 2015.

can also be adjusted by living environment (urban or rural), as well as by the size of the town (corresponding to the different service levels expected and thus to different state investment levels).

- **The local authority's policy**, which will define its own sanitation policy, for example, by promoting a particular type of facility at a given price (cost of improved facilities and means of financing, maintenance cost).
- **Consumer expectations**, as expressed during the surveys, on the type of facilities most commonly requested (always taking account of their financial situations).

There are several distinct phases involved in the forecasting stage:

- *In the short-term*, from 3 to 5 years (up to 2015 for the Millennium Development Goals, for example), it is advisable to select an assumption that is consistent with the national strategy. If there is no national or local objective in place, the simplest solution is to use the MDG, if they have not already been met or exceeded.
- *Between 7 and 10 years*, a period which usually corresponds to that for realizing projects that are already in progress or are planned; the objectives and expected results of these projects should be taken into account.
- *Over 10 years*, the forecast becomes a simple simulation that calculates the consequences of a given choice being considered by the managers.

Wastewater volumes, pollution load

Most assessments of demand for sanitation concentrate on the types of facilities to promote to households rather than on wastewater discharge volumes. However, the careless discharge of this wastewater into the natural environment can lead to high levels of pollution.

It is therefore equally important to identify the volumes discharged. This can be done in two stages:

- *The volumes of water consumed by the households* (now, and in the future covering the forecasting period) are provided by the domestic water demand assessment, as described in previous chapters.
- *The volumes discharged* are obtained by multiplying the volumes consumed by a discharge coefficient. For domestic consumption, this coefficient varies depending on the type of household facility. Generally, however, it is around 70 to 80% on average, according to whether or not there is a garden that is watered. If there is wastage at home, however, the ratio is lower: the water used for watering the lawn, washing cars and other similar types of use doesn't flow into the sewerage system.

The daily pollution load⁸³ is calculated from these volumes (quantities and quality) to size the treatment plant. This pollution load can be expressed as 'inhabitant-equivalent' (or IH). A 'water' IH equates to 140 liters of wastewater.

The quantity of sludge produced by a treatment plant is calculated from the wastewater volume and pollution load.

⁸³ The definition given by the *Dictionnaire Environnement et Développement Durable (Dictionary of Environmental and Sustainable Development)* is as follows: 'the quantity of pollution passing through the network over a defined period, usually a day. This quantity is expressed in Kg BOD5 (organic matter), Kg COD/d. (organic matter), Kg MLSS/d. (suspended matter)'.

Non-domestic demand

Methodological approach

Although similar to the methodology used for non-domestic water demand assessments, the approach used to conduct an assessment of demand for non-domestic sanitation is, nonetheless, different. These differences relate to the following three points:

- access to sanitation, current and future: existing facilities (type and condition), investment intentions and expectations as regards the local authority;
- water consumption and quantities discharged;
- the quality of the wastewater discharged.

A direct field observation is nearly always advisable, whether for analyzing the current situation or for identifying needs and expectations. However, it is important to deal with the issue differently for each type of organization concerned:

- educational establishments and healthcare facilities;
- other public establishments: markets and stations (railway and/or bus); military and/or police camps, as well as the prison (generally large water consumers) and administrative buildings, etc.;
- industries and areas of artisanal production (highly polluting activities).

The identification of those organizations to survey is a very important part of the assessment.

– Organizations connected to the network: this point was dealt with in the water demand assessment (in Chapter 3, in the part that looks at non-domestic demand, in the section entitled: Non-domestic consumers connected to the network).

– Organizations not connected to the network: every effort should be made to compile as exhaustive a list as possible, notably from administrative information. It should be possible to compile this list quite quickly and easily due to the low number of these organizations (the quality of the information provided upfront will anyway need to be checked during field visits).

Access

In order to study access (i.e. to non-domestic sanitation facilities), the organizations concerned need to be grouped according to category and size, then each group examined separately using a two-stage process:

- Current situation: diagnostic established from a field survey of those organizations concerned;
- Future needs: estimated either from international quality and privacy standards (see Table 1.5) or national standards (as laid out in the National Strategic Plan, for example). These standards take into account the principle of separate public toilets for men and women.

WHO recommends the standard ratio of one improved latrine or WC to 50 pupils and one

TABLE 15. Standards for planning the minimum number of non-domestic sanitation facilities in public places

ORGANIZATION	SHORT-TERM	LONG-TERM
SCHOOL	1 latrine/WC to: – 30 girls – 60 boys	1 latrine/WC to: – 30 girls – 60 boys
HOSPITAL	1 latrine/WC to: 20 beds	1 latrine/WC to: 10 beds
HEATH CENTER	1 latrine/WC to: 50 outpatients	1 latrine/WC to: 20 outpatients
MARKET	1 latrine/WC to: 50 stalls	1 latrine/WC to: 20 stalls
OFFICES	1 latrine/WC to: 20 employees	1 latrine/WC to: 20 employees

Source: Taken from *Minimum Standards in Water Supply, Sanitation and Hygiene Promotion - SPHERE, 2004*
Adapted from Harvey, Baghri and Reed (2002), *Emergency Sanitation: Assessment and Programme Design*, WEDC, Loughborough University, UK

latrine for teachers, with separate toilets planned for boys and girls.

SPHERE proposes different standards, elements of which are provided in the Table 15. These standards differentiate between the immediate situation (the minimum to be carried out) and the situation at completion (representing a target to be achieved).

Educational establishments and healthcare facilities

Current situation

As the number of establishments is relatively low, it is possible to survey all of them with the aid of an adapted questionnaire⁸⁴ to establish:

• The establishment

- *School, high school, secondary school*: type of establishment and number of classes; number of pupils and teachers, broken down by gender.
- *Hospital*: number of hospital beds; number of staff employed.
- *Healthcare centers*: number of outpatients per day; number of staff employed.

• Latrines

- number of latrines by type (description);
- date(s) of construction;
- current state of these latrines;
- operation: cleaning and on-going maintenance, cost, staff used;
- access to water: piped water in the establishment and the latrines;
- basic hygiene rules: knowledge and practice;
- satisfaction and expectations.

84 The length of the questionnaire will vary based on the specific objectives of the assessment and the means available for conducting it.

Current and future needs

These needs are estimated by dividing the number of users (current or future) by a standard specifying the ratio of number of users to improved latrine (or WC):

- *Number of people concerned* corresponding to establishments per category: pupils and teachers (by gender), hospital beds, healthcare center outpatients per day: current situation; future: forecast.
- *Quality and privacy standards.*

For healthcare establishments, however, special standards need to be used for wastewater discharges with a high health risk.

► **Example calculation:** a secondary school of 875 pupils, of which 380 are girls, with one block of 5 latrines (not separate) has, in fact, one latrine to 175 pupils (with no gender distinction). The immediate need, based on the standards provided in the Table 15 (p. 115), is for 21 latrines: 13 for girls and 8 for boys.

Markets and stations

The same approach should be used with the same table of analysis; the number of pupils or hospital beds being replaced by: the number of stalls in the markets; the number of users in the stations. To estimate these (average) numbers, quick field surveys need to be conducted.

Offices, businesses and services

The same approach should be used with the same table of analysis; the number of pupils or hospital beds being replaced by the number of employees in the offices; the number of visitors, if the organization is open to the public.

To estimate these (average) numbers, quick field surveys (or surveys with the competent authorities) need to be conducted.

Other administrative structures

The approach remains the same: a quantitative and qualitative diagnostic of the existing situation followed by a needs estimate:

– Military and police camps often contain three types of premises: offices, family accommodation, communal accommodation (barracks). Each type of building corresponds to a different standard; 20 people to a latrine or WC is an absolute maximum.

– Prison: here, the number of prisoners and supervisory staff need to be taken into account. In most cases, considerable effort needs to be made to ensure there are an acceptable number of facilities in place to ensure a minimum of hygiene.

To estimate these (average) numbers, quick field surveys (or surveys with the competent authorities) need to be conducted.

Industries and other economic activities

The approach used is markedly different from that applied to other types of organization: the quantitative and qualitative diagnostic of the existing situation, then the needs estimate comes directly from the survey conducted with the organizations concerned.

The survey

The survey should be organized in the same way as that for large water consumers, but in a more targeted fashion: as the assessment budget is limited, it is difficult to question more than 30 industries. As a result, the organizations (industries and other economic activities) to be prioritized for the survey need to be selected based not only on the volumes of water they consume, but also on how polluting their activity is.

The survey methodology is similar to that described in Chapter 3 on the demand for water, using a semi-quantitative method and a specialized interviewer, using an interview guide. The main topic is always the production and the process⁸⁵, then sanitation.

- *Current situation*

- Production and process: generating wastewater with some level of pollution.
- Volumes of water consumed.
- Wastewater treatment method: is the organization equipped with a wastewater treatment unit (technology, treatment capacity, etc.)?
- Cost of treatment and/or of maintaining sanitation equipment.
- Location of outfall: wastewater quality, location (number of outfalls, receiving environment);
- Satisfaction.

- *Future evolution*

- Planned production prospects, process changes?
- Expectations with regard to the local authority in terms of sanitation.

One of the main difficulties of these surveys usually stems from the fact that many establishments are reticent to provide information as they don't operate in line with wastewater treatment legislation and discharge water into the natural environment that is either untreated or poorly treated.

Sanitation needs

The current and future needs of these establishments are identified from: the analysis of the establishment's activity (volumes of water consumed, and of wastewater discharged); the amount of any wastewater treatment equipment they have;

the wastewater discharge quality standards that exist in the country⁸⁶.

With many of these establishments, it is not so much the number of latrines or WC that is considered, but the wastewater treatment units, such is the high level of the pollution load.

Wastewater volumes, pollution load

The volumes of non-domestic wastewater discharge are usually a lot lower than domestic volumes. Their pollution levels are often much higher, however.

A two stage process needs to be followed to calculate the volumes discharged:

- **The volumes of non-domestic water consumed** (now and in the future covering the forecasting period) are provided in the assessment of demand for non-domestic water, as described in previous chapters.

- **The volumes discharged** are obtained by multiplying the volumes consumed by a discharge coefficient. For non-domestic demand, it is vital to distinguish between the different types of consumer activity:

- educational establishments and healthcare facilities;
- hotels: between 50 and 80%, depending on whether there is a garden that is watered and a

⁸⁵ Knowledge of the production (type of product and quantities produced) means that wastewater discharge volumes can be identified (with details either provided by the company in question or using production standards). Knowledge of the process enables identification of the quality of the wastewater discharged.

⁸⁶ If such standards aren't yet in place in the country, then the most commonly accepted international standards should be used.

swimming pool supplied via the public water network.

- industries: there is no general rule. This can vary from between a few % (if water is used in the industrial process) to domestic-type percentages if it is an industry with only offices and warehouses.
- offices and purely commercial activities: from 70 to 80%.

The daily pollution load is calculated from these volumes (quantities and quality).

Once both sanitation demand components have been studied, all the elements will be in place for calculating the total demand.

It is worth noting that there can be some confusion over terminology here: the data calculated corresponds more to needs than to a real demand.

Total demand

Indeed, many households aren't aware of their need for improved sanitation facilities and a number of non-domestic users are reticent to invest in often costly treatment equipment.

The results of the assessment should:

- give year by year forecasts for each year of the forecasting period;
- be broken down by large geographical area so that the results can be examined by catchment area;
- form part of a clear municipal strategy listing the main sanitation options: for example, the respective roles of conventional and small-piped sewerage systems and on-site sanitation, or even the types of facility that the local authority wishes to promote (usually as part of social programs), etc.

Total access

Combining domestic demand with non-domestic demand means that the various needs for sanitation facilities within the town can be grouped together.

The supporting measures need to be identified to complement the facility installation programs:

- **For households:** means of financing the purchase of equipment, but also health and hygiene promotion programs in order to transform the need for sanitation into demand;
- **For non-domestic organizations:**
 - social operators (schools, healthcare centers, etc.): promoting sanitation to the managers concerned in order to release credit to quickly develop facilities;

– economic operators: local authorities need to ensure the strict application of laws relating to the environment. They should therefore carry out regular controls and even issue fines should legal obligations not be respected.

Wastewater volumes / pollution load

Combining both domestic and non-domestic demand enables identification of: wastewater volumes and quality; the pollution load; quantities of sludge.

Knowledge of wastewater volumes and quality means that the size of not only the (conventional and small-piped) sewerage systems, but also the on-site sanitation pit emptying systems (vacuum trucks) and the treatment plant can be adapted to the volumes discharged.

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CHAPTER 5

Consumer behavior:
Economic Approach
Marketing Approach

Economic factors influencing the consumer's

Capacity to pay, willingness to pay for an improved service

The 'social basis of the tariff'

As already stated, one of the users of an assessment of demand for water and/or sanitation is the finance manager in charge of developing a Business Plan that links the water company's operation and investment to earnings. To do this, a tariff needs to be set that needs to be well-balanced throughout the forecasting period in order to be sustainable:

– financially: as the water company's accounts need to balance;

– socially: as the poorest households should not be crippled by bills they can't pay; this would be socially unacceptable and financially unprofitable.

The issue of aligning the tariff to the financial means of households forms part of any water demand assessment, regardless of its precise topic. It is important not to overlook the financial aspects of the water service or the social aspects: there can be no sustainable water policy without financial stability; there can be no social policy without a stable financial management framework.

It is, therefore, necessary to test those pricing elements that relate to consumers:

- For households connected to the public network, the amount on the bill, from which the price per m^3 is calculated by dividing the amount deemed acceptable for the bill in terms of consumption to the demand expressed in m^3 (by including the unsatisfied demand);

- For households not connected to the public network the exercise is more complicated as this may involve both the cost of (i) installing the connection, if the household wants to be connected to the public network and (ii) the water bill.

In fact, households' financial means need to be dealt with in two ways: objectively (capacity to pay) and subjectively (willingness to pay).

The capacity to pay for an improved service

The capacity of households to pay for water is based on an analysis of the households' financial capacities. This is a relatively objective way of approaching the households' situation that takes both their income and expenditure into account. It involves determining how many households are unable to pay their bill at a given tariff; in other words, how many households are poor to the extent of not being able to pay for water.

For this approach, the methodology for analyzing the households' financial capacity looks at: their incomes; the proportion of certain expenditure in the family budget (expressed as % of this income) and, especially, of expenditure on water and sanitation. This percentage is often called a 'budget coefficient' by statisticians, or 'effort rate' by urban planners, however these both refer to the same thing.

Income

Within a given area, there are 'wealthier' households and 'less wealthy' households. The latter live in more precarious conditions than the former, particularly in terms of accommodation. They are confronted by several tangible problems, including funding any connection to the public networks (electricity, drinking water, sanitation, if available) and then paying the regular bills that relate to consumption and/or the use of any improved sanitation facilities. It is possible to define this aspect of the town's population more closely by establishing a method of classifying households that is as simple as possible and by considering that the

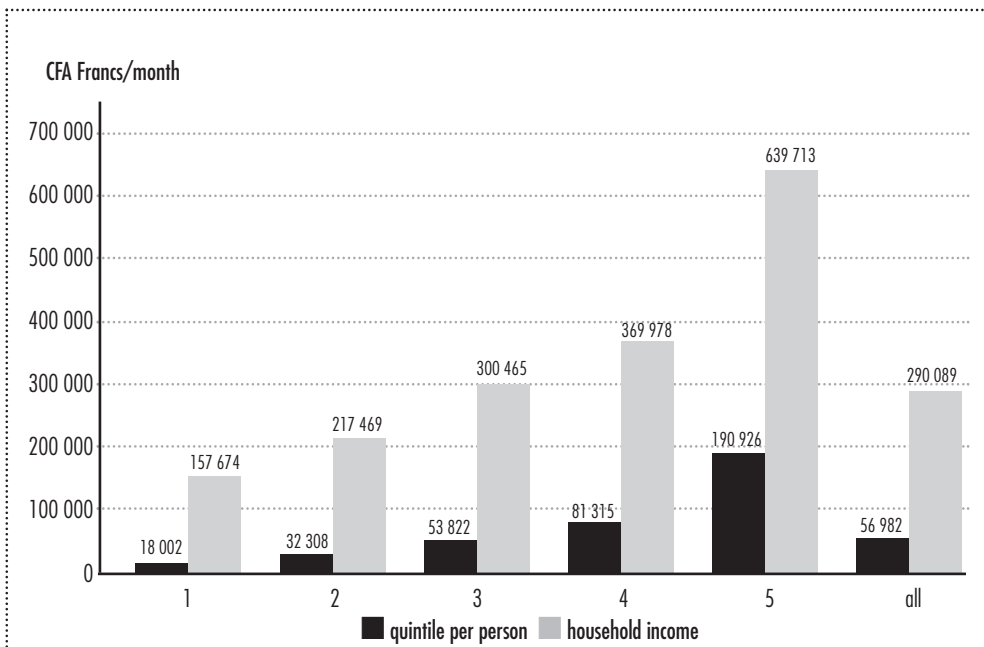
section of the lowest ranked groups in the breakdown by income indicates a certain level of inequality and of poverty, and so social difficulties.

Income quintiles

Households are classified according to 'income quintiles' in two stages:

- Firstly, a reference indicator is selected: the 'income per person' indicator, which is calculated by dividing the total household income by the number of people within that household. This indicator gives all individuals equal weighting, regardless of the household to which they belong: we know how much money an individ-

FIGURE 9. Household income, per household and per person in Lambaréné (Gabon), in 2004



Source: Enquête sur la consommation d'eau et d'électricité des ménages au Gabon (Survey into Household Consumption of Water and Electricity in Gabon), ECONEM 2004, Hoche Consultants, G. Roger, March 2006

TABLE 16. Income per Unit of Consumption (UC) or Adult Equivalent, in standard of living assessments

To calculate the ‘income per person’, all members of the household are considered in the same way: each member is considered as a Unit of Consumption.

To be more specific, the ‘income per adult equivalent’ can be calculated by:

– Allocating a ‘statistical weight’ to each member of the household that varies according to household status and age. For this, an equivalence scale is used.

– Dividing the total household income by the number of adult equivalents in the household.

There are two equivalence scales that are normally used: the Oxford scale and the OECD scale. The Oxford scale assigns more adult equivalents to families than that of the OECD; consequently, this leads to more pessimistic results of families’ standards of living compared to that of the individuals themselves.

The OECD scale is now often preferred to the Oxford scale, long used

Member of the household	Scale	
	Oxford	OECD
Adults		
First adult (head of the household)	1.0	1.0
Additional adults	0.7	0.5
Children		
over 14 years old	0.7	0.5
under 14 years old	0.5	0.3

by statisticians and where an additional adult has a value of 0.7 and a child 0.5, as the OECD scale is better able to take into account the economies of scale today achieved by households.

ual within a household (of whatever size) personally has available to live on. As a result, we are able to approach the concept of ‘poverty’ (or wealth) with more precision; this concept depends largely on the level of income and expenditure that is actually available.

To be more specific, we are not necessarily interested in the ‘income per person’ by taking into account all the members of a household in the same way, but in the ‘income per adult equivalent’ (see Table 16, above).

- Secondly, the households are ranked in ascending order according to the income value per person. Then, the total number is divided into parts each equal to 20% by following the ascending order of this value. By definition, the households in the 1st quintile are the poorest; those in the 5th quintile the wealthiest

The example in Table 16 above clearly shows the income progression from one quintile to the

next. This classification enables subsequent analysis of all water and sanitation demand variables (mainly source of water supply, unit consumption, expenditure, etc.) based on the poverty criterion.

Criticism: many people apparently criticize the quality of data collected on household income and expenditure during the quantitative surveys organized for the demand assessment. It is true that income is usually under-estimated. However, when comparing this to the results of household budget consumption surveys conducted by the Offices for National Statistics, it becomes clear that this under-estimate is not considerable.

Attention: in order to obtain information of credible quality, care needs to be taken during the creation of the survey (to include control questions in the questionnaire), then during the field surveys (to spend adequate time on collecting the necessary information, carefully monitor-

ing the completed questionnaires), and finally during the data processing stage (to look for anomalies from abnormal values identified by comparing certain variables).

Lastly, it is important to remember that the income-expenditure variable is vital for calculating one of the fundamental indicators for water demand, which is:

% of family income dedicated to water

Wealth index

As a result of the above criticism, certain economists⁸⁷ have proposed a method of classifying the population without using income, but which is instead based on certain characteristics of the household, principally household facilities. This involves creating a Wealth Index (WI) which enables households to then be ranked on different scales.

87 For example: Filmer, D. & Pritchett, L. (2001), *Estimating wealth effect without expenditure data-or tears: An application to educational enrollments in states of India*, *Demography* 38, 115-132.

As for income, this process is carried out in two stages:

Firstly, the Wealth Index is calculated: the index "is created based on the answers to questions on household possessions and signs of wealth or status (level of education of the head of the household, electricity connection, whether there is plumbing in the dwelling, equipment used for sanitation, etc.) and does not use financial answers, open to errors of over or under-estimates, purposeful or not, from those interviewed"⁸⁸.

The Wealth Index is specifically aimed at "considering the highly subjective and sensitive answers provided and at providing a more neutral indicator, but one that is highly significant and very useful for handling socio-economic surveys, where wealth (or poverty) is a central criterion that determines the various attitudes, behaviors, practices and decisions of the households interviewed".

88 Source: *Programme d'amélioration de l'alimentation en eau potable de la ville de Lomé*, Etude d'identification et de faisabilité, Rapport intermédiaire, op. cit.

TABLE 17. Monthly household budget, based on Wealth Index quintiles, in Lomé (Togo), in 2007

WEALTH INDEX		SAMPLE OBSERVED		HOUSEHOLD BUDGET
Index	Meaning	Households	%	(CFA Francs / month)
IR 1	Poorest households	212	20.8	81,287
IR 2		169	16.5	92,141
IR 3		181	17.8	114,155
IR 4		223	21.8	154,774
IR 5	Wealthiest households	236	23.1	265,040
	Total	1,021	100	151,919

Source: *Programme d'amélioration de l'alimentation en eau potable de la ville de Lomé*, Etude d'identification et de faisabilité, op. cit.

Then, the households are ranked in ascending order according to the value of the Wealth Index. The total number is then divided into parts each equal to 20% by following the ascending order of this value. By definition, households with a Wealth Index of 1 (WI 1) are the poorest; households with a Wealth Index of 5 (WI 5) are the wealthiest.

The results obtained through this approach are conclusive, as shown in the Table 17 above, which cross-references the average household budget with the Wealth Index into which the household has been ranked.

Application of standards

The place of water and/or sanitation expenditure within the household budget is important because, intuitively, we know there is a threshold above which spending on water becomes too much for the household to afford, meaning that the latter risks no longer being able to pay for something as essential as water. In order to limit the price of water and sanitation, it is possible to empirically define a household inaccessibility threshold that is not to be exceeded.

Standards of international organizations

International organizations have put standards in place to facilitate decision-making relating to funding infrastructure investment in developing countries:

- the World Bank usually requires that, following a loan, the water bill should not exceed a figure of around 3 to 5% of household income;
- for other international organizations, the recommended thresholds vary from between 3% for the UNDP to 4% for the OECD and European Union and to 5% for the African Development Bank.

These percentages, however, are given with no further precision, which means that it is impossible to tell whether they relate to all households or just the poorest. Sanitation expenditure is also commonly overlooked.

Our recommendations

Faced with this lack of precision in international standards, a decision has to be made. It is for this reason that we recommend applying the following standards⁸⁹:

- expenditure relating to both water and sanitation;
- the maximum percentage to be used is: 5% for those households with the lowest incomes (1st quintile) and 3% for average households.

Taking once more the above example of Lambaréné, the capacity of households to pay for an improved service, using the standards that we recommend, will be as follows:

- On average: $290,089 \times 3\% = 8,703$ CFA Francs per month
- In the 1st quintile: $157,674 \times 5\% = 7,884$ CFA Francs

From the standard to the reality: direct observation

The household survey enables calculation of the proportion of the family budget dedicated to the main public services: water, sanitation, electricity, household waste. It is also advisable to consider the purchase of bottled and/or bags of water (an indispensable addition for a good number of households), as well as any other significant expenditure (cell phone, for example).

⁸⁹ The setting of standards for 'capacity to pay' needs to be done after thorough research to clarify the vague situation that currently exists and is detrimental to all those working in this field.

Expenditure on public services

It is possible to identify the expenditure allocated to public services through the household surveys. It is the average monthly expenditure that is of interest. To obtain this, for households connected to the public network, it is always necessary to:

- note down on the questionnaire the expenditure over several months in order to eliminate any fluctuations from one month to the next and to calculate the monthly average;
- separate the monthly cost of consumption (or two-monthly in the case of bi-monthly billing), including the fixed charges, from the rest of the bill (for example: consumption arrears identified as such on the bill, and particularly monthly connection payments⁹⁰, but also the cost of volumes delivered to neighbors).

However, considered in isolation, expenditure on water only provides a partial picture of the true social situation as the quantities consumed largely depend on the means of access: households connected to the network consume a lot more than those who aren't and at a better price. It is therefore necessary to calculate the price per m³, by dividing the total expenditure by the volume consumed over the same period.

Taking once again the above example of Lambaréné, the households' expenditure on water is as follows:

- **Households connected to the network:**
6,167 CFA Francs per month
- **Households not connected to the network:**
5,284 CFA Francs per month.

In the above example, the amounts spent on water by connected and non-connected house-

90 If the consumer is paying for the connection on credit.

holds appear to be quite similar. In fact, however, the differences are fairly significant: calculating the price per m³ of water consumed by each type of household gives: 373 CFA Francs/m³ for connected households, and 907 CFA Francs/m³ for non-connected households.

The part of the family budget allocated to public service costs

The part of the family budget allocated to public service costs is calculated by comparing monthly expenditure to monthly income, from the information provided by the survey. This gives percentages that can then be compared: water compared to electricity, but also tap water compared to bagged water, etc.

The most important comparison is that between the observed situation and the standard. This comparison enables identification of actual household expenditure compared to the maximum that can be borne by the household. It therefore enables us to calculate if it is possible to increase the water price without this becoming unbearable for households.

Taking once again the above example of Lambaréné, the proportion of the family budget taken up by water was:

- For households connected to the public network: 2.34% on average, but 4.15% for the poorest households (those in the 1st quintile);
- For those households not connected (including neighbor vendors): 2.63% on average, but 3.55% for the poorest households (those in the 1st quintile).

Examination of these figures leads to the conclusion that the cost of water is relatively high (as not far off 3% on average and 5% for the 1st quintile households), but not socially unacceptable (as it is significantly lower than the thresh-

olds). It can also be seen that expenditure on water weighs a lot heavier in the budget of those families not connected (as the water has been sold on) than of those households who are connected to the public network.

The purchase of bottled or bagged water

The purchase of water in bags should be taken into consideration as much as possible where this is common practice. In the questionnaire, several questions should be dedicated to this, not only for ascertaining quantities and price, but also for establishing the reasons behind this consumption.

This information is important as this expenditure may potentially be transferred to water from the network, provided that the service quality is better.

Conclusion

Economic rigor should not replace the social aspect of water consumption: the 'human right' to drinking water and sanitation is the right to water and sanitation at a price affordable to all. If there is no other option than to charge for water, even if only to prevent wastage, this does not mean that everyone should pay the same price.

The willingness to pay for an improved service

Economists respond to this question through a range of methods with various technical terms. Identifying the information we wish to obtain is most important here, however, which can be summarized as:

Pay what and how?

Here we wish to establish the expectations of households (and/or of other consumers) for improved services. I.e.:

– What type of individual facilities do they wish to have in their home and under which conditions (quality, financial, etc.)? If this is connection to the public network, this should include the connection cost (and means of payment) and also the total of the bill (and desired billing method)

OR

– Would they prefer to have access to a shared facility and under which conditions (distance from the home, opening hours, water price, etc.)?

OR

– Would they prefer something else?

Pay what?

An assessment into the willingness to pay for improved services needs to be precise and define exactly what is to be included. The elements included can be very different and the corresponding amounts can also vary considerably.

• An issue of cost:

– Water: consumption only?

– Water: consumption plus household connection⁹¹?

– Sanitation: wastewater discharge, plus either household connection to the sewerage system, or on-site sanitation and pit emptying?

– Water (consumption only), plus sanitation (wastewater discharge, plus either household connection to the sewerage system, or on-site sanitation and pit emptying)?

⁹¹ Can be paid for on credit over a number of years (sometimes 5 to 7 years).

– Water (consumption plus household connection), plus sanitation (wastewater discharge, plus either household connection to the sewerage system, or on-site sanitation and pit emptying)? Finally, it is important not to overlook public latrines, where these exist, as the cost of using these may be quite high – especially for poorer households.

• **A general issue**

The range of offers that propose technical and financial elements for which households need to state their preference both qualitatively and quantitatively: which technical offer and at what price? The pricing study conducted in Burkina Faso in 2007 provides a good example of the approach.

TABLE 18. Range of offers for sources of water supply, used during a pricing study

<p>1. MINI-NETWORK</p> <p>With the mini-network, you can have a connection at home, but it is not sold to you directly by the ONEA, you are billed by a private manager or association.</p>	<ul style="list-style-type: none"> – Unplanned settlement – Household connection: on-plot tap – Billed ‘in bulk’ by the operator, bill to be shared out between all users each month – Cost of access similar to that of an ONEA (National Office for Water and Sanitation) connection – Lower monthly expenditure than at the standpipe
<p>2. SHARED DISTRIBUTION POINT (SDP)</p> <p>With the SDP, you can benefit from an individual tap with your own meter. It is not in your yard, but outside the plot nearby.</p>	<ul style="list-style-type: none"> – Planned settlement or nearby – Private: tap with a padlock – No waiting – Volume on demand – Monthly ONEA bill – Lower cost of access and bills than for an ONEA connection
<p>3. PREPAID STANDPIPE</p> <p>Like a standpipe, but you pay for water in advance with a card.</p>	<ul style="list-style-type: none"> – Queues possible – Volume on demand – Prepayment by card bought in a shop – Lower expenditure than at the standpipe
<p>4. STANDPIPE</p>	<ul style="list-style-type: none"> – Not located as far away as the current standpipe – Queues possible – Volume per 20 liters or 200 liters – Same expenditure as at present
<p>5. VENDOR</p>	<ul style="list-style-type: none"> – Home delivery – Possible wait for the vendor – Volume per 20 liters or 200 liters – Same expenditure as at present from a vendor

Source: V. Verdeil, Etude tarifaire 2007-2011 de l'Office national de l'eau et de l'assainissement, Phase 1, Rapport de l'enquête ménages, Version provisoire - ICEA/SOGREAH, September 2007

Pay how ?

This, in fact, means, based on what type of billing frequency? This point is particularly important for those poorest households who nearly always have the capacity to pay, but for whom the ability to save – even over the period of a month – and thus their capacity to pay a large bill (corresponding to accumulated consumption over time) is very low.

Assessment method

There are several methods used to deal with these questions. All of them, however, consist of meeting and questioning those consumers concerned:

– **to assess the historical situation**⁹², i.e. past household behavior, to find out their preference(s) for any given facility. The assumption here is that the same conditions can produce the same effects in the future.

– **or to assess the future by asking – individually – the households** opinions (and/or other consumers who are confronted by the same type of problems as households, but don't necessarily have the same interests) of their willingness to pay for an improved service: by conducting a statistical household survey⁹³.

– **or to assess the future through use of a so-called participative method**⁹⁴ with the community concerned and with all members of that community: to analyze the complexity of the anticipated solutions (the constraints and opportunities) and to identify the solution(s) most likely to meet their expectations.

Out of all the techniques used as part of this approach, one of the most common is the organ-

92 This method is often called the 'Revealed Preference Survey method'.

93 This method is often called the 'Contingent Valuation Method'.

94 This method is called 'Participatory Rapid Appraisal' (PRA).

What is a focus group ?

A focus group (or discussion group) is a qualitative study technique that consists of bringing together, usually in one room, between 5 and 10 individual consumers or prescribers to gain an understanding of their attitudes or behavior in relation to an offer: service, product, concept, etc.

For water and sanitation, focus groups enable organizations to develop, test and discuss different service offers (both technical and financial) before including them in programs. This approach also enables information to be collected regarding market potential and public reaction to ensure that the service will be widely accepted.

ization of focus groups that enable qualitative and quality information to be collected within a short time. However, given the small number of people questioned, the results obtained using this method cannot claim to be statistically representative of the population studied.

The advantages and disadvantages of each of these methods are presented and compared in a table in Annex 4.

The Contingent Valuation Method

The most classic approach, known as the 'Contingent Valuation Method', consists of estimating the value that households may place on an improved service. To do this, a 2 stage process must be followed:

- **Stage 1:** Precisely define the improved service and the associated financial conditions.

- **Stage 2:** collect the opinions of those interviewed, using one of the following methods:
 - *Bidding method:* test an initial price and then look to determine the maximum and minimum price using rising or falling ‘bids’. If the interviewee refuses the initial price offered, lower the price step-by-step; at each step asking if the interviewee agrees to the price and continuing until reaching a price that is accepted. Conversely, if the interviewee accepts the initial price offered, raise the price little by little, asking each time if he agrees until reaching a price he refuses;
 - *Open question:* in the absence of an initial price, the interviewee is asked to state how much he is ready to pay;
 - *Payment card:* the interviewee is presented with a list of price brackets and asked to select one;
 - *Closed question:* the interviewee is offered only one price that he either accepts or rejects (‘yes’ or ‘no’ answer).

There are, however, some difficulties inherent in this method: defining a complete service to test upfront, with no prior consultation, and, notably, with an entire technique and a price, is easier as it is more definite. Proceeding in this way, however, limits the consumers’ choice and leads them to assume that the offer being tested, including the price and payment methods, will in fact be applied (this can be very socially counter-productive).

In contrast, several alternative offers can be tested, each with a realistic and coherent technique + price (and payment methods). In this case, the consumer is confronted with a simple choice: he can express a preference without necessarily assuming that any one particular offer will be implemented.

Applying the bidding principle, high or low, means submitting the interviewees to an avalanche of small questions, which does not always provide the thinking time required. This would, therefore, need to be simplified.

A simplified version of contingent valuation

Various methods using a contingent valuation type approach, from the most sophisticated to the most simple, can be used.

FIGURE 10. Example of questions relating to the willingness to pay for a water connection, asked during a household survey

The cost of installation for having water in the house (with an individual meter) is currently an average of 80,500 CFA Francs (including an advance for consumption). It is possible to pay a certain amount immediately and the balance in monthly installments.

Given these conditions, would you agree to pay for a water connection with an individual meter in your name?

Yes No

a. If YES

- paid in cash: CFA Francs
- on credit: CFA Francs
- how much per monthly installment: CFA Francs
- how many monthly installments:

b. If NO

What is the maximum you would agree to pay:

- in cash: CFA Francs
- on credit: CFA Francs
- how much per monthly installment: CFA Francs
- how many monthly installments:

With an initial set price for the cost of a water connection: simplified bidding

The starting point is a price that is set in advance and then a series of questions is asked:

– Acceptance of the price proposed (aim of the test), then a choice of payment methods

OR

– Rejection of the price proposed (aim of the test): request a counter-proposal and then provide a choice of payment methods. See Figure 10 above, an example of a recently conducted survey in Africa.

A more complete approach consists of collecting the data in two stages:

– *Stage 1*: ‘spontaneous’. The question above is preceded by a totally open question wherein the interviewee is asked how much he would be prepared to pay for the connection. This leads the interviewee to evaluate the proposed technical solution. This information is of interest to those managing the water service as it enables them to assess the amount of communication and awareness-raising activities they need to undertake to encourage consumers to consider the price proposed.

– *Stage 2*: ‘informed’. The question above is asked as in its original format. By taking a position in relation to the price proposed, the interviewee thus expresses his willingness to pay.

This set of questions is often validated with the assistance of additional questions, notably on:

- the origin of the funds mobilized to pay;
- the degree of certitude of being able to pay.

This method is relatively simple to apply, despite the fact that the interviewees often have a poor understanding of the concept of credit (of taking into account the interest to be paid over the duration of the loan).

Without an initial set price for the sum of the bill: the psychological price

The willingness to pay a certain amount per month for water from the public network (of a clearly defined quality) is expressed by households who answer 3 questions relating to the billing amount that they would or would not accept to pay or not:

- the maximum price, above which the household would decide to cease paying as the water would be too expensive;
- the minimum price, below which the household would refuse to pay, considering that the stated quality of the water could not be assured;
- the ‘normal’ price.

The acceptance rates for the price of water are worked out from the first two questions, which enable calculation of the percentage of non-buyers at a certain price. By combining the percentages of these non-buyers at a price that is too high or too low, we obtain the percentage of non-buyers that includes the two approaches (and the 2 household declarations). Subtract this percentage of non-buyers from 100 to give the acceptance rate or percentage of households accepting to pay the price.

The acceptance rates are presented in a table identical to that given below.

➔ **Example.** The willingness to pay studied concerns the monthly amount of the bill for drinking water distributed by the public network (the desired billing frequency was dealt with in an additional question). The table below shows, within a range of 250 CFP Francs⁹⁵, the % of households accepting to pay a monthly bill of a given amount.

Note on the example: the amount accepted by the largest number of households is within the range of 1,150-1,400 Francs per

95 This is in Pacific francs, i.e. ‘5.5 Francs’: 1 CFP Franc = 5.5 CFA Francs

TABLE 19. Willingness to pay for water from the public network: price acceptance rates

Billing amount ¹ (CFP F./ month)	Price acceptance rates (% of households)
400 - 650	18 %
650 - 900	48 %
900 - 1 150	58 %
1,150 - 1,400	67 %
1,400 - 1,650	58 %
1,650 - 1,900	57 %
1,900 - 2,150	45 %
2,150 - 2,400	47 %
2,400 - 2,650	45 %
2,650 - 2,900	48 %
2,900 - 3,150	40 %

¹ Price accepted by a maximum of households.

Source: L'eau potable en Polynésie française: entre pertes, gaspillage et déficits, Commune de Faa'a (Drinking Water in French Polynesia: between losses, wastage and deficits) – AFD/G. Roger, March 2009

month: 2 out of 3 households accept this price range. This low concentration (67%) reflects the low consensus among the population who still agree, however, to pay a lot more than at present (the current average bill is very low: 832 Francs per month).

The Table 19 also enables other ranges to be tested and information to be collated on any risks: the 1,650-1,900 F./month range is still acceptable to 57% of households.

Moving on from acceptable billing to corresponding consumption

The information collected by the survey, regardless of the method used, is the amount the inter-

viewee would accept to pay for water supply (over a given period of a month, for example) with a better quality service.

This information cannot be used directly to set the water price, which generally increases in brackets. It is a total tariff, to be applied to consumers, which needs to be discussed with the managers.

Therefore, the raw data collected during the survey needs to be transformed into consumption; then the consumption of the various households needs to be grouped into brackets. This involves a two stage process:

First operation: we transform this amount into consumption to provide the answer to the following question: how many m³ correspond to the amount households are prepared to pay? The calculation is based on a twofold approach:

- With the current tariff, the amount declared can be transformed into 'expected consumption'.
- The expected consumption is already known: it is the sum of current consumption and unsatisfied demand. This calculation can be adjusted for those households not currently connected to the network and which want a connection: a figure for demand can be attributed to them that is identical to that of other households within the same quintile (or having the same Wealth Index) who are already connected to the public network.

In general, we take the first figure that directly relates to the household's perception, which was expressed as an amount the household clearly stated it was prepared to pay.

- **Second operation:** we group this 'expected consumption' into consumption brackets that are sufficiently refined and numerous to enable different consumption bracket groupings to be tested.

Willingness to pay – Willingness not to bill

The attitude of consumers can often be seen to be radically different to that of the managers.

The majority of consumers express a clear willingness to pay for water, provided that they have understood they are being offered an 'improved service' that will significantly raise their standards of living. Of course, the extent of this willingness is dependent upon the financing methods that accompany the improved service offer. This willingness is even more clearly expressed when consumers currently have access to a poor service or no service at all.

Municipal managers, in contrast, often express

reservations, not over the principle of improving service quality, but over the financial repercussions of such an improvement, as these improvements unavoidably lead to an increase in the water price.

As a result, it is often said that 'the poor can't pay', which is mostly untrue. This assertion can have serious consequences in that it can result in certain investment aimed at improving the service being frozen.

It is not, therefore, so much the reticence of consumers that needs to be overcome as that of the managers. This means that the results of the survey on willingness to pay are of great strategic importance.

Marketing factors influencing the consumer: profiles, satisfaction

Consumer profiles

In order to be effective, the water company should adapt its policy, programs and activities to its clients. Yet these clients can be diverse: they can be more or less wealthy, are supplied with water through different sources, live in different neighborhoods, etc.

It is for this reason that it is necessary to consider the consumers in homogenous groups – or market segments.

The segmentation criteria

The criteria that should systematically be used are as follows:

- **the wealth/poverty level**, to better identify households' characteristics, from the poorest to the wealthiest;
- **the type of dwelling**; this can be related to the legal status of land use;

96 In many countries, the construction of water and sanitation infrastructure is not authorized in those areas where the land property status of the occupants does not conform to current legislation.

- **the source of the water supply:** network connection/standpipe/other;
- **the type of sanitation facility;**
- **the geographical area:** neighborhoods (or groups of neighborhoods: for example, town center, outlying neighborhoods) or large areas created by the water company (that may correspond to a local branch);
- **the status of the dwelling's occupants,** as the investment decision (for a household connection and/or improved sanitation facility) is not the tenant's to make, but rather the owner's, and the latter is rarely motivated to spend money on his tenants.

In most cases, the characteristics tend to accumulate. For example, the poor households are most often those with no connection living in 'poor' or outlying neighborhoods, poorly supplied with water (few or no household connections) and often occupying the land illegally.

Of course, it is always possible to go further into the statistical analysis of data collected during the household survey to develop a more refined segmentation. However, although such an analysis is often interesting from a scientific perspective, it doesn't always lead to working conclusions and can complicate further analysis of the survey.

How to use the segmentation criteria for processing the survey data

In practical terms, the socio-economist responsible for processing the household survey data should proceed in several stages:

- **Define a list of criteria:** this should be quite short so as not to make data processing unnecessarily cumbersome (due to excess detail);
- **Systematically extract all the statistical tables** by cross-referencing the variable studied with the segmentation criteria; this in a way that systematically asks the question: what about poor households? What about non-connected households?, etc.;

By analyzing the results in this way, it is very easy to extract elements from the report that constitute the profile of any given category of household.

Consumer behavior

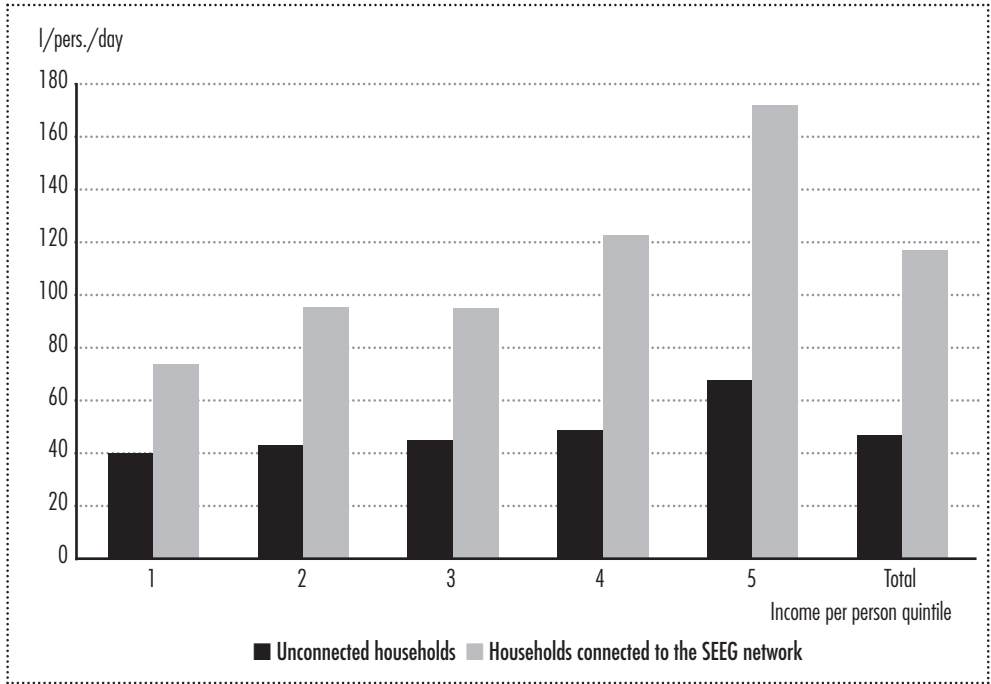
Having an understanding of the attitudes, motivations and behaviors of households belonging to any given category enables us to:

- **Plan for the future,** for example, by providing the answer to the question: 'how would consumption be affected if a household currently not connected to the public network were to move into the connected category?'. In all likelihood, it would have similar consumption to a connected household of the same wealth/poverty level. This information is systematically provided by the household surveys, for example, in Gabon in 2003 (see Figure 11 on the following page).
- **Define adapted policies, for example:**
 - *For poor households*⁹⁷: to promote access to drinking water and improved sanitation by adapting the service offer to their means, without putting too great a strain on water company and local authority finances.

⁹⁷ Defined according to precise socio-economic criteria.

FIGURE 11. Unit consumption of households based on source of water supply and the income per quintile

Example in Gabon, in 2003.



– *For landlords* who do not want to carry out improvements on the accommodation they rent out: to explain their tenants' views to them and clarify that these tenants are prepared to pay for change.

– *For households* with high consumption rates: to make the progressive pricing mechanism all the more dissuasive to reduce either wastage in the home or over-consumption.

Consumer satisfaction

Why study consumer satisfaction?

Data on consumer satisfaction enables us to define activities aimed at improving the current situation. It also helps answer the question: what topic(s) and attribute(s)⁹⁸ should be prioritized? This means, in other words, what are the topics and attributes that contribute most to the overall satisfaction or dissatisfaction of consumers? Qualitative analyses show that improvement activities differ when dealing with reducing

⁹⁸ Technical term used to indicate the 'sub-topics'.

dissatisfaction on the one hand and achieving excellence in service quality on the other. It is for this reason that consumer satisfaction is analyzed from two different angles:

- activities that will ensure the maximum number move from being ‘dissatisfied’ towards being ‘mostly satisfied’ (removing weak points), and
- activities that will ensure the maximum number move from being ‘mostly satisfied’ towards being ‘very satisfied’ (confirming strong points).

Which consumers?

All consumers should be studied as their issues are not all the same:

- **Households**, given their number, often constitute 2/3 of the town’s total water consumption. Their behavior, and the opinions they express, is partly related to the satisfaction of a basic need (to have enough water to live properly), a desire for comfort (better living) or even an aspiration to a certain amount of luxury (better living with no concerns). As a result, each household has expectations which are aligned to its means.
- **Non-domestic consumers** have very different interests: for them water is a tool, not only for normal personal needs (toilets, bathing), but also for cleaning the premises and the machines and for cooling the machines; in some cases it is even an element of production (where water is included in the process).

For them, water is a simple operating expense for which they calculate the cost: the cost of purchasing and storing water (and of treatment, in-house, if appropriate) and of wastewater treatment (internally, i.e. prior to the water being expelled into the environment). Their satisfaction is mostly measured in economic terms.

‘Satisfaction maps’

Consumer satisfaction is represented graphically where each topic is indicated by a point based on its importance for households and the degree of households’ satisfaction. The graph is set up as follows: on the horizontal axis is the satisfaction level; the vertical axis gives the weight or importance of the topic.

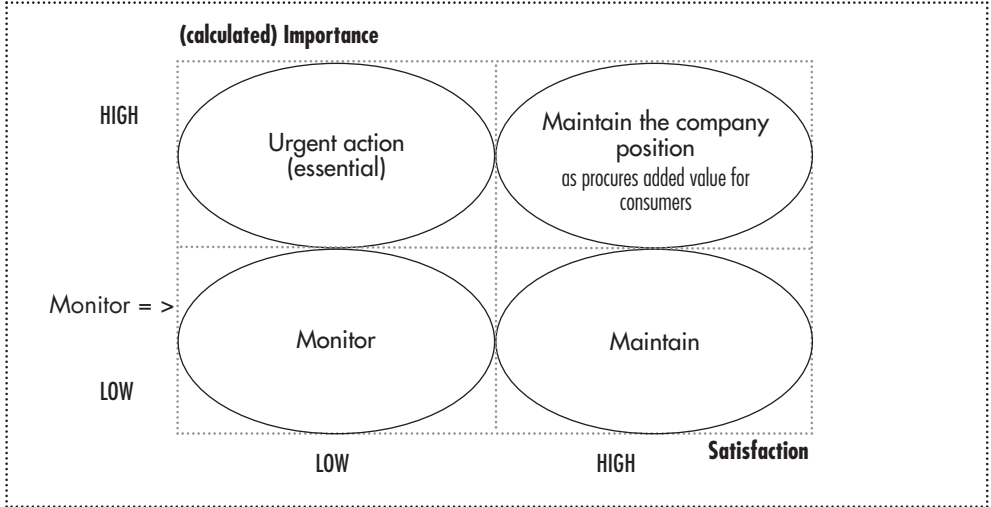
There are 4 areas or segments that can be seen in this graph:

- **Top left:** those topics which are most important and most poorly graded by consumers are in this segment. Urgent interventions are necessary: priority should be given to these.
- **Top right:** those topics which are most important and best graded by consumers are in this segment. To maintain consumer satisfaction at a high level, current activities need to be continued.
- **Bottom left:** those topics which are least important and most poorly graded by consumers are in this segment. These topics need to be closely monitored.
- **Bottom right:** those topics which are least important and best graded by consumers are in this segment. The issue here lies in maintaining the situation as it is.

To conclude, this method of analysis has a number of data collection is simplified. The question of satisfaction is asked in relation to a number of topics to be defined (10, 20 or 30, the number is not really important as long as the topics are clearly defined⁹⁹; however, the higher the number, the more precise the analysis), by distinguishing between at least 4 levels of satis-

⁹⁹ For example, if you wish to ask a question on water turbidity, it is better to use the expression ‘with particles’. For the question of water availability at specific times (usually peak times), it is a good idea to explain the term ‘opportunity’ to the interviewees, if used (as, with no explanation it is likely to be misinterpreted).

FIGURE 12. Map of the relationship between consumer satisfaction and the importance of the topic discussed



faction¹⁰⁰: very satisfied, mostly satisfied, mostly dissatisfied, very dissatisfied.

However, it is advisable to pay attention to where in the questionnaire the question relating to overall satisfaction is placed: 'Overall, are you satisfied with the water from the network?' If the question is placed before the topic-by-topic analysis, satisfaction is over-estimated as the response is spontaneous, with no specific analysis taking place. Putting it after the topic-by-topic analysis, however, provides a more realistic and more severe picture as the interviewee has had the time to analyze the situation in detail and take all the negative aspects mentioned into account. Whilst both sets of information are interesting, they don't have the same meaning.

Processing the data is simple provided that good statistical software is used: satisfaction maps, like the one above, are produced automatically. In addition, these maps are easily understandable by all.

There is an immediate assimilation of the results: the satisfaction maps enable the managers to immediately identify those urgent activities that would most increase consumer satisfaction. It also enables these managers to compare their personal impressions of the price, the different components of quality of the water service, etc. with consumer expectations.

The set of questions relating to satisfaction is often supplemented by one or more open questions on: any major issues within the water and/or sanitation system; desired improvements, ranked in order of importance.

100 Not having an 'average level' that corresponds to 'not really satisfied and not really dissatisfied', forces the interviewees to take a position of either satisfaction or dissatisfaction.



CHAPTER 6

Communicating and using the results

Communicating the results

In general, the party ordering the assessment of demand for water and/or sanitation is the only person who receives the results; it then up to him to organize or enable their further dissemination.

The decision-makers

The decision-makers have the right to receive all the results, as the aim of the assessment is to contribute to an improvement in the community's standard of living. However, if consultation work with the partners has been organized normally and conducted regularly, then the decision-makers will already be up-to-date with the results, as they are stakeholders in these results: most of the assumptions will have been discussed with, and accepted by, them. Normally, a certain amount of political involvement will have been assured throughout the assessment, which means it is not necessary to worry too much about the communication of results.

In contrast, what should be said to the non-technical municipal managers and elected officials? This type of decision is not, of course, taken by the socio-economist, but by the ordering parties and their end client (the municipality). Transparency is, however, recommended so as many people as possible are involved.

In which format should the results be communicated to the decision-makers?

– *Oral presentation* using PowerPoint® to a relatively restricted audience that includes not only the municipal services, but also some services from the state administration, with a discussion following the presentation. However, it is best not to be too brief, so care needs to be taken to ensure the presentation is neither too short nor too long.

• *On paper*, in a few pages, give a detailed summary of the main indicators, the main conclusions and the main issues that result. This in such a way as to involve them in the implementation of the proposed program: for example, in the construction schedule that may cause disruption to daily life due to the start of works, pricing policy, etc.

A list of the main indicators to be reviewed during an oral presentation and in the report can be found on the following page.

The main anticipated outcome of this information transfer is a sense of ownership of the water and sanitation issue by the municipality and the adoption of a real water policy that ultimately results in:

- acceptance of the diagnostic of the current situation, whatever that may be;
- acceptance of the program to be set up, and of all its positive and negative aspects;
- involvement in the awareness-raising activities to be conducted with the population, notably in information, education, communication.

Technical staff

The engineers and other technical and commercial managers of the water production and distribution system and/or their consultants, are natural 'clients' of the water demand assessment, the results of which they require to support their models or programs:

- *Water models* (groundwater table, surface water), using the demand data (in m³);
- *Network simulation models*¹⁰¹, using the demand data (access, total demand in m³, by small geographical area);
- *Financial models*, using the demand data (in m³) and that relating to the capacity and willingness

to pay, as well as certain tables resulting from statistical manipulation of the water company's client files;

- *Marketing program and social policy*, using all the demand data.

In which format should the results be communicated to engineers and technicians, from the consulting firm and/or the municipality?

Engineers expect figures and maps: Excel files with brief explanations, but also geographically referenced information.

The qualitative data is most often destined for the sales/marketing manager, who seeks to redefine and/or orientate the policy based on this data (a lot of which will be new to him).

TABLE 20. List of the main indicators and results of the assessment of demand for water

1. Domestic demand	2. Non-domestic demand																				
<p>1.1. Access - % households</p> <p>Historical evolution in the town: pace of growth over the last 15 years</p> <p>Current situation by geographical area/neighborhood (map) according to the household poverty level</p> <p>Future evolution forecasting assumptions: referring to the 2015 MDG</p> <p>1.2. Unit consumption - l./p./d.</p> <p>Current situation by source of water supply based on the household poverty level unsatisfied demand</p> <p>Future evolution forecasting assumptions</p>	<p>2.1. Large consumers</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 50%;">Current situation</td> <td>volumes</td> </tr> <tr> <td></td> <td>satisfaction</td> </tr> <tr> <td></td> <td>expectations</td> </tr> <tr> <td>Future evolution</td> <td>forecasting assumptions</td> </tr> <tr> <td></td> <td>quantities</td> </tr> </table> <p>2.2. 'Local' demand</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 50%;">Current situation</td> <td>volumes</td> </tr> <tr> <td>Future evolution</td> <td>volumes</td> </tr> </table> <p>2.3. Other</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 50%;">Current situation</td> <td>volumes</td> </tr> <tr> <td>Future evolution</td> <td>forecasting assumptions</td> </tr> <tr> <td></td> <td>volumes</td> </tr> </table>	Current situation	volumes		satisfaction		expectations	Future evolution	forecasting assumptions		quantities	Current situation	volumes	Future evolution	volumes	Current situation	volumes	Future evolution	forecasting assumptions		volumes
Current situation	volumes																				
	satisfaction																				
	expectations																				
Future evolution	forecasting assumptions																				
	quantities																				
Current situation	volumes																				
Future evolution	volumes																				
Current situation	volumes																				
Future evolution	forecasting assumptions																				
	volumes																				

101 In general, the hydraulics engineer can obtain statistical tables of consumers and corresponding consumption by small geographical area (meter reading areas) by processing the information contained in the water company's client files, without going through the socio-economist in charge of the water demand assessment.

1.3. Cost of water

. Budget per family	average amount / source of water supply
. Budget per family	average amount, based on the poverty level
. % of family budget	by source of water supply
. % of family budget	based on the poverty level
. Capacity to pay	average amount / source of water supply
. Capacity to pay	average amount, based on the poverty level
. Willingness to pay	average amount / source of water supply
. Willingness to pay	average amount, based on the poverty level

1.4. Satisfaction with the service - % households

by source of water supply
by geographical area/neighborhood (map)
based on the poverty level

1.5. Total domestic demand - volumes

Current situation	by geographical area/neighborhood (map)
Future evolution	by geographical area/neighborhood (map) 3 scenarios - Awareness

2.4. Total non-domestic demand - volumes

Current situation	by geographical area/neighborhood (map)
Future evolution	by geographical area/neighborhood (map) 3 scenarios - Awareness

3. Total demand**3.1. Current situation**

volumes: consumption
volumes: demand

3.2. Future evolution

volumes: demand
3 scenarios - Awareness

The main result expected from this information transfer is more realistic and more economically and socially balanced planning of improvements to the water and sanitation service.

The civil society and the general public

The civil society and general public are often left out of the assessment results communication process. This is regrettable, as this is way of:

- Thanking them: having been invited to partic-

ipate in the study during field surveys and asked to respond to fairly personal questions, consumers usually like to be informed of the survey results. Giving them this information is a way of thanking them for their participation and of showing them how useful this participation has been for identifying programs adapted to their needs and expectations.

- Involving them: consumers wish to know what their municipal managers are going to do with the survey and assessment. It is therefore advisable to explain what is planned for the future, whether this be related to the investment policy

for water and/or sanitation or to the pricing policy, etc.

In which format should the results be communicated?

- If possible, in as wide-ranging a format as possible: press conferences, radio, television and media interviews, etc.);
- On paper, in a few pages, make a detailed summary of the main conclusions and issues. This

in such a way as to involve them in the implementation of the proposed program: information on the pricing policy, for example, or disruptions to their daily life when work begins, etc.

The main result expected from this information transfer is a better assimilation of messages given out as part of water and/or sanitation related awareness-raising campaigns: know more to participate more.

Using the results

What are the results used for?

The results of an assessment of demand for water and/or sanitation are often highly anticipated, not only by the assessment teams, but also by the decision-makers. Indeed, these results can be used to technical, economic and social ends:

• **Technical use:**

- For estimating the required water resource: the figures on current and future demand are used to identify those volumes necessary to satisfy demand;
- For sizing the water treatment plant(s) and the wastewater treatment plant(s): what volumes of raw water or wastewater need to be treated, what is the quality of the wastewater, how much sludge will this produce;

- For network planning: the figures are used to support the distribution model at each distribution network hub, for sizing the network and carrying out a simulation in areas where network extensions are planned.

• **Economic use:**

- For calculating necessary investment (for water resources, distribution network, sources of water supply and/or sanitation facilities in the home, etc.) to meet demand over the course of the forecasting period;
- For adjusting the tariff: the capacity to pay / willingness to pay studies constitute the 'social basis of the tariff'.

• **Social use:**

- For specifying the sources of water supply and the types of sanitation facilities best adapted to consumer expectations, giving maximum consid-

TABLE 22. Turnover structure of a water company based on a tariff structure per bracket and with a fixed charge¹ (domestic consumption)

CONSUMPTION BRACKET ² (/MONTH)	CONSUMPTION (in m ³)	TARIFF (in F /m ³)	TO BE BILLED (before tax)	TAXES (rate in %)	TO BE BILLED (incl. TAX)
INDIVIDUAL CLIENTS					
- Fixed charge					
1. 0 - 6m ³					
2. 7 - 15m ³					
3. 16 m ³ and +					
TOTAL					

(1) Fixed sum, invoiced regardless of consumption (sometimes known as 'meter rental'). Some tariffs don't have a fixed charge and only bill the cost of m³ consumed.

(2) The consumption brackets presented in this table are purely indicative.

eration to the need for financial stability of the system¹⁰²;

- For developing and leading a real marketing policy adapted to different market segments;
- For developing and leading a real social policy for water and/or sanitation.

In this chapter, only two topics are developed: the tariff and the marketing and social aspect; technical aspects are widely dealt with in many other publications.

102 Planning needs to be technical, social and economic as it deals with ensuring there is the best quality facility at the lowest (investment and operation) cost, taking the means of the poorest households into account.

Which tariff to choose?

The tariff

The amount on the bill represents water consumed over a given period (between two meter readings) with a price per m³ consumed, which varies (often progressively) according to the consumption bracket. It is advisable to look at the components of the tariff:

- the existence of a fixed charge and its amount;
- the existence of consumption brackets;
- the size of these brackets;
- the price per m³ in each bracket, usually progressive.

Attention: The principle of a progressive water price per bracket of consumption has been criticized over the past twenty years by some analysts,

who consider it to be anti-social or socially unjust:

Up until 1989, *"we accepted the preconceived idea that a pricing system in progressive brackets helps the poor. After having examined the situation more closely, however, we have realized that in fact the opposite is true.*

*'In Ghana, researchers have observed that the majority of people live in multi-family dwellings equipped with only one water meter. Households who consume low volumes of water in reality pay a higher price for their water. The poor therefore find themselves doubly disadvantaged as they have to share the water charges'"*¹⁰³.

It is true that, in most African towns, the rate at which connections to the water network are shared is higher the poorer the household. Consequently, the average number of people per connection to the water network (and so per meter) is higher among poorer households than those who are better off; this is the same for the volumes consumed, even if unit consumption is a lot lower for the former.

Nearly 20 years after this observation, the matter has still not been settled due to lack of conclusive research. The system of progressive pricing brackets has become the standard over time.

The contribution of the water demand assessment to the pricing study

Here, it is not about dealing with pricing methods, as the socio-economist should not be involved with financial assessments¹⁰⁴. He should, however, know the subject well enough to be able to produce or group together the social and economic data required by the finance manager for building the Business Plan:

¹⁰³ Dale Whittington, op cit.

- the 'social basis of the tariff', i.e. the capacity to pay and the willingness to pay for an improved service, such as those described above;
- the breakdown of consumption by consumption type and consumption bracket.

The 'social basis of the tariff'

This point was presented in detail above. It is important to remember two principles:

- *Consultation*: from the design stage of the survey on the willingness to pay for an improved service, the socio-economist needs to verify with the finance manager that the data he plans to produce is in line with expectations;
- *Communication of results*: all of the information produced as part of the demand assessment needs to be passed onto the finance manager so that the social aspect can be integrated into his financial model to produce a realistic tariff.

The consumption by bracket statistics

The work schedule of the socio-economist includes conducting a rapid analysis of consumption based on data processed from the water company's client files. However, this analysis can often be rather superficial, whereas the finance manager needs more detailed information.

Indeed, for his own analyses, the socio-economist needs to have access to the client files. The

¹⁰⁴ However, it is recommended that the socio-economist understands the 4 main pricing principles:

- Acceptable cost recovery: contribution made by the pricing policy to seeking financial stability;
- Economic effectiveness: consumers' awareness of the value of water;
- Social equity: do not exclude the most disadvantaged households;
- Acceptability: by households, but also by the public authority.

TABLE 23. Size of consumer classifications to be compiled, based on current consumer consumption, for a pricing study

CURRENT CONSUMER CONSUMPTION			CLASSIFICATIONS TO BE COMPILED	
m ³ per month			Intervals (m ³)	Classifications
between 0	and less than	50m ³	Classifications of 5m ³	0-4, 5-9, 10-14, 15-19, ... 45-49
between 50	and less than	150m ³	Classifications of 10m ³	50-59, 60-69, 70-79, ... 145-149
between 300	and less than	500m ³	Classifications of 25m ³	150-174, 175-200, ... 275-299
between 500	and less than	1,000m ³	Classifications of 50m ³	300-349, 350-399, ... 450-499
between 500	and less than	1,000 m ³	Classifications of 100m ³	500-599, 600-699, ... 900-999
1,000m ³ or above	Open classification		1,000 and +	

simplest way of doing this is for the water company to provide an extract of those files that include the variables he is interested in and that enable him to carry out his analyses. The socio-economist can then extract tables relating to the demand without needing to interrupt the water company's IT service (and/or sales department).

As a result, the socio-economist is then able to provide the finance manager with precise tables on the breakdown, by consumer category (at least, domestic/non-domestic and, if possible with more refined categories) and consumption, consumers, volumes consumed and corresponding turnover classifications.

Once the finance manager has the statistics per refined consumption bracket available, he can easily make different groupings over the course of his research and compile adapted pricing brackets.

Marketing policy for water – the social policy for water

Having knowledge of the market and consumers enables the water company to define and implement a commercial strategy aimed at satisfying demand. Marketing is defined as being all those techniques that aid decision-making when promoting a product or service.

The marketing mix

The combination and amount of the different elements available for marketing (product, price, service, brand, distribution methods, communication tools, advertising, etc.), the marketing mix is formed by gaining maximum understanding of human, technical, financial, temporal and geographical constraints and by comparing these as best as possible with socio-demographic, economic, social, competitive,

political, legal, cultural, consumerist and ecological environments. Consequently, as Benson Shapiro said: "the marketing mix provides decision-makers with a means of ensuring that all parts of their program have been considered in a simple and ordered manner. Everyone can describe the essence of nearly all marketing strategies by presenting the target market segment, as well as the elements of the marketing mix, in a concise form"¹⁰⁵.

In practical terms, the marketing mix consists of all marketing activities planned or conducted in relation to product, price, communication and distribution policy. Usually known as the marketing tactic or operational tactic, this commercial policy is based on the 4P¹⁰⁶.

Application to water from the public network

Water is a specific case as, not only does it include the water, but also the service that surrounds it. Any marketing strategy needs to take these multiple aspects of water into account, from its production and treatment to its distribution, technical and financial management, social aspects and the collection and treatment of wastewater, etc. These aspects are usually grouped together in 4 main topics¹⁰⁷:

- **Service** (*decisions pertaining to the definition and characteristics of the water service and how this can be best aligned to expectations*): organoleptic qualities: taste, smell, color;

105 Source: emarketing.fr

106 This family of activities is usually referred to as the '4P' as it relates to: Product, Price, Place, Promotion.

107 When applying the concept of the marketing mix to the water sector, some authors have broken the '4P' down further into '7P': Product, Price, Promotion, Place, People, Process, Presence. Source: Strategic marketing to improve both water utility finances and services to urban poor urban water consumers - Kevin Sansom, Sue Coates and Cyrus Njiru (WEDC, UK), Richard Franceys (IHE, The Netherlands) - June 2000

physio-chemical and biochemical qualities: potability; technical qualities: pressure, shut-offs, service continuity, quantities available; economic and social qualities: price, billing frequency.

- **Distribution** (*choice of route and distribution areas*): what type of operator: public, private; sources of water supply, based on distribution areas; type of sanitation, based on distribution areas.
- **Price** (*determined from cost price, all depending on the water company's commercial policy*): connection cost; price of water consumed; sewerage surcharge; capacity to pay/willingness to pay; social policy/decision whether to subsidize the service.
- **Communication** (*actions to be undertaken to inform consumers of the quality and advantages of the public network: public relations, advertising, etc.*): promotion of the potability of water: health and hygiene; promotion of improved sanitation facilities: health and hygiene; promotion of water saving activities: not wasting water; promotion of civic-mindedness: paying for water and sanitation:

► **Example.** In the 1990s, the SEEG in Gabon launched the slogan 'right – right, i.e. 'the SEEG is right to offer you a quality service, so please act in the right way by paying your bills'.

Implementation of the marketing mix should enable those objectives arising from the marketing strategy to be achieved. The decisions taken within the different variables are interdependent.

The social policy of water

The marketing approach consists of taking the particularities of the different groups of the population into account. It should be applied to the poorest population to find solutions adapted to their living conditions: poor quality housing in geographical areas often not supplied by public

services, with precarious land property status, job insecurity, low and irregular income, etc.

The specific marketing plan will consist of developing an offer adapted to this population:

- **Technically:** household connection or standpipe, bearing in mind that:

- The majority of this population will live in outlying areas of the town, in neighborhoods not supplied by the public network. For this reason, extending the public network will be expensive, but the amortization of this cost does not necessarily have to be borne only by the population concerned¹⁰⁸.

- Opting for water to be supplied through standpipes means keeping the water consumption very low for the population concerned: around 20 liters per person per day or less, whereas the consumption of the same population would be at least two times higher were they to benefit from a household connection.

- **Financially:** a charge for water in all cases, by selecting one of the sources of public water supply:

- Opting for a household connection has far-reaching price related consequences for households, so it is up to the water company to propose suitable costs: an adapted price for connection (a relatively low price due to a system of adjustment that provides a subsidy for those less profitable investments in the short-term); an adapted water tariff (but with charges shared out between the total population); an adapted billing frequency¹⁰⁹ (that can vary from one neighborhood to the next); any 'special social measures' to assist the most disadvantaged households.

- Opting for standpipes has many advantages: the investment cost is reduced for the local authority; for households, the issue of paying for water is diminished as they spend a little a day each time they visit the standpipe. There are major disadvantages that remain, however: the distance between the dwelling and the standpipe represents a sizeable cost (loss of time taken to fetch water and also for queuing, physical effort), the quantities consumed are very limited, the water quality and its potability suffers from the fact that it has to be transported (unclean containers, used in oblations, games, etc.) between the standpipe and the dwelling.

Marketing policy for sanitation

In order to aid decision-making and to create conditions in which all of the community can participate (associations, political, religious and economic communities) as much in the planning as in the management of systems, the study needs to facilitate the development of an adapted information program.

This program is made up of 3 sections:

¹⁰⁸ A pricing policy based on the principle of adjustment can enable all consumers to bear the cost of larger investment.

¹⁰⁹ Long billing periods result in an automatic increase of the amount to be paid. Yet, the poorest households have such low income levels that it is virtually impossible for them to save up for one or two months. When the bill arrives, they often find it impossible to pay; they therefore have their supply temporarily, or often permanently, cut off. Increasing the billing frequency, by following the example of other domains, will reduce the risk of non-payment.

Information, Education and Communication (IEC)

The use of Information, Education and Communication (IEC) for the promotion of sanitation, based on basic elements, such as hygiene and health education, is centered on consultation with, and the participation of, the communities. This local approach consists of 3 stages:

- collection with, and by, the population of basic information on their environment, notably the constraints and difficulties;
- analysis of this information so as to raise awareness, and instill a sense of ownership, of the program objectives;
- taking the decision to obtain a sanitation facility (this supposes that the beneficiary is able to construct this facility and then maintain it).

Each of these stages is accompanied by one or several activities, which are themselves illustrated by pictures highlighting the serious lacks of hygiene in the environment and the proposed solutions (health and hygiene education is essential in this approach, for households as much as for the school environment).

Mass communication

The local IEC activities contribute greatly to the success of sanitation promotion programs. However, they are even more effective when supported by information activities for the general public via the medium most commonly used by the population: radio, television, the written press, etc.

It is often not possible to implement such a communication program because of its cost. This type of program, however, has the advantage

of being able to address a large number of people in a short space of time, and so spread the sanitation program message even wider.

Advocacy and political will

Sanitation does not often get paid much attention by politicians, except, perhaps when they attend the inauguration of a wastewater treatment plant or sewerage system. It is highly recommended, however, that these politicians actively participate in the general promotion of sanitation and in the promotion of those sanitation technologies best adapted to the needs of the population. In addition, one of their roles should also be to convince donors to invest in sanitation programs.

Communication programs for consumers

A water demand assessment usually leads to activities that will have a major impact on the lives of consumers. Some will be positive (service improvements), others less so (for example, price rises in return for improvements, or a water saving policy, or even a health education program that includes water and sanitation, etc.).

Inform

Usually being one of the elements of a much larger study, assessments of demand for water and/or sanitation precede investment activities that accompany administrative and social measures.

Network extension programs for water supply and/or sanitation

The programs need to detail what is going to happen: what type of works, where, how, based on what implementation schedule?

- **Water:** household connections; standpipes, kiosks, protected wells: with a charge for use with a cashier attendant, or with a prepaid water meter, or other¹¹⁰;
- **Sanitation:** improved facilities. This technical information is always accompanied by pricing information: cost of the facility, operating cost, consumption tariff.

Pricing programs

- **Water:**
 - household connections: connection cost (with installation of individual meter) and payment conditions, water tariff (based on actual consumption) and billing frequency, supply cut off in the event of non-payment. Conditions of eligibility to the social connections program;
 - standpipes: price of water at the standpipe.
- **Sanitation:** improved facilities: the cost of the different facilities, maintenance cost and management method.

Raise awareness

A long-term water and sanitation policy needs to include major changes to consumers' living conditions. Many consumers perhaps won't consider these changes to be an obvious necessity and so may be more inclined to refuse them. The managers should, therefore, plan to undertake awareness-raising activities to convince consumers of the interest of such changes.

In order to build arguments adapted to consumers, the managers need to have available the results of the surveys conducted as part of the demand assessment that detail the consumers' opinions and expectations.

These programs can be very diverse:

- promotion of social connections to the water supply;
- promotion of improved sanitation facilities, whether on-site or a small-piped sewerage system;
- awareness-raising on hygiene, at home as well as in the workplace (for example in the school environment);
- promotion of water saving measures;
- etc.

110 Putting in place standpipes with prepayment means that subsidized access to drinking water can be preserved to meet basic needs when these standpipes are reserved for the most disadvantaged population (free below a certain threshold, above which there is payment per m³ consumed). In this case, the corresponding cost of the free water is met by the municipality and the water company, as part of the social policy.





ANNEXES

Glossary

Defining demand

Several authors have analyzed the different expressions used to specify certain aspects of demand. Some of those most commonly used are worth defining further:

- **Absence of demand:** this expression is sometimes used in relation to sanitation. Households are not always necessarily aware of the health and hygiene risks associated with having poor sanitation or no sanitation in their homes. The arguments supporting family health often don't motivate them, essentially because they are unaware of hygiene rules and their consequences, but also because they are not told about the options for improving their conditions (through an improved sanitation offer).

This situation is not definitive, however: it can change through the implementation of awareness-raising activities that can give rise to an expression of demand, known as an 'informed demand'.

- **Created demand:**

- **For water:** this expression is sometimes used where the population is unaware that their water is unhygienic (for example, non-potability of water drunk at home, very poor quality water used for other uses, etc.). It is therefore advisable to promote access to a source of good quality water supply through the use of adapted programs: standpipe or even household connection.

- **For sanitation:** this expression is often used. Where there is an absence of demand but an obvious need, managers need to create a desire for improved sanitation programs through the use of adapted communication programs, which will lead to demand for (both technically and financially) adapted facilities.

- **Solvent demand:** this comes from consumers whose standard of living (households) or operating budget (non-domestic entities) is high enough for them to be able to afford to pay for water and/or sanitation services.

- **Effective or real demand** is all solvent and recognized demand. It can be empirically assessed as being current consumption.

- **Excessive demand:** demand can be considered excessive if it exceeds certain recognized standards. For example, according to current standards for domestic demand, quantities above 150 liters to 200 liters per person per day are considered tantamount to wastage in the home (except in very specific cases). The expression 'excessive' refers to a social approach (enough water for all) and to an environmental approach (both removing and then discharging a minimum amount of water into the environment). It is subjective, implicitly referring to a water policy that should exist in all countries and in all towns of the

country. As a result, excessive demand can become undesirable and be treated as such.

- **Unrealistic demand:** this can refer to an expressed demand but one that doesn't take constraints into account, whether these be technical and/or financial.

- **Negative demand:** this can exist where there is a service of poor water quality or an unsatisfactory sanitation facility. For example, if water distributed by the public network is not potable and this is a recognized fact, a certain number of consumers may decide to substitute water from the network with other water (bottled, for instance). This can refer to an expressed demand but one that doesn't take constraints into account, whether these be technical and/or financial.

- **Declining demand:** this corresponds to the 'end of life' period of a product or service:

- **water:** ultimately, which means following the implementation of programs promoting improved sources of water supply, this should relate to 'unprotected' sources of supply that most often provide water of poor quality, or even that is non-potable (wells, surface water, etc.);

- **sanitation:** ultimately, which means following the implementation of programs promoting improved sanitation facilities, this should relate to open defecation and facilities such as latrines which are not sufficiently hygienic (see Chapter 4: The demand for sanitation).

- **Sustained/irregular demand:** this refers to seasonal variations in demand, which is higher during the hot seasons and lower during the cooler seasons (generally accompanied by rain). Often, the increase in demand during the hot season can't be satisfied due to a lack of water resources.

This situation therefore results in unsatisfied demand.

- **Latent demand:** this can correspond to an unsatisfied demand (see Chapter 3, Domestic unit consumption, the section entitled: From consumption to demand). Owing to an insufficient water offer (lack of resources and/or losses on the public network) and/or an overly high tariff, consumers are unable to consume the quantities of water they want. However, they state their desire to increase their consumption and that they will do so once circumstances allow. Desires can also be manifested for those products or services that currently don't exist: for example, in sanitation. It is therefore necessary to qualify and quantify this expectation, which can later become a demand.

- **Explosion in demand:**

- **For water:** if care is not taken, this can happen when the service quality is suddenly improved and when consumers go from not having water available in sufficient quantities to having it 24 hours a day, 7 days a week. The improvement to the service releases the unsatisfied (latent) demand and can lead to dramatic increases in consumption, which thus adds to demand. One of the methods for controlling the outcome of this explosion in demand is to use the water price.

- **For sanitation:** this can happen where campaigns for on-site sanitation promoting technologies adapted to consumers' needs at an acceptable price have been a success. For example, a few years ago, the Sanitation Program in Peri-Urban Neighborhoods of Dakar [Programme d'Assainissement dans les Quartiers Périurbains de Dakar (PAQPUD)] resulted in an explosion in demand for facilities once the price of those facilities proposed was halved and payment conditions offered.

Defining the end user of the service

There are at least 5 ways of defining the end user of water and/or sanitation services: each has its own meaning.

Indebted

This word denotes that someone is indebted, or owes something, to another: 'to be indebted to a creditor for a certain amount'. It relates to the time when there was municipal management of the water service, where no distinction was made between the local authority's accounts (who were in charge of distributing water) and the water account. The price of water most commonly amounted to an annual fixed payment, similar to a tax owed by the people to whom the service was provided. This word is hardly ever used today.

User

This word can be perceived in two radically different ways:

- **A simple person** who uses a public service, the public domain, etc. The user is therefore considered as the simple user of a product or service, based on the terms defined as part of the relationship with the provider. The service distributor needs to satisfy this 'user' as it is in his commercial interests.
- **Holder of a real right of use**, the user has rights (to a minimum quantity of water of a set quality, for example) and expectations (of a certain service quality). As the service is distributed within the framework of 'public service obligations', the distributor of this service needs to fulfill these

obligations as it is the law in force in the country (and/or because these obligations are defined in their contract with the authority). It is obviously in the interests of the distributor to meet these obligations, yet also to exceed his simple contract obligations if user demand is high and he can pass on the cost through the price of the service.

The word 'user' is often used today in relation to a 'public service'.

Subscribed consumer

- **A subscribed consumer is someone who has taken out a subscription**, a subscription being an agreement between a supplier and a client, at a clearly defined price, for the regular delivery of products or regular use of a service. To be considered as 'subscribed', it is usually necessary to have a subscription and to have signed a subscription contract or continue with an existing contract (for example, with the landlord of a dwelling).

- **However, an end user can also:**

- Receive the service without being registered as a subscriber, either because he shares a connection with a neighbor without being the subscription holder, either due to negligence on the part of the water distributor, or due to fraud. He can also use the drinking water distributed by the water company not at home, but from a stand-pipe (registered as a subscriber) or from a water vendor (who himself is 'subscribed').

- Not receive the service, although he has a connection: this is a frequent case in towns with severe water shortages and where a number of

connections rarely or never receive water. These subscribed consumers are rarely listed in the client files by the water distributor. However, once the subscribed consumer stops paying the bill, they are subject to administrative sanctions and the supply is cut off; they are then classified as 'inactive' in the client files.

Purely technical, the expression 'subscribed consumer' is a more neutral way of describing the end user of the water and/or sanitation service.

Client

Describing the person who buys a service emphasizes the almost commercial relationship between the water and/or sanitation service provider and the person buying the service. The advantage of this term is its clarity: the distributor has to offer a service whose quality corresponds to the price charged and the client has to pay his bills on time.

This relationship is not totally commercial, however, as in many towns the client has no choice: there is rarely any competition in place among drinking water distributors.

The word 'client' is that most commonly used by private water distributors.

Consumer

A consumer is a person who uses goods, wealth and services to satisfy his needs.

This word is often used by economists and by citizen groups defending the rights of these economic consumers often considered as without interest and so without voice. For both groups, 'consumer satisfaction' is key: over the last twenty years, water and/or sanitation companies, as well as large donors, have started to attach more and more importance to consumer expectations. As a result, it is now commonplace to highlight the willingness to 'rehabilitate the consumer' and to study 'awareness / reactivity / demand responsiveness'.

The advantage of the word 'consumer' is that it places everyone in context:

- The end user takes precedence as he has the right to expect a quality service at a reasonable price (without this being a drain on the local authority budget).
- The service provider needs to adapt to consumer expectations and satisfy these both quantitatively and qualitatively (in so far as the tariff applied to the service allows).

FOR or AGAINST Household surveys?

Conducting a household survey as part of an assessment of demand for water and/or sanitation is highly recommended by some experts,

whereas its usefulness is clearly contested by others. Here, both sides of the argument are examined in more detail.

AGAINST

A widespread opinion

The fact that these surveys may be of little use is a direct consequence of low quality results, which seem even poorer given the effort required: budget, time, etc. The reasons most often given are notably:

- **Poor results**, because often they:
 - don't provide the satisfactory explanations (quantitatively and qualitatively) required to better define the outlines of any 'socio-economic issues for water';
 - are too general and don't include enough geographically detailed knowledge of the area studied;
 - often claim to be able to predict the future behavior of consumers¹¹².

¹¹² According to some publications, the purpose of the surveys should be threefold: explorative, explanatory and predictive. This kind of assertion has led to high expectations on the part of managers and, finally, to misunderstandings. This conviction often leads to deployment in the surveys of 'quantitative methods', to 'explanation' of behaviors through econometric models, to the pseudo-predictive powers of 'behavioral models', etc. However, these analyses rarely result in a clear definition of a 'socio-economic optimum' which

- **The sampling method**: the sample size is often judged to be too small based on a priori mistrust of survey practices, the use of which immediately condemns the results.

This conviction is so widespread that any result different to that expected by the water company is criticized at once, or denied, evoking the implementation method. As a result, engineers from the water company or managing the study (Master Plan, etc.) are often seen to blame the survey method, which in most cases they don't properly understand.

Yet, the majority of genuine surveys give very different results to those expected¹¹³. Indeed, 'what was expected' most often stems, not from field observations, but from estimates derived by applying 'standards' of sometimes dubious origin and relevance, poorly adapted to the

relieves managers from the operational task of properly considering what a water policy should be. This results in reservations from some ordering parties regarding household surveys which they consider to be an unnecessary expense.

¹¹³ This is also because intuition, and often evidence, shows that the data used doesn't correspond (or no longer corresponds) to the reality that is included in a survey in large assessment programs.

situation observed; this is when they are not purely and simply imported from elsewhere, such as standards proposed by some large donors.

- **Poor quality responses**, due to:
 - The interviewers who, it is claimed (by critics), don't respect the instructions they are given¹¹⁴, leading to biased implementation of the sampling procedure and low quality data collection. In principle, this comment is not incorrect. It is for this reason that, prior to making this comment based on mere supposition, it is necessary to check the training given to the interviewers, what controls have been set up and how these have been carried out.
 - The interviewees who, it is assumed, can't or don't want to give reliable responses to the questions they are asked. Some critics go as far as to say that there are some topics for which it is impossible to obtain reliable answers: some cite the source of water supply, others the volumes of water consumed and the associated cost, others household income, and others still the willingness to pay (according to them, how can a household give a valid estimate of the volume of water they want to consume or estimate the price they are prepared to pay for water once the service quality has been significantly improved?).

- **In conclusion**, the poor quality of many of the surveys and their frequent 'uselessness' in relation to the raised expectations they create, explains why many managers (municipal officials, technical services, and even engineering consulting firms) are often against this type of investigation. This reaction is normal, although only partially valid.

However, rather than criticizing with no analysis, it is advisable to go into more detail and attempt to answer 2 questions:

- Why this very poor, and sometimes even dreadful, quality?
- What can household surveys be useful for?

Our comments

Which surveys are being discussed? And what kind of staff is conducting them? Indeed, numerous surveys, often given fine-sounding titles, are carried out within different frameworks, using occasionally vague methods and staff who are more or less well-trained in the methods required. In addition, many of these 'surveys' only provide the planner with very little data that would enable him to refresh or further his knowledge of the water and/or sanitation market, and so useable for calculating the demand for water. There are some precise criticisms that can be leveled at these 'surveys':

- **The objectives are often poorly defined or they are too general.** Often, nobody knows what the results are going to be used for:
 - exact knowledge of access to water, the calculation of the demand for water (with all associated baseline data to be collected), the satisfaction and expectations of users are barely mentioned;
 - the geographic criterion is rarely rigorously defined, i.e. in line with the needs of the assessment. Yet water consumption habits vary widely from one area to another, from a neighborhood supplied by the public network and somewhat wealthy, to another that is partly or not supplied with water and inhabited by mostly poor households.

114 Way of asking questions, etc.

The disappointment of those receiving the survey results is often a direct result of insufficient consideration of the objectives, as well as of the issue and assumptions to be tested. Yet, a survey with no precise objective doesn't need to take place: a survey is not conducted just 'to see'; to see what?

- **The survey budget**¹¹⁵ – the financial budget and time-budget – is often too small to involve a specialist, himself capable of forming an experienced team to carry out and monitor the survey. Yet, it is an important rule: if there is no minimum budget or minimum timeframe available then it is pointless, if not counter-productive longer-term, to carry out a household survey. Indeed, in this situation, the survey can only ever be a rush job; worse, it often gives the impression of having produced interesting data for little expense.

How much dubious, or downright incorrect, data must be lying around in files in ministries, consulting firms and water companies? Established some time ago with a methodology that nobody now knows anything about, they act as 'local standards' and are often used for all planning work.

- **The staff** is often ill-suited to the issue at hand:
 - the design and realization of the surveys is often entrusted to non-specialists. Being unfamiliar with this type of investigation and/or the particularities of the topic of the survey, they are generally unaware of the difficulties and risks involved. This results in an accumulation of approximations and even errors which often leads to disappointing conclusions, as much for their quantity as for their quality.
 - the staff conducting the surveys often leaves a lot to be desired. Many survey managers think that absolutely anybody can carry out this work:

carelessly recruited¹¹⁶, poorly trained, sometimes given unrealistic productivity outputs, poorly supervised¹¹⁷, poorly paid or paid by ineffective methods (e.g. per questionnaire), the interviewers rarely work in conditions that would enable them to carry out work of any quality.

- **The 'sampling procedure'**, if there is one, often leaves a lot to be desired:
 - either the survey report makes no reference to this, which may be considered normal in many cases, as many survey managers are poorly trained in sampling methods;
 - either the sample is too geographically concentrated, which has a negative impact on the quality of observation due mainly to possible bias (which is classic but difficult to curb) tied to the existence or non-existence of a water distribution and/or wastewater collection network, or to the very localized presence of any given source of water supply;
 - either the geographical criterion has not properly been considered, meaning that the survey only provides general averages for the whole town or some large areas. This often results in the managers becoming frustrated as they are unable to use overly generalized data for refined planning of water and/or sanitation distribution in the town;
 - or implementation of the sampling procedure is inadequate: if the interviewers are not properly trained and then supervised in the field, they may considerably bias the initial sampling procedure:

115 Conducted as part of an assessment of socio-economic aspects of the demand for water or a water demand assessment, etc.

116 When not simply using water company staff, e.g. meter readers.

117 Essential explanations of methodology are not provided at the start of the survey leading to systematic errors that are not highlighted or corrected.

not respecting the 'rate' imposed for selecting households, preferring certain areas or dwellings that are easily accessible (main roads, roadside dwellings) over those where access is more difficult (small untarmacked and dirty lanes, houses in poor condition at the end of these small lanes), frequently replacing the sample households if there is a problem (household is temporarily absent or refuses to participate, etc.).

- **The questionnaire** often poorly covers the subject in hand: it is often the case that some of the most important variables to be considered for planning are not included in the questionnaire:

- poor use of terminology for describing the sources of water supply, meaning that the following sources are not precisely defined: the concept of shared/registered connection or of an unconnected household supplied by a connected neighbor, or of different categories of households not connected to the public network, etc.;

- very approximate terminology used for the types of sanitation facility due to possible confusion between greywater and blackwater, between public sewerage systems and illegal sewers, etc. and due to poorly understood concepts, such as septic tanks, etc.;

- unit consumption (liters/person/day) information is not collected, meaning that unit consumption for the different sources of water supply cannot be identified. Some surveys have claimed even to have estimated the unit consumption of connected households without a meter or equipped with a meter that doesn't work. From experience, this attempt:

- is bound to fail if the taps are located inside the house: in this case, the only solution is to organize a metering program by installing around a hundred meters in individual homes¹¹⁸.

- can give satisfactory results if the tap is located

outside the house. Indeed, household consumption can be estimated by 'counting the buckets' in which the water is transported into the house¹¹⁹.

- unsatisfied demand: concepts as important as the demand for water and unsatisfied demand are often completely ignored.

- cost of water: often poorly observed if the cost components (volumes consumed, price of each container) are not listed. In many survey reports, it is not specified whether the 'average costs of water' given in the report only include those households who pay for water, or also those who pay nothing: if there are a high percentage of households who don't pay for water, then the average cost is highly biased. Furthermore, the commercial policy aimed at households not yet connected should differ according to whether they pay for their water or not.

- willingness of households to be connected to the network(s), willingness to consume more water (and how much), willingness to pay: these topics are the most cited examples by those opposing the use of surveys. These topics are certainly some of the hardest to deal with, but there are proven ways of overcoming most of these difficulties¹²⁰.

118 This is the minimum number below which it is virtually impossible to obtain results of any statistical importance.

119 Here, the household's water consumption is taken into account both inside and outside the house (for washing laundry, for example).

120 A quantitative survey questionnaire is a lot more than a simple list of topics or questions (as is often supposed). In fact, a questionnaire acts as the aid, directing the questioning which is presented as part of a logical system: the person questioned being guided in their answers and led in successive stages towards those areas of consideration that the survey aims to explore. Example: The method for testing the willingness of households to consume more water (activities supporting improvements to service quality having been made possible), or the willingness to pay for a potential future connection or water bill.

A large number of specialized surveys, for example, those on willingness to pay, are affected by systematic bias:

- they only deal with one part of the subject and fail to collect data essential for planning any given source of water supply or sanitation facility, or data on unit consumption or even, sometimes income;
- they only cover one part of the population (only those households connected to the network or only those not connected, etc.) and forget that the social body is a whole¹²¹ and that the future behavior of certain categories of the population are likely to strongly resemble certain other categories within the same town.

As a result, the information extracted is often truncated, partial and sometimes biased (through the desire to ‘scientifically’ support a given conviction); a situation which neither the planner nor the manager can do much about.

The format of the questionnaire, and particularly the way in which the questions are selected, formulated and then organized in relation to one another is often totally overlooked. This results in questionnaires that are often biased and seriously prejudice the quality of the data; indeed, obtaining a response to a question (poorly) asked does not necessarily produce useful information.

- **No precise (written) definition of the different variables** is usually given and the Instruction Manual for Interviewers is often impossible to

¹²¹ ‘Ones’ are not different from the ‘others’ and the difference (characteristics, size, etc.) cannot be qualified or quantified by comparing it with other groups. Any activity program that benefits one should also take into consideration the existence of the others, the characteristics of whom it is therefore important to be aware of.

find. Indeed, this fundamental aspect of the survey is often overlooked: after having read numerous survey reports, it is clear that many concepts have been poorly defined and that, in all likelihood, the interviewers themselves have not been given enough precise instructions to enable them to ask questions correctly and so obtain clear and precise responses. In these conditions, the results of these surveys can often not be used as they refer to concepts for which the meaning is hard to determine.

How is it possible to be surprised by this situation knowing that a large number of surveys are conducted by people with a very poor ‘water culture’ (and one which is even poorer for sanitation)? The concepts that need to be used are not simple and only experience of using this type of survey can enable issues to be developed that are aligned to the local situation: if the issue is poorly expressed, there is virtually no chance of obtaining satisfactory responses, i.e. responses which enable better understanding of the reality of the situation in all its diversity and complexity.

- **Household income (or expenditure)** is often poorly observed: in many surveys, the percentage of indecisive responses is high (around 50% or higher) making it necessary to systematically recover the missing information from the observed data: from those households from whom income data has been collected, work out the regression equation that enables household income to be estimated by taking into account certain observed socio-economic data, then estimating the income of each of those households that did not respond. This practice, although mathematically rigorous, appears inadmissible for at least two reasons:

- a survey is conducted to observe the reality of the situation and quantify this in the form of statis-

tical data. Consequently, the non-response rate should be low (lower than 10%), especially for the 5 or 6 most important variables, one of which is income;

– the application of the recovery method described above depends on an implicit

assumption: those households not responding to the question on income have the same socio-economic profile as those who do. This assumption is incorrect, however; discussion with the interviewers and supervisors about specific observed cases will provide confirmation of this.

FOR

Carrying out a survey worthy of the name can only be justified in relation to clearly stated and precisely defined objectives. It is for this reason that, prior to entering into methodological details, it is advisable to review the survey objectives.

Assessment objectives

Overall objectives

A survey is conducted to:

- gain an understanding of the real situation in its various guises and by highlighting certain particular aspects of this reality;
- test the assumptions, whether these be planned pricing approaches (tariff level, payment methods, etc.), technical assembly (different types of possible access to water, different types of sanitation facilities) or other.

However, to ensure that the survey provides precise results in relation to what is required (facts accompanied by correlations), it is impossible to restrict oneself to overall objectives alone. It is advisable to go into detail, to at least

define the topics and sub-topics (e.g. by establishing a list of questions to which the survey should provide the response), such as those presented, in brief, below:

Specific objectives

Even though a certain amount of baseline data should always be collected by the household surveys (see Chapter 3, part 1 and Chapter 4, part 2), not all surveys have the same specific objectives: these can vary from one survey to the next depending on the overall objectives defined beforehand.

1. **Access to water** (and/or to sanitation), i.e. the breakdown of the total population by source of water supply and/or sanitation and income level:
 - at general level, i.e. all of the study area;
 - by geographical¹²² area for modeling the network, for example.

¹²² Between 7 and 20 areas (maybe more), depending on the sample size used for the survey.

For this it is necessary to have a good and precise understanding of the concepts of: connection (household or sewerage system, public or private network, etc.), shared connection, household supplied by a neighbor sharing a connection, standpipe (public or private), etc.

Use:

- **For planning:** whether this be for calculating the demand for water, or estimating the cost of an investment program and so the creation or review of the tariff;
- **For studies on the delegation of public services,** as the concession contract sets 'access to supply objectives'. These objectives are set based on actual access at the time of delegation. If this actual access is poorly defined and measured (or even poorly estimated) then there is every chance that these objectives will be unrealistic (as they are based on initial data that was incorrect). This can lead to serious problems of understanding between the delegatee and the public body (regulator) charged with ensuring that the clauses in the delegation of public service contract are respected: for example, an over-estimated access rate will mean an under-estimated investment program and, consequently, an under-estimated water tariff;
- Having access figures by wealth/poverty level available means potential clients can be better identified, as it is possible to measure the extent to which the population has unequal access to supply.

Notes:

The 'indirect estimates' of access, made based on the number of connections (or registered consumers), are usually sullied by major uncertainties. They are carried out using an average number of people per connection/registration;

however, the validity of this figure is not known and can often be incorrect (see Chapter 3, page 69, Estimation without going into the field);

One of the advantages of quantitative surveys over all other methods is that these surveys produce coherent data: for calculating indicators (rate of access, for instance), the surveys generate both the numerator (population concerned by a given phenomenon) and the denominator (the whole population, regardless of whether they are concerned by the phenomenon).

2. Consumption/Demand for water (liters/person/day), based on source of water supply and geographical area and the wealth/poverty level.

Use:

- It is impossible to find this data updated in any other information source;
- It is vital for understanding current, and planning the future, behavior of households, regardless of whether or not they are supplied by the public network.

There is the possibility to bring together 3 essential concepts:

- **The current unsatisfied demand** by comparing current consumption to the demand expressed by the same household (but obviously taking into account the additional cost engendered by consuming more water);
- **The current and future solvent demand** by considering the financial means of households and the necessary alignment of the tariff to the real situation of households and to the potential market;
- **The current potential market by household income level,** estimated from the difference in the consumption of households with the same income, but differ-

ent sources of water supply (connected or not connected to the network).

3. Current cost of water:

- By source of water supply, geographical area and level of income;
- Distinction between those households who pay for water and those who don't;
- Percentage of the family budget allocated to water and/or sanitation¹²³;
- Elasticity of demand in relation to the price of water and household income.

Use:

- It is impossible to find this data in any other source of information;
- It is vital for a commercial and pricing policy that is adapted to the local situation.

It is possible to approach the concept of the social policy for water by having an exact understanding of the financial means households' have available to pay for a connection and for their water and/or sanitation bill (based on their likely consumption).

Note:

Knowledge of household income (and expenditure) is essential for enabling proper analysis of the proportion of the family budget taken up by water and/or sanitation, as well as the real possibilities available to them for increasing their consumption. It is for this reason that household income features in a number of the most important variables to be observed in a survey.

4. Capacity to pay/Willingness to pay (for a connection, a monthly or bi-monthly bill, etc.):

¹²³ Often called the 'budget coefficient' by statisticians or 'rate of effort' by urban planners.

- By source of water supply, geographical area and wealth/poverty level;
- Distinction between those households who pay for water and those who don't.

Use:

- It is impossible to find this data in any other source of information;
- It is vital for a commercial and pricing policy that is adapted to the local situation.

It is possible to approach the concept of the social policy for water based on an objective approach (capacity to pay) and a subjective approach (willingness to pay) to the households' financial means of paying for a connection and/or facility, as well as their bill (based on their likely consumption).

Note:

Knowledge of household income (and expenditure) is essential for enabling proper analysis of the households' capacity to pay for an improved service, as well as the actual possibility of households agreeing to pay a higher bill (due to an increase in their consumption or the tariff). As a result, household income features in a number of the most important variables to be observed in a survey.

5. User satisfaction of the service quality, notably defined in terms of:

- Technical characteristics: pressure, turbidity, daily duration of supply, etc.;
- Consumption: quantities, availability, opportunity¹²⁴, price, etc.;
- Organoleptic characteristics: color, smell, taste;
- Cost of water and/or sanitation.

¹²⁴ Availability at certain times of day, e.g. at 'peak times'.

6. User expectations, for both connected households and those not connected (source of water supply and/or sanitation facilities, quality, quantities, price, etc.).

Use:

- It is impossible to find this data in any other source of information;

It is important for donors, the regulator (in the case of delegation of the public service) and other bodies that need to evaluate and grade the water company's performance¹²⁵;

- It is important for the water company itself, who can thereby adapt its commercial policy to the reality of the local situation: this information should form the basis of a true communication policy¹²⁶.

- It is possible to create a typology of consumers based on objective criteria (source of water supply/sanitation facility, cost of water, income, etc.) and subjective criteria (opinion of service quality, desires, willingness to pay, etc.).

7. Potential market, by wealth/poverty level, assessed and analyzed from several variables:

- Unit consumption;
- Cost of water: per m³, per month;
- Percentage of income dedicated to water.

Use:

- It is impossible to find this data in any other source of information: this information is rarely found in publications, not even in those studies and specialized publications on demand for water;

- It is important for analyzing the consequences of an improvement in access on household consumption and so on the additional turnover generated by directly supplying (i.e. by household connection) households not currently connected.

8. Water and the disadvantaged population (/poverty):

This is the particular role of standpipes and other sources of good quality water supply ensuring the same service.

This includes analysis of the main technical and social factors determining consumption/demand for water by poverty level: access, consumption/demand for water, cost of water, capacity to pay – willingness to pay for water, etc.

Use:

- This is a very important subject for donors, as they rarely have precise and effective information available on this topic (i.e. that permits them to make appropriate decisions);

- It is vital for defining a commercial and pricing policy aligned to the situation of the disadvantaged population: location, current conditions of water supply, real financial means, expressed opinions and desires, etc.

Note:

The willingness to study certain particular geographical areas of the town and/or certain categories of the population (defined in terms of poverty or living areas, etc.) enables substantial modifications to be made to the sampling procedure to ensure that statistical representation is assured for these areas and categories. By clearly setting this objective prior to carrying out the survey, it is possible to over-represent certain areas in the sample in order to better understand them and create adapted programs¹²⁷; this

¹²⁵ Independent Reviews, Project Performance Audit.

¹²⁶ Enabling, for example, the water company to prevent wastage of water or to explain a tariff increase.

¹²⁷ The introduction of such bias doesn't change the value of the averages calculated for the whole of the town, as it is possible to rebalance the sample during data processing based on the actual population of the different areas.

operation is all the more interesting as it is inexpensive.

Methodological table

It is not advisable here to enter into the details of the methodology of a classic statistical (or quantitative) survey as that would take up too much space and it is not the main topic of this section. However, it is vital that the main elements of the methodological analysis table are reviewed for a survey created and carried out by a professional, as dictated by best practice.

A model survey summary report is provided below: this gives a practical overview of the type of data that a household survey needs to produce, and of the type of strategic thinking that the creation of this data should normally give rise to.

Base

The survey methodology needs to be adapted to the budget it has been allocated, as well as to the timeframe forecast for the operation, as part of a project considered in general.

- **Detailed budget** for the survey: the budget, often defined in the Terms of Reference or imposed by the assessment's overall budget, is often a major constraint. However, it is not the only one: many assessment companies systematically decide to allocate a budget that is too low to this part of the assessment (in other words, to 'make savings' in this area), and so they entrust the realization of the survey to a local partner whose qualifications and/or experience have not always been verified with sufficient rigor¹²⁸.

- **Detailed scheduling** of the survey: it is difficult to do much in less than 3 to 4 months:

- Preparation: around 1 month for developing the sampling procedure and the questionnaire;
- Data collection in the field: around 3 weeks (this partly depends on the sample size), as the number of interviewers should never be increased as they are difficult to train and even more difficult to supervise;

- Data processing and analysis: 3 weeks (including data cleansing) and 2 to 3 weeks (including the presentation of results) respectively. Thus, at the end of 3 to 4 months, the project should have a detailed report available on the socio-economic conditions of consumption and demand for water, and on the sanitary conditions (this period covers all activities, including typing up the report with tables, graphs and annexes).

A sample survey can be conducted in a lot less time provided that all components are considerably reduced: basic objectives, reduced sample size, simplified sampling method, very short questionnaire, etc. However, this is only possible if the expectations of the ordering party regarding the results to be produced are also reduced and, in any case, there are certain timescales that are almost impossible to shorten, such as the preparation time.

- **Adapted staff**

- Selection of a competent and experienced survey manager, capable of generating an issue as the focus for the survey and designing the survey (questionnaire, sampling procedure), then supervising the data collection and processing and, lastly, conducting the analysis and drafting the report.

¹²⁸ As if it were easier to find a competent survey statistician than a hydraulics engineer.

– Selection of a team for carrying out data collection in the field, coding, data capture and then data cleansing of the files, respecting the schedule and the budget at all times.

Preparation

- **Survey objectives:** to be clearly and precisely defined. This phase is vital and it is worth devoting enough time to discussions and consultation, etc.

- **Geographical areas:**

– Study areas: precise demarcation, notably to identify which of the town's outlying areas should be integrated into the perimeter.

– 'Extrapolation areas': for how many geographical areas, in addition to the whole town, are meaningful results required.

- **Sampling procedure¹²⁹:**

– Sample size (300 to 1,000 households, or above in certain cases), and geographical representation (a minimum of 100 households per different area);

– Sampling frame: for stage one composed of geographical areas (preferably find an existing frame) and stage two (establish a list of households within the sample-areas);

– Drawing from the sample, most often 'area sampling', in two stages: areas (stage one) and then households within the sample-areas (stage two);

– Stratification, dispersion.

- **Questionnaire:**

– **Design:** for each variable¹³⁰, the precise definition and its adaptation to local practices is studied. Organizing the variables into a hierarchy, so as to organize the interviewers' training then monitor the questionnaires and focus every

one's attention on the essential points;

– **Survey method**, notably to estimate: the water consumption; the cost of water; willingness to increase water consumption; to be connected to the network; to pay the connection cost and water bill and/or for sanitation facilities, etc.;

– **Test(s) in the field**, from the initial qualitative surveys (with or without focus groups) to classic questionnaire-based tests: expected outputs of the interviewers; instruction Manual for the interviewers.

- **Staff:**

– Survey manager: the demand assessment manager needs at least to oversee the survey design and, if possible, carry out general supervision (with perhaps a short absence of two weeks from the field due mainly to budget reasons);

– Recruitment: supervisors and interviewers;

– Training: in class and in the field;

– Monitoring: in the field (by the supervisors) and in class (by the survey manager);

– Return visits to the field, if necessary.

- **Logistical arrangements:**

– Vehicles; communication between the field and the office.

Execution: Field surveys

– Systematic controls (in the field and in the office) and supervision;

129 For more detail, please see Annex 3.

130 The number of variables can vary considerably from one survey to another, depending on the objectives used (around 60 to 160, as a general rule); however it is often necessary to reduce this number to a minimum to limit the time to be spent on data processing and analysis.

- Frequency of interviewer visits to the office, role of the survey manager;
- Re-surveying in the field: during data collection and also during data processing, if required.

Data processing & analysis

- **Computer-based processing:**

- Software: selection of specialized software for handling surveys, rendering processing simple, quick and rigorous thanks to its perfect alignment to the issues in hand;
- Staff (coding administrators, data capture administrators, supervisors): recruitment and training (notably on the use of the specialized software);
- Coding (including controls and rectifications);
- Data capture: preparation of input masks (with

filters and other automatic controls) with software for handling surveys and data capture (including controls and rectifications);

- Data cleansing of files: list of the main anomalies to look out for, research and correction procedures (by returning systematically to the questionnaire and even to the field, if necessary).

- **Analysis and drafting of the report:**

- Staff: this work is conducted by the survey manager himself;
- Tabulation (output of statistical tables);
- Drafting the report: description of the results and first level analysis;
- Presentation of the results as part of a meeting or workshop, etc.;
- More detailed analysis (if requested): analysis of the data (including typology).

Some technical details for a survey on water and sanitation

		TYPE OF SURVEY		
		IN-DEPTH	AVERAGE	BRIEF (inventory survey)
SAMPLE SIZE (SEE THE SUBSEQUENT ANNEX FOR MORE DETAILS) (HOUSEHOLDS)				
Geographical level at which data should be meaningful	Whole town	300 to 500	300 to 500	300 to 500
	3 areas	500	500	500
	10 areas/ neighborhoods	1,000	1,000	1,000
	50 areas / neighborhoods or above	–	–	Up to 5,000 or above
QUESTIONNAIRE SIZE				
Questionnaire variables (number)		160	100	10 maximum
Length of interview (minutes)		45 to 60 maximum	30 (as there are questions on income and expenditure)	7
PERSONNEL REQUIRED				
Interviewers' output (number of interviews per day)		8	12	65
Length of survey (number of days), set in advance during general planning of the survey		12 or 2 weeks	12	12
Days x interviewers (required to respect the planned deadline)		1,000 / 8 → 125	1,000 / 12 → 83	5,000 / 65 → 77
Interviewers (number required)		125 / 12 → 11	83 / 12 → 7	77 / 12 → 7
Monitors (number required)		11 / 3 → 4	7 / 3 → 4	7 / 3 → 4

Model survey summary report

PREFACE

Summary

1. Presentation of the survey

- 1.1. Assessment scope
- 1.2. Survey objectives
- 1.3. Socio-economic approach to water consumption
- 1.4. Geographical approach to water consumption

2. Households' standard of living

- 2.1. Size of households
- 2.2. Type of dwelling
- 2.3. Type of occupation of the dwelling
- 2.4. Elements of standard of living
- 2.5. Definition of income
- 2.6. Economic factors influencing the population
- 2.7. Breakdown of households by income
- 2.8. Average income
- 2.9. Wealth/poverty levels (quintiles and deciles)

3. Source of water supply

- 3.1. Several sources of water supply
- 3.2. Purchase of mineral/purified water
- 3.3. Drinking water network
- 3.4. Other source(s) of supply
- 3.5. Conclusion: the access to supply policy
- 3.6. The storing of water

4. Volumes of water

- 4.1. High-consuming household equipment
- 4.2. Average unit consumption
- 4.3. Wealth/poverty level
- 4.4. Elasticity of water consumption in relation to price and income?
- 4.5. Potential market

5. Cost of water

- 5.1. Definition
- 5.2. Overall cost
- 5.3. Cost per m³
- 5.4. Cost of water in the family budget
- 5.5. Analysis by households' wealth/poverty level

6. Sanitation

- 6.1. Bath/shower, WC/toilets
- 6.2. Wastewater (grey)
- 6.3. Wastewater (black)
- 6.4. Households with a septic tank
- 6.5. Willingness to have improved facilities

7. Consumer satisfaction

- 7.1. Water: overall approach – wealth/poverty level – satisfaction maps
- 7.2. Sanitation: overall approach – wealth/poverty level – satisfaction maps

8. Willingness to pay for a connection and...for water

- 8.1. Willingness to pay for an improved facility (household connection/other)
- 8.2. Willingness to consume more water
- 8.3. Willingness to pay for water

9. Willingness to pay for improved facilities and...for sanitation

- 9.1. Willingness to pay for an improved facility
- 9.2. Willingness to pay for wastewater treatment

10. Capacity to pay: is a tariff increase socially acceptable?

- 10.1. Price of water and of sanitation, price of electricity
- 10.2. Estimate of price of water and/or sanitation with standards (3%, 4%, 5%)
- 10.3. Conclusion

ANNEXES

1. Detailed results by geographical area
2. Questionnaire
3. Instruction manual for interviewers
4. Sampling procedure

The sampling procedure for a household survey

Objectives

The objective of the statistical survey is to obtain information relating to water and sanitation in the town. However, this survey only uses part of the population (called the 'sample') to produce information on the whole (called 'universe' or 'population').

It is imperative that this objective is specified to ensure we get what we want and are not disappointed once the survey has been completed. There are two questions that need to be answered:

- What information needs to be collected (because it is required): a little or a lot?
- At what geographical level: only the whole town or the different neighborhoods in the town, or only certain neighborhoods and/or only certain segments of the population, etc.?

The survey managers often raise these questions when presenting the questionnaire to the sector managers and when discussing the sampling procedure. Usually, this is too late, as the budget (financial and time budget) has already been fixed and the framework cannot be changed.

It is, therefore, essential to think about these questions far in advance, when setting the survey strategy, and ensure that this reflection leads to the development of a budget and works schedule.

What information?

The questionnaire is an essential part of a survey. A tool for collecting information, its size and complexity depends on the survey objectives: what information do we wish to have available and what do we want to do with it?

A lot of information

When wishing to enter into the detail of water and sanitation issues, it is advisable to not only collect information on the households' socio-demographic characteristics, on the source of water supply and consumption, but also to specify their willingness to pay for facilities (water and/or sanitation) and then the bill. It is also necessary to examine households' satisfaction and their expectations of an improved service. Lastly, household income and expenditure needs to be recorded.

For example, the survey objective can be formulated as follows: 'this [sample] size should enable analyses of different social categories (gender-specific groups, vulnerable groups, strategic groups) and/or socio-economic categories (income classifications: analysis by quintile, the same quintile, if possible; access to water: households connected or not connected to the drinking water network, etc.)'.

In addition, is the collection of qualitative information required to better determine certain behaviors?

A little information

When an 'inventory survey' is required, for example a survey on access to water and/or existing sanitation facilities (see Chapter 3, page 68: 'in-depth' survey or 'brief' survey), we only look to collect a little data on each household (less than 10). Only a few questions are asked, which the interviewees can answer very quickly and without difficulty.

Between a little and a lot of information

There is, no doubt, an optimum that enables enough detailed information to be obtained with limited means. This optimum is difficult to find, however, as the final recipients of this data don't properly understand the difficulties involved in data collection: they tend to want to 'take advantage' of the opportunity to ask additional questions, making the questionnaire considerably more cumbersome and compromising the quality of the data collected.

It is, therefore, important that consideration is given to setting priorities.

At what geographical and/or social level is it meaningful?

The information collected must be statistically meaningful, i.e. it needs to give the correct picture of the population over the whole town and even (where this is planned) over the different areas making up the town and/or the different segments of the population.

In fact, having an understanding of the overall situation for the town is of limited interest if the aim is to plan the water and/or sanitation service in different areas of the town, and adapt this service to the needs and expectations of the

population. In general, the managers need information at a more refined geographical level so as to be able to take the social, technical and institutional particularities of small geographical areas into account.

Definition of the level of geographical detail expected is essential: it constitutes the starting point for the creation of the sampling procedure.

The particular case of partial assessments needs to be clearly dealt with. Certain assessments only look at one part of the town (outlying neighborhoods, for instance), or at certain categories of the population (poor households, for example). For reasons of economy, there is a tendency to select a sample exclusively from the population concerned by the assessment: particular neighborhoods or a particular category of the population. This choice has serious consequences: yes, we know the characteristics of the population interviewed, but we have nothing against which to compare them. It is these elements of comparison, however, that enable objectives to be defined for a policy to improve living conditions in these neighborhoods and for this population.

It is therefore recommended to always select a CONTROL SAMPLE, composed of 'normal' neighborhoods (in the example above, this would be the non-outlying neighborhoods), and/or the 'normal' population (in the example above, this would be the population that is not poor). Of course, the control sample needs to be relatively small; however it is clear that it will cancel out a sizeable part of the survey's total sample (at least 25% of the total).

Size and composition of the sample: finding a compromise

To find a reasonable balance between the high expectations¹³¹ of the managers of the town (elected officials and technical services) and the limited means they have at their disposal, the simplest method is to consider the length of the interview between the interviewer and interviewee; this takes into account both the number of questions on the questionnaire and their difficulty. For the same budget and the same survey schedule:

- a short interview (less than 10 minutes) means a large sample can be surveyed;
- a long interview (from between 45 minutes to an hour) results in a much more reduced sample size.

Prior to dealing with the technical aspects of a sampling procedure, managers need to provide clear answers to the issues above. It is mainly from these answers that the sample size is determined, which results in a compromise being made between the budget available for the survey, the time available for conducting the survey and the survey objectives.

In order to design an effective sample, statistically representative of the population in each area, it is recommended that the following principles are applied:

131 Which are also often very imprecise, often resulting in ambiguities that have serious repercussions.

132 "A sampling frame is a complete and up-to-date list of the units making up the whole of the population to be studied [...] The term "list" should be understood in its broadest sense: it is often a file (paper or electronic) or an administrative source, but it can also be an aerial photo that is then divided into basic areas, when using an area sample method.

There are several examples of sampling frames:

Principles

One of the main principles is to be as practical as possible, which means using information that already exists to develop the sampling procedure. To do this, it is necessary to draw on those institutions best able to provide a sampling frame¹³², or even to design a sampling procedure and obtain a truly representative sample.

Large sample

The larger the sample, the more precise the statistical indicators. In other words, the greater the number of households interviewed, the better the results.

This principle needs to be applied carefully, based on the survey objectives but taking into account the budget available for conducting the survey.

For a survey conducted within the (current or future) perimeter of the town, the size of the sample will differ depending on whether we want to obtain results that are:

- General, which means relating to the population of the whole town: between 300 and 500 households is sufficient (the difference lies solely in the level of precision required);
- Detailed by geographical area /neighborhood and/or by segment of the population: a

– The "lists" of administrative documents (for example, list of tax-payers) or lists from previous surveys (particularly the census),

– A list of area units, notably the Enumeration Area [sometimes called Census Districts, Enumeration Sectors, etc.] used in the population census, from which a sample of units is taken".

Source: Rémy Clairin, Philippe Brion - Manuel de sondages (applications aux pays en développement) – Sampling Manual (applications in developing countries - Documents et Manuels du CEPED N°3, Paris, February 1996.

minimum of a hundred households per neighborhood and/or segment of the population. As a result, the size of the sample to be surveyed directly depends on the number of areas or segments of the population considered.

For example, in a town where results from 10 different areas are required, a sample size of at least 1,000 households is necessary, regardless of the population of the neighborhoods under consideration.

- For the specific case of ‘inventory surveys’, the samples are usually a lot larger.

For example, if in a town of 100,000 inhabitants, comprising 15,000 households, we want to know the breakdown of the population by source of water supply and/or type of sanitation facility at a highly refined geographical level (e.g. 50 areas), the sample size can easily reach 5,000 households. Moreover, this initial survey can be used as the sampling frame for a second, more in-depth survey.

Dispersion

The results are more statistically meaningful the more the sample is dispersed in the field. This principle needs to be applied based on the budget available.

In practical terms, to ensure the sample is well-dispersed, it is recommended that some simple rules are applied:

- For an ‘in-depth’ survey¹³³, the data collection work in the field needs to be organized in such a way as to ensure that the interviewer changes interview areas nearly every day. As a result, for an in-depth survey with 1,000 households, for which the average output of an interviewer is 8 questionnaires a day, the survey must be planned to cover 125 different small geographical areas (1,000/8).

These ‘small areas’ are purely operational: they are used to ensure effective dispersal of the sample across the town and to organize the work of the interviewers in the field.

The link between the 10 large areas/neighborhoods for which statistically meaningful results are required is as follows: the 125 small areas need to be equally shared out across the 10 areas, which means 12 small areas in each large area (with 5 large areas having 13 to reach the total of 125).

- For an ‘inventory’ survey¹³⁴ with a large sample, the average output of an interviewer has little influence over the method. Indeed, the interviewers should cover all the neighborhoods in the town, with the only prerequisite being that the work is well-organized (to ensure that all neighborhoods, roads and lanes are covered without exception). As a result, for a survey of 5,000 households in a town of 100,000 inhabitants (and so 15,000 households), the survey should be planned in such a way that the interviewers question one in three households by visiting all areas.

Stratification

Instead of taking the sample directly from the total population, it can also be taken from within homogenous sub-groups of the population, identified using social criteria (such as type of dwelling or households’ socio-economic level) and/or using technical criteria linked to the survey topic (source of access to water, predominant sanitation facilities, etc.).

133 The questionnaire includes around 160 variables, and the interview between interviewer and interviewee should last for around 45 minutes to an hour.

134 The questionnaire includes a maximum of 10 variables, and the interview should be less than 10 minutes long.

Stratification is desirable in theory, however it is often difficult to organize in practice as not all the necessary information is available. So, what can be done in such a situation?

- It is nearly always possible to clearly define the perimeter of areas supplied by the water network, as well as those not supplied by the network: this is done by simply superimposing the plan of the network over the plan of the town. The same can be done for sanitation with the sewerage system, where one exists in the town. This is then to be taken into consideration in the sampling procedure.
- It is also possible to distinguish the areas defined a priori (by local managers with knowledge of the reality of the field) as 'wealthy' and the areas considered 'poor' and take this into account in the sampling procedure.
- Etc.

Attention: most of the time, the different strata will not have the same size population. However, this is not particularly serious. There is no obligation to take samples of a size proportional to the population for each of the strata.

Representivity

The construction of a sample is always done with the aim of obtaining a reduced, yet reliable, picture of the whole from which the sample is taken, at least as far as the characteristics studied are concerned.

However, it is not necessary for the sample to be an exact reduced model of the universe: certain parts may be over-represented in the sample (provided, of course, that the necessary rectifications are made during the data processing phase). *"Two countries of different sizes conducting surveys from the same sized samples based on simple area samples and on varia-*

bles representing the same dispersion will obtain similarly precise results, although the sampling ratios are different¹³⁵".

Survey method

In practical terms, how are the households we wish to interview to be selected most effectively (to obtain good representation)? In other words, how can we randomly 'select' those households that will make up the sample to be surveyed?

Position of the problem

The method that gives the most precise results is one-stage sampling, however, 'two-stage sampling' is often recommended due to its practicality.

In practice, all depends on the size of the sample and the size of the town in which the survey is to be conducted. To clarify the issue, a two-step process is to be followed:

- Calculate the sampling fraction by comparing the sample size to the total number of households in the town. A sample of 1,000 households in a town of 100,000 inhabitants (i.e. 15,000 households) equates to a sampling fraction of 7%, or one in 15 households. A sample size of 500 households within the same town equates to a sampling fraction of one in 30 households.
- If the sampling fraction is small enough (a maximum of 1 in 10 households), a simple one-stage method can be adopted, as the interviewers should not have too many difficulties in the field. Anything above this and two-stage sampling is preferable.

135 Source: Manuel de sondages (applications aux pays en développement), op. cit.

One-stage sampling

The statistical units to be considered are the households.

Method

The selection of households is made by the interviewer directly in the field. The sample households are drawn systematically, by using what is known in technical jargon as the 'rate of x'.

Taking once more the example of an inventory survey in a town of 100,000 inhabitants (15,000 households):

- For inventory surveys with a sample of 5,000 households, the interviewers need to question one in three households: they need to pass through the town applying a 'rate of 3', which is feasible as the next household to be questioned is never too far away from the previous one.
- For in-depth surveys with a sample size of 1,000 households, the interviewers need to question one in fifteen households: they should pass through the town applying a 'rate of 15', which is far more difficult as the next dwelling may be further away from the first (and, in this case, the interviewer may be tempted to reduce the rate and so not apply the method).

The difficulty of applying the method

The practical application of a one-stage survey often presents major difficulties:

- It will take a lot of time and cost to establish a list of all the households within the town, as visiting each neighborhood will be a long and expensive process;
- It is unreasonable to expect the interviewers to travel across the whole town, in all directions, questioning a household now and again as they

will be tempted not to respect the rules they have been given.

If these difficulties prove insurmountable, a two-stage survey is used as this method enables two problems to be resolved:

- If there is no overall sampling frame available (listing all the town's households), work can be conducted to partially establish this frame: only exhaustive knowledge of the primary units (areas) is required. The work can therefore be limited to establishing the list of primary unit households taken at the first stage;
- Overall, savings can be made in time and travelling expenses (for the interviewers).

Multi-stage surveys

The eventual choice of a two-stage survey usually comes down to its practicality.

The two-stage survey consists of using a succession of statistical unit groupings from which to draw the sample. Generally, the following process is followed:

- First stage: a sample of 'area units' is taken, i.e. small geographical areas;
- Second stage: a sample of households is taken from the area units that make up the first stage.

The following example can be used to explain this method: an in-depth survey is to be conducted that should be meaningful over 10 of the town's neighborhoods; the sample will therefore be made up of 1,000 households drawn at random.

1) First stage

The statistical units to be considered are the 'area units', or the small geographical areas.

The area sampling frame most commonly used is 'census mapping', which means the map used as the basis for the General Population and Housing Census: the whole of the national territory (urban and rural) has been broken down into small geographical areas, called 'Census Districts (CD)', containing a similar size population of about 1,000 people on average¹³⁶. The Office for National Statistics has all these maps and they are usually able to make these available to third party organizations, subject to defined terms and conditions.

There are two disadvantages associated with this mapping frame:

- It is often out-of-date, which creates problems in towns experiencing rapid growth, especially in outlying areas. As a result, if the maps are more than five years old, they will need to be updated;
- The size of the CD is often too big to enable ease of use. Indeed, the recommended size is around 300 to 500 people (50 to 80 households), a figure much lower than the average of 1,000. This means that it is often necessary to break the CD down further into 'sub-CD' of a smaller size.

What can be done if the census mapping plans are not available? A minimum frame must be created (and budget found for this) based on the work of the urban planners, which means using a land use map¹³⁷ and population data; the breakdown into areas can then be done from this map.

If there is no land use map then one needs to be created quickly: this task will not only be useful for designing the sampling procedure for the household survey, but also for the population study (a prerequisite for calculating the demand for water).

In practical terms:

- Select the Census Districts (CD) at random from within the area sampling frame, i.e. the Census Mapping;
- If the CDs selected are too large, these need to be broken down into 'sub-CD' of equal sizes, then one of these sub-CDs is selected¹³⁸.

In the example above, 125 area units need to be taken, which means that interviews will be conducted in 125 small areas of the town (CD and/or sub-CD) selected at random.

2) Second stage

The statistical units to be considered are the households, selected at random from within the area sample units, CD or sub-CD.

There are two possible methods of carrying out the selection of households to be interviewed:

- **1st method** (prior to the interviewer going out into the field). This involves two steps:
 - In the field: counting the households. A list is established of all the households in each sample CD or sub-CD. This list is the second stage sampling frame.
 - In the office: households are selected from the list that has just been compiled (for example, by retaining 1 in 10 households on the list if this contains 80 households).

Then, the interviewer going out into the field is given a precise list of only those households he should interview with their exact location in the sample CD or sub-CD.

¹³⁶ This size varies greatly from one country to another. However, within the same country, the CDs can be of different sizes depending on the housing area: the CDs are generally larger in the urban environment than in rural areas.

¹³⁷ Containing several categories of residential use and corresponding densities.

¹³⁸ In this case, the survey consists of three stages: the first stage doubles as the first stage for the CDs and a 2nd stage for the sub-CDs.

- **2nd method** (during the interviewer's field visits): in this case, it is the interviewer himself who directly identifies those households to interview in the field. As he goes through the sample CD, he passes all the dwellings and sample households are drawn systematically by using the 'rate of x'. For example, where there is a CD of 80 households, the interviewer must question 8 households in each sample CD, so must apply a 'rate of 10'.

The first method is recommended, as leaving it up to the interviewers themselves to select the sample is not ideal. Indeed, this often results in an unrepresentative sample¹³⁹, which cannot claim to precisely reflect the situation.

3) Disadvantages of the method

The practical application of a two-stage sample also presents difficulties.

An area sampling frame is not always available that is recent and of quality. So what can be done when there is no census mapping frame?

- Either abandon this method and use one-stage sampling with a lot of care;
- Or create this frame from existing documentation, for example, from the urban planning department (who usually has maps and information on the population breakdown within the town) or from the administrative services (who often have population data, recent or otherwise), or from satellite images available from Google Earth®.

The clear objective here is to obtain a reasonable quality map of the town, with population data that is more or less up-to-date, in order to be able to divide up the town into a fairly large

¹³⁹ For example, if the interviewer questions all the households in one building, the data collected is likely to be very similar. As a result, there is a high chance that the situation corresponding to this building will be over-represented in the sample in relation to other situations.

number of basic areas to enable random sampling.

There is less statistical precision: multi-stage sampling is, in general, less precise than one-stage sampling. This is due to the 'cluster effect': the statistical units grouped together in the same area unit are often similar and have common characteristics. This precision can be improved, however, by:

- Stratifying the area units, by considering the existence of a water and/or sanitation network, for example;
- Increasing the number of sample area units and reducing the number of households within each area unit: it is better to have a lot of area units, with few households interviewed in each one, than few area units with a lot of households in each.

Precision of the sample

Principle

The precision of the survey depends on the size of the sample used. The confidence interval varies depending on whether the variable observed is an average or a population, but in both cases the size of the population of the universe (i.e. the town) plays no role:

- **average:** the value of the average "a" has a 95 percent chance of being included in the following confidence interval:

$$a \pm (1.96 \sigma / \text{square root of } n)$$

where "σ" is the standard deviation of the variable observed and "n" is the sample size.

TABLE 24. Specification of a theoretical sample, based on its size and the type of variable observed

SAMPLE SIZE (a)	CONFIDENCE INTERVAL 95%	RELATIVE ERROR (±, in %)
Average - size of household of		
100	[5.41 – 6.59]	9.8
300	[5.66 – 6.34]	5.7
333	[5.68 – 6.32]	5.4
500	[5.74 – 6.26]	4.4
1,000	[5.81 – 6.19]	3.1
2,000	[5.87 – 6.13]	2.2
PROPORTION - p = 10%		
100	[0.04 – 0.16]	58.8
300	[0.07 – 0.13]	34.0
333	[0.07 – 0.13]	32.2
500	[0.07 – 0.13]	26.3
1,000	[0.08 – 0.12]	18.6
2,000	[0.09 – 0.11]	13.2
PROPORTION - p = 50%		
100	[0.40 – 0.60]	19.6
300	[0.44 – 0.56]	11.3
333	[0.45 – 0.55]	10.7
500	[0.46 – 0.54]	8.8
1,000	[0.47 – 0.53]	6.2
2,000	[0.48 – 0.52]	4.4

(a) Number of households questioned
 (b) Calculations made based on people with a $\sigma = 3$.

• **proportion:** the value of the proportion “p” has a 95 percent chance of being included in the following confidence interval:

$$p \pm 1.96 \sqrt{\frac{pq}{n}}$$

where “q” is equal to (1-p) and “n” is the sample size.

As a result, the larger the sample size, the greater the precision and the narrower the confidence interval. The value observed has:

- 66 percent chance of being situated in the interval value observed $\pm \sigma$.
- 95 percent chance of being situated in the interval value observed $\pm 2\sigma$.

Application in a town of 100,000 inhabitants

In a town of 100,000 inhabitants and 15,000 households, there can be contrasting results depending on whether the survey needs to be meaningful in general, by large area or by neighborhood:

- For an average, such as the size of the household presented in the table above, the relative error stands at 3.1% for the whole town. However, it becomes 5.4% if meaningful results are required for 3 large areas (for example, the old town center, the modern town center, outlying areas) and 9.8% if meaningful results are required for 10 neighborhoods, as the sample is divided by 3 and by 10 respectively.
- For a proportion of 50%, such as the proportion of households supplied by a standpipe, the relative error is 6.2% for the whole town. However, this becomes 10.7% if the 3 large areas are considered and 19.6% if the 10 neighborhoods are considered, as the sample is divided by 3 and by 10 respectively.
- For a proportion of 10%, such as the proportion of households supplied by surface water (river or backwater), the relative error is 18.6% for the whole town. However, it becomes 32.2% if the 3 large areas are considered and 58.8% if 10 neighborhoods are taken into account, as the sample is divided by 3 and by 10 respectively.

TABLE 25. Table of methodological choices (for sample surveys)

Two-stage sampling	<p>Almost inevitable for cost and time reasons.</p> <p>Increases variances and the risk of under-estimation: cluster effect.</p>
Selection with Probability Proportional to Size (PPS) at the first stage	<p>There are always advantages in stratification.</p> <p>The administrative divisions are acceptable criteria. However, it is advisable to avoid very elaborate criteria (quality of information and too many small-sized strata) and 'omnibus' surveys.</p>
Stratification at the first stage	<p>This needs to be justified based on the survey objective and the correlation between variables of interest and the size of the PU. It is necessary to consider the calculation of probabilities of inclusion in the PU, as well as to groupings and segmentation of the PU.</p>
Sampling frame	<p>It is preferable to use the results from the latest, comprehensive, General Population and Housing Census rather than samples from other surveys.</p> <p>One solution to ensure the PU size doesn't become outdated is to take the probability proportional to estimated size (PPES).</p> <p>Care needs to be taken with rough population forecasts that suppose, often mistakenly, that population growth will be constant and uniform.</p>

140 PU: Primary Unit (in sampling).

<p>Selecting the PU</p>	<p>Systematic drawing verifies most criteria requiring a drawing algorithm. If the order of the PU is random, systematic drawing can be compared to random sampling and the classic variance formula can be applied. If the order of the PU is not random, implicit stratification of the PU can increase precision (the same increase as that of 'explicit' stratification) calculated only if the drawing frame is available.</p>
<p>Households drawn from each PU</p>	<ul style="list-style-type: none"> • If the PU are selected based on a PPS drawing method, drawing a constant number of households provides a self-weighting sample. • If drawing the PU is done by PPES, a constant number of households is still better for the field work. • If the census and enumeration sizes are similar, this will result in an almost self-weighting sample.
<p>Stratification at the second stage</p>	<p>Stratification at the 2nd stage needs to be justified by the survey objectives and based on additional quality information, the collection of which should not hinder the enumeration.</p>
<p>Replacement</p>	<p>Any replacement of households needs to be documented and the households concerned identified in the database. The replacements need to respect the stratification, if there is stratification at the 2nd stage.</p>
<p>Post-stratification</p>	<p>Be careful of serious rectifications that consist of multiplying the extrapolation coefficients by an overall rectification factor. It is preferable to identify the type of households that are under-represented and proceed with post-stratification.</p>
<p>Archiving and extrapolation</p>	<p>The sampling procedure should be documented and published. The survey files should be preserved and documented and choices justified. It is possible to correct a lot of bias when all information on each of the sampling stages is available.</p>

Source: Elai Ouedraogo, Aude Verdasco, Effets du plan de sondage dans les enquêtes emploi: les enquêtes 1-2-3 en Afrique de l'Ouest, Revue Stateco n° 102, 2008

MAIN TECHNIQUES FOR EVALUATING DEMAND

	ELICIT RELATIVE DEMAND BETWEEN DIFFERENT SERVICES* FÉRENTS SERVICES*	PRA OPTION SELECTION: INTERNALLY FACILITATED* IN THE COMMUNITY	PRA OPTION SELECTION: EXTERNALLY FACILITATED* IN THE COMMUNITY
Description of technique	Improvements to a wide variety of different services such as water, drainage, roads, etc. are considered by the communities, who express their relative demand for these services.	Community volunteers are encouraged and trained to undertake a participatory survey in their own community. Preferences and commitments are then agreed in meetings.	A variety of PRA techniques are used by trained researchers or facilitators to triangulate and confirm the preferences of different community groups, who are also involved in the analyses.
Potential benefits	Simple and easily understood Expresses 'real' demand if only in relative terms. Preferences can be refined during micro-planning. Inexpensive. Compatible with PRA work.	Very good community sense of ownership. Enhances empowerment. Useful if the demand assessment involves on-going negotiation.	Good community sense of ownership. Extension staff can assess appropriate time to elicit demand. Can enhance empowerment. Can be used in changing institutional environment.
Potential risks and constraints	Possible group or strategic bias. Willingness-to-pay for different service levels not readily known. Process can be manipulated by extension workers, who do not use sufficient technical and financial rigor.	Possible group bias. Liable to lack technical/financial rigor. Reliant on skills being in the community. Requires substantial flexibility by external funding agencies and local support institutions.	Possible group bias. Process can be manipulated by extension workers, who may not use sufficient technical/financial rigor if not adequately supervised. Extension workers with good facilitation skills are required.
Typical usage	Suitable for village or slum general improvement projects. NGOs often use this technique.	More suitable where low-tech, low-cost solutions are definitely viable, e.g. handpumps and latrines.	Suitable in most situations, possibly complemented by other methods.

(*) Estimated costs of technically viable options are needed for these techniques.

► MAIN TECHNIQUES FOR EVALUATING DEMAND

REVEALED PREFERENCE SURVEYS (RPS)	CONTINGENT VALUATION METHOD (CVM)*	'REAL' DETAILED OPTIONS CONSIDERED BY COMMUNITY GROUPS OR BALLOT
<p>RPSs estimate time and financial costs of household behavior. For example, payments to water vendors and the time saved in collecting water.</p>	<p>A questionnaire survey to determine the maximum willingness-to-pay of individuals for various options for level of service (including improved reliability), payment arrangements, within the context of the current or specified institutional regime.</p>	<p>Detailed options and their implications (costs, O&M, institutional, etc.) are considered by communities using PRA or ballot.</p>
<p>Can provide reasonably accurate estimates of current time and cost expenditure and hence possible willingness-to-pay for service improvements. Data and analysis requirements are modest. Good baseline data for impact assessment. Compatible with PRA.</p>	<p>If the survey is conducted properly, provides good data: — For Project Appraisal; — On willingness-to-pay and potential revenues for different service levels. Can guide tariff subsidy and cost recovery policy. Similarity to public opinion polls means results conceptually easy for non-specialists and politicians to understand.</p>	<p>More precise cost estimates lead to less confusion. Institutional charging of O&M implications can be thoroughly assessed. Can be used in a changing environment.</p>
<p>Cannot estimate households' response to price increases (including for new levels of service options). Poverty may constrain ability of poor people to convert time savings resulting from service improvements into cash payment for them. Rarely used for sanitation projects.</p>	<p>Risks inhibiting community decision-making and ownership, for instance by raising expectations about particular options. Relatively high cost and requires specialist consultant for reliable results. Inaccuracies may occur in a changing institutional environment.</p>	<p>Risk of key decisions being based on misleading results from an unrepresentative group unless care is taken to avoid group bias. Requires detailed cost information, so earlier demand assessment may need to use other methods. Detailed work on some options can be redundant.</p>
<p>Suitable where substantial water supply problems exist. To be used in conjunction with say PRA methods.</p>	<p>Suitable for informing strategic decisions on levels of service in large investment programs.</p>	<p>Suitable where difficult choices are to be made between different options.</p>

Source: DFID Guidance manual on water supply and sanitation programmes - Water and Engineering Development Centre, Loughborough University/DFID, 1999

METHODS OF REVEALING CONSENT TO PAY, USED IN CONTINGENT VALUATION METHODS

	OPEN-ENDED QUESTION METHOD	BIDDING METHOD	
		SIMPLE CLOSED QUESTION	DOUBLE CLOSED QUESTION
Principle	A question is asked such as: 'How much would you be willing to pay to benefit from the service?'	A question is asked such as: 'Would you be prepared to pay xxxx to benefit from the service?'	Proceed by repeating the same closed question: If the answer to the first question is: <ul style="list-style-type: none"> • 'Yes', make a higher offer; • 'No', make a lower offer.
Statistical treatment of data	No treatment to be applied (directly numerical values).	Logit or Probit model (CAP function).	Logit or Probit model (CAP function).
Disadvantage	Strategic behavior. Risk of a high rate of zeros as the interviewees don't know the extent of the value of the assets being assessed.	The amount of information collected is low, so needs a larger sample size than for open questions (3 to 4 times larger). Complicated statistical treatment of data.	Requires a face-to-face or telephone interview. Starting point bias. Interviewees become weary if the number of bids is too high. Cumbersome statistical treatment.

► METHODS OF REVEALING CONSENT TO PAY, USED IN CONTINGENT VALUATION METHODS

CLOSED QUESTION + OPEN QUESTION	PAYMENT CARD METHOD	VALUE SCALE METHOD
<p>Proceed by repeating the same closed question.</p> <p>At the end of a set number of repetitions of the same question, ask about consent to pay using an open question.</p>	<p>Present the interviewee with a series of amounts, from zero value to a large value, and ask an open question.</p>	<p>Present the interviewee with a scale of values and ask him to select an interval.</p>
<p>No treatment to be applied (directly numerical values).</p>	<p>No treatment to be applied (directly numerical values).</p>	<p>Modeling from interval limits, or by least squares or by Cox or Tobit on the classification centers.</p>
<p>The same bias as for closed questions.</p>	<p>Starting point bias of the values proposed.</p>	<p>The central column is associated with an average value.</p> <p>Response judged reasonable, so influenced.</p>

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CMS Methodological Guides

on water and sanitation

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NUMBER 1

How to develop a concerted municipal strategy for water and sanitation in large towns in Africa

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NUMBER 2

How to create a regional dynamic to improve local water supply and sanitation services in small towns in Africa

.....
NUMBER 3

How to analyze the demand of current and future users for water and sanitation services in towns and cities in Africa

.....
NUMBER 4

How to select appropriate technical solutions for sanitation

.....
NUMBER 5

How to manage public toilets and showers

The aim of the CMS Methodological Guides series is to provide aids and tools that correspond to water and sanitation service-related issues to best meet the needs of sector stakeholders. These guides are designed to evolve over time and be regularly updated. To assist with this process, please send any feedback or suggestions for improving this publication to the following address: le-jalle@pseau.org



How to analyze the demand

– of current and future users for water and sanitation services in towns and cities in Africa

Methodological Guide N°3

In many developing countries, particularly in Africa, access to water supply and sanitation comes under the remit of local authorities. To assist the local contracting authorities in developing this service, programme Solidarité Eau (pS-Eau) and the Municipal Development Partnership (MDP) have initiated and coordinated the Concerted Municipal Strategies program (CMS – water and sanitation for all). This program has enabled pilot municipal strategies for water and sanitation to be developed in twelve large towns in West, Central and East Africa and has led to greater consideration being given to the concept of pooling resources on a regional scale so as to improve services in small towns in three countries of West Africa.

To complement these activities, a number of tools and methodological guides have also been developed as part of the CMS program to assist decision-makers and local stakeholders.

The aim of this Guide n°3 is to help local and national decision-makers and their partners to gain a better understanding of the demand of current and future users of water and sanitation services. Developed with a view to optimizing the allocation of financial resources and to promoting equity between users of water and sanitation public services, this guide provides decision-makers and development stakeholders with the key concepts and tools of intervention required to carry out robust and usable demand analyses.

Concerted Municipal Strategies (CMS), a program coordinated by the Municipal Development Partnership (MDP) : pdm@pdm-net.org and programme Solidarité Eau (pS-Eau) : le-jalle@pseau.org

www.pseau.org/smc

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