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International standards for service activities relating to water supply and sanitation: Do they match with a comprehensive sector perspective?

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TABLE OF CONTENTS

ACKNOWLEDGEMENTS II

TABLE OF CONTENTS III

ABSTRACT V

LIST OF TABLES VI

LIST OF FIGURES VII

ABBREVIATIONS VIII

GLOSSARY IX

1. INTRODUCTION 1

1.1. PROBLEM STATEMENT 1

1.2. OBJECTIVES OF THE MASTER THESIS 4

1.3. BASIC PRINCIPLES 4

1.4. OUTLINE 5

2. METHODOLOGY AND APPROACH 6

3. INTERNATIONAL STANDARDS FOR SERVICE ACTIVITIES RELATING TO WATER SUPPLY AND SANITATION 8

3.1. INTRODUCTION TO STANDARDISATION 8

3.2. INTRODUCTION TO THE REVIEWED DRAFT INTERNATIONAL STANDARDS 9

3.3. CONTENTS OF THE REVIEWED DRAFT INTERNATIONAL STANDARDS 10

3.3.1. Contents of ISO/DIS 24510 11

3.3.2. Contents of ISO/DIS 24511 13

3.3.3. Contents of ISO/DIS 24512 15

4. LOGFRAME ANALYSIS OF WATER SUPPLY AND SANITATION SYSTEMS 17

4.1. INTRODUCTION 17

4.1.1. Structure of the logframe analysis 18

4.1.2. Water supply 19

4.1.3. Sanitation 20

4.1.4. Phases of water supply and sanitation systems 21

4.1.5. Aspects of water supply and sanitation systems 22

4.1.6. Stakeholder 23

4.1.7. Institutional aspects 25

4.2. LOGFRAME ANALYSIS FOR WATER SUPPLY SYSTEMS 27
4.2.1. Problem analysis for water supply systems *27*
4.2.2. Objectives analysis for water supply systems *43*
4.2.3. Strategy analysis for water supply systems *45*
4.2.4. Logframe matrix for water supply systems *46*
4.3. LOGFRAME ANALYSIS FOR SANITATION SYSTEMS 50
4.3.1. Problem analysis for sanitation systems *50*
4.3.2. Objectives analysis for sanitation systems *66*
4.3.3. Strategy analysis for sanitation systems *68*
4.3.4. Logframe matrix for sanitation systems *68*

5. PERFORMANCE INDICATOR SYSTEMS 72

5.1. INTRODUCTION 72
5.2. PERFORMANCE INDICATORS FOR WATER SUPPLY SYSTEMS 73
5.3. PERFORMANCE INDICATORS FOR SANITATION SYSTEMS 77

6. WATER SUPPLY AND SANITATION TECHNOLOGIES 81

6.1. INTRODUCTION 81
6.2. WATER SUPPLY TECHNOLOGIES 83
6.3. SANITATION TECHNOLOGIES 84

7. DISCUSSION OF THE REVIEWED STANDARDS 87

8. SUMMARY AND OUTLOOK 92

9. REFERENCES 95

ABSTRACT

The International Organization for Standardization ISO is currently developing three international standards for service activities relating to drinking water and wastewater. They are dealing with the management of water and sanitation systems, the service to users and their assessment. Their contents are being criticised, because they do not sufficiently consider the situation of less developed countries. For this reason it is assessed, to which extend these draft international standards reflect a comprehensive perspective of the water and sanitation sector. This comprehensive perspective is created with the support of the logframe analysis (also called logical framework approach LFA), and the assessment of related performance indicators and current technologies for water supply and sanitation. The comparison between these findings and the draft international standards reveals substantial potentials for their review, mainly regarding institutional, technical and environmental aspects.

Die Weltnormenorganisation ISO (International Organization for Standardization) entwickelt zurzeit drei internationale Normen zu Dienstleistungen im Siedlungswasserbau. Diese beziehen sich auf das Management von Trinkwasserversorgungs- bzw. Abwasserentsorgungssystemen, deren Kundenservice sowie deren aller Bewertung. An diesen Entwürfen wird die Kritik geübt, dass sie die Situation weniger entwickelter Länder zu wenig berücksichtigen. Aus diesem Grund ist der Bedarf gegeben, den Inhalt der Normenentwürfe daraufhin zu untersuchen, ob sie einer ganzheitlichen Betrachtungsweise des Siedlungswasserbausektors entsprechen. Dieser ganzheitliche Blick gelingt mit Hilfe einer Logframe Analyse (auch logical framework approach LFA genannt), und wird mit der Formulierung entsprechender Kennzahlen und der Untersuchung aktueller Technologien im Siedlungswasserbau vertieft. Im Vergleich mit den daraus gewonnenen Erkenntnissen zeigen sich Defizite und Überarbeitungspotentiale für die Normentwürfe. Diese betreffen besonders institutionelle, technische und umweltbezogene Aspekte der Wasserversorgung und Abwasserentsorgung.

LIST OF TABLES

Table 1: Index of the problem analysis for water supply systems 28

Table 2: Importance of aspects in different phases of water supply systems ... 46

Table 3: Logframe matrix for water supply systems 47

Table 4: Index of the problem analysis for sanitation systems 50

Table 5: Importance of aspects in different phases of sanitation systems 68

Table 6: Logframe matrix for sanitation systems 69

Table 7: Performance indicators for water supply systems 74

Table 8: Performance indicators for sanitation systems 77

LIST OF FIGURES

Figure 1: Process cycle 21

Figure 2: Aspects of water supply and sanitation systems 22

Figure 3: System requirements and choice 81

Figure 4: Choice of technical components for water supply systems 83

Figure 5: Choice of technical components for sanitation systems 85

ABBREVIATIONS

DIS	Draft international standard
FAO	Food and Agriculture Organization of the UN
GTZ	Deutsche Gesellschaft für technische Zusammenarbeit GmbH
IBNET	The International Benchmarking Network for Water and Sanitation Utilities
ISO	International Organization for Standardization
IWA	International Water Association
LFA	Logical framework approach
NGO	Non-governmental organisation
O&M	Operation and maintenance
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO-IHE	United Nations Educational, Scientific and Cultural Organization - Institute for Water Education
UNICEF	United Nations Children's Fund
U.S.	United States (of America)
WHO	World Health Organization
WSSCC	Water Supply & Sanitation Collaborative Council

GLOSSARY

Community	Group of persons and their organisations in the geographic area of water and sanitation systems
Drinking water	Water that does not harm human health when being consumed
Effectiveness	Extent of achievement of results
Efficiency	Extent of efforts needed to reach results
Greywater	Wastewater that is not mixed with faeces and urine
Institutions	Public or private entities responsible for different aspects of the water and sanitation sector
Maintenance	Activity intended to restore or retain the function of a unit
Operation	Day-to-day activity for the provision of services
Relevant authority	Institution defining policies or framework conditions, or checking their compliance
Responsible body	Institution which has the legal responsibility for the provision of services
Sanitation	Handling of wastewater, urine and faeces for the preservation of public health and the human environment
Stakeholder	Persons and their organisations interested in or affected by a water and sanitation system

Utility	Institution operating and maintaining water and sanitation systems or its components
User	Persons and any kinds of organisations benefiting from a water and sanitation system
Wastewater	Mixture of water and dissolved or suspended solids, carrying wastes from homes, businesses, industries and other users
Water supply	Provision of access to water for domestic purposes and small-scale industries

1. Introduction

1.1. Problem statement

Following a French initiative, the International Organization for Standardization, ISO is developing a series of three standards for service activities relating to water supply and sanitation, focusing on the management of water and sanitation systems, and the service to users and their assessment. These standards are in the enquiry stage and therefore carry the name DIS – Draft International Standard.

The three actual draft standards are:

ISO/DIS 24510 "Service activities relating to drinking water and wastewater – Guidelines for the improvement and for the assessment of the service to users" (ISO/DIS 24510, 2006)

ISO/DIS 24511 "Service activities relating to drinking water and wastewater – Guidelines for the management of wastewater utilities and for the assessment of wastewater services" (ISO/DIS 24511, 2006) and

ISO/DIS 24512 "Service activities relating to drinking water and wastewater – Guidelines for the management of drinking water utilities and for the assessment of drinking water services" (ISO/DIS 24512, 2006)

The draft versions of these standards are facing a lot of criticism, mainly arising from NGOs and representatives from less developed countries, saying that in many cases theses standards are not very practicable and do not lead to favourable solutions. They further criticise that the standards do not mention technologies that are currently used and that these technologies could therefore fall under disregard.

These criticisms reflect the need to examine whether or not these standards meet the expectations of a comprehensive approach. Their formulation is quite general, as they exclude financial and ownership models as well as technical specifications. However, they do focus on certain institutional, technological, ecological and other systems and framework conditions. From an international

standard it can be expected that it meets the highest expectations regarding comprehensiveness and global applicability and, to an even greater extent, when it refers to such an important and complex sector as the water and sanitation sector.

Water and sanitation systems are of fundamental importance for any human society. Throughout history, humankind has been making significant effort to meet its essential need for water and the safe removal of related residues. Nowadays the water and sanitation sector on a global scale is still far from having found best solutions for these needs.

Water and sanitation related hazards to public health, low service quality or entire lack of service, high or even unaffordable system costs, environmental pollution that interferes with the populations' increasing ecological sensibility and endangered fresh water sources are some of the most important challenges facing these systems today. These examples immediately show that water and sanitation systems do not only have many competing aspects, but also depend on human values and priorities that are constantly changing and evolving.

The United Nations Development Programme gives a general idea about how much still has to be done in the sector, saying that *"Currently, over 1 billion people lack access to drinking water and over 2.4-billion lack access to basic sanitation"* (UNDP, 2006). Improved access to water and sanitation directly influences three of the 18 targets under the UN Millennium Development goals that were adopted at the UN Millennium Summit in September 2000. These are, with a time horizon until 2015: reducing by two-thirds the under-five mortality rates (Target 5); halving the proportion of people without sustainable access to an improved water source (Target 9); and halving the proportion of people without access to improved sanitation (Target 10 as amended in the Johannesburg Summit in August 2002) (OED, 2003).

Unfortunately, the water and sanitation sector projects in the scope of international development cooperation rank among the poorest performing, as it is the case in World Bank projects (OED, 2003). Moreover, the sector is reliant on some of the most expensive public infrastructure assets.

As stated before, water and sanitation systems have complex and conflicting aspects that are strongly depending on human needs and expectations. Improvements in one aspect can cause aggravation in several other aspects. To overcome the severe difficulties in the planning, implementation and operation of water and sanitation systems, a comprehensive approach is necessary. First, we have to understand that the only objective of these systems is to deliver the required results in the most efficient way and with minimised adverse affects. This implies the society's definition of needs, values and goals.

Possible solutions have to be analysed holistically in their compliance with the social, economic, institutional, ecological and technical requirements and their applicability in the enabling environment. All these aspects then have to be integrated in the implementation and operation of the systems, keeping an eye on future needs and requirements. In order to be realised, these general ideas have to be known and respected by all relevant stakeholders, ranging from members of relevant authorities and responsible bodies to utilities staff and users. As a requirement and reference, it is important that this knowledge is available not only in technical documents but also in those documents which finally define the implementation and operation of water and sanitation systems: official documents such as legislations, regulations and last but not least standards at national and international level.

It is evident that developing countries face enormous difficulties in managing their public administration and many of them are lacking relevant authorities and policies for the water and sanitation sector. In these countries, international reference documents can play an important role for knowledge transfer and can have a strong influence on the shaping of their systems. In order to suit the local situation, international standards have to incorporate the specific characteristics of developing countries, which can vary significantly from the situation in higher developed countries. Therefore, it is important that international standards meet the highest expectations regarding a comprehensive approach and that they have the best available balance between accurate specification and local flexibility.

1.2. Objectives of the master thesis

It is the objective of this work to compare the draft international standards ISO/DIS 24510 (2006), ISO/DIS 24511 (2006) and ISO/DIS 24512 (2006) (refer to chapter 1.1 for their full titles) with a comprehensive perspective of the water and sanitation sector and to deduce potentials for their review.

The comprehensive approach consists of three parts, a logframe analysis of the water and sanitation sector, the more detailed formulation of related performance indicators that allows for a comprehensive monitoring and the assessment of actual technical systems available for water supply and sanitation.

Due to the limited extent of this work, a specific analysis of institutional, financial, environmental and stakeholder aspects cannot be included even though they would be necessary for a full assessment of the sector. Anyway, these aspects find their consideration in more or less detailed ways throughout this work.

1.3. Basic principles

Water and sanitation matters are public matters. Water and sanitation are of vital importance for any individual and any society and therefore the public needs to have, and keep the power to take principal decisions in this area.

The language used in this work conforms to the terms and definitions in the respective standards as far as possible in order to facilitate the comparison of these documents. Important differences derive from the more general perspective presented in this work (see chapter 4.1.2 for water supply and chapter 4.1.3 for sanitation).

1.4. Outline

Chapter 2 presents the main methodology and approach used in this work. This attempts to draw a comprehensive perspective of the water and sanitation sectors with the help of a logframe analysis, the formulation of related basic performance indicators and an assessment of actual technical water supply and sanitation systems. This facilitates the comparison with the reviewed draft international standards ISO/DIS 24510 (2006), ISO/DIS 24511 (2006) and ISO/DIS 24512 (2006) with the aim to detect potentials for their review.

Chapter 3 presents the three draft international standards and their contents, starting with standardisation and their importance in general.

Chapter 4 contains the logframe analysis of the water and sanitation sector, trying to draw a comprehensive and coherent view of the water and sanitation.

Chapter 5 gives further examples for performance indicators that match with the logframe analysis in chapter 4.

Chapter 6 presents actual technologies solutions for the different components of water supply and sanitation systems.

Chapter 7 links the previous chapters together, assessing the extent to which the draft international standards match with the findings from the comprehensive analysis of the water and sanitation sector, as performed in chapters 4, 5 and 6. Here, comments on the draft international standards and proposals for their review are given.

Chapter 8 sums up the work and gives an outlook on what still needs improvement in the sector.

2. Methodology and approach

Three new international standards for service activities relating to water supply and sanitation are about to be approved (refer to chapter 1.1 for their names and numbers). Criticisms about their contents are mainly arising from less developed countries. They argue that in many cases theses standards are not very practicable and do not lead to favourable solutions. For this reason, this work should provide an assessment of the actual draft versions of these international standards.

The need for international standards dealing with the management of water and sanitation systems, the service to users and their assessment has been proven by the International Organization for Standardization ISO and can be referred to in the respective business plan for the standards.

In this work on hand, the contents of the draft international standards are assessed. As a matter of course, the simple review of these documents reveals their contents and limits, depending on the reader's knowledge and perspective of the water and sanitation sector. In order to meet scientific demands, a more comprehensive perspective of the sector is necessary.

As a starting point, standardisation in general is discussed. Then the three draft international standards are introduced and their contents are presented.

The creation of a comprehensive perspective of the water and sanitation sector, without exceeding the size of a master thesis, is a big challenge. In this case, three tools are selected for the analysis of the water and sanitation sector, related performance indicators and the technologies currently being used.

The first tool is the logframe analysis, a common planning and assessment tool that is widely used for multiple purposes (e.g. planning, implementation, evaluation, assessment). In this case, it will help to get a comprehensive view of water and sanitation systems, especially their aspects and objectives. This comprehensive sector view defines the reference for the comparison with the contents of the draft international standards later on. Without this reference, no clear assessment of the standards would be possible.

Secondly, performance indicators formulated in the logframe analysis are discussed more in detail. It is necessary to dedicate an entire chapter on this subject because performance indicators are important parts of the examined draft international standards. As tools for the assessment of water and sanitation systems, their definition and formulation focuses and prioritises the whole system. There is a high risk to lose sight of aspects that are not integrated in a performance indicator set.

Technical systems are indispensable material assets of water and sanitation systems. It would be impossible to draw a comprehensive picture without knowing which technical solutions are actually being used. The reviewed draft international standards clearly mention different technical systems and their components. That is why in a third step, present water supply and sanitation technologies and some of their main features are presented. This technological overview is then needed to assess whether or not all technologies are mentioned in the draft international standards.

Finally, the contents of the standards are compared with the findings of the comprehensive perspective previously created. Potentials for the revision of the standards are assessed and proposals are given accordingly.

3. International standards for service activities relating to water supply and sanitation

3.1. Introduction to standardisation

"Right from the start, standardization has been concerned with efficiency, rationalisation, reduction of costs of production in order to develop uniform standards in the interest of functioning markets and adequate exploitation and application of the current state-of-the-art of technology." (KORINEK, 1997)

In his lecture at the occasion of the Open Session at the CEN General Assembly 1997 in Vienna, Dr. Dr. h.c. Karl Korinek, President of the Austrian Standards Institute from 1986 to 2002, clearly discussed important questions in the context of standardisation, such as the demands on democratic legitimacy of standards and the necessity of rapid standardization activities.

Standards, no matter if they are national or international, are not mandatory as such. They only become mandatory by public declaration, *"i.e. by virtue of a contract, by an instruction to produce in conformity with standards, by inclusion in the terms of reference of an official authorization, by reference in a law or administrative regulation etc."* (KORINEK, 1997).

To an ever-increasing degree, our world is shaped by technical systems. Due to rapid innovations and the increasing complexity of technological systems, public institutions reached their limits to provide for accurate and actual legislations and regulations. Governments set general normative levels for protection and safety and leave the definition of specifications to standardisation institutes (ZUBKE-VON THÜNEN, 1999).

"In concrete terms, it is correct if authors state that European standards are more and more supplementing the European legal provisions on which they are based in an ever increasingly de facto manner and that the Community legislator is more and more backing out of his responsibility and leaves the realization of Community regulations up to standards bodies." (KORINEK, 1997)

As a result of inadequate public legislation and regulation, standards become de-facto mandatory and their importance and relevance for many aspects of our daily live is hard to under-estimate. For all these reasons, standards, and even more so, international ones, should comply with highest expectations regarding not only rationalisation and reduction of costs, but also in relation with the protection of human life and its environment. This is especially true for standards that apply to less developed countries, where legislative and regulative systems typically are weak.

3.2. Introduction to the reviewed draft international standards

Many standards for water supply and sanitation give technical specifications about the various aspects of conventional, piped water and sanitation systems and requirements to their management. Three new international standards take a step beyond:

ISO/DIS 24510 "Service activities relating to drinking water and wastewater – Guidelines for the improvement and for the assessment of the service to users" (ISO/DIS 24510, 2006)

ISO/DIS 24511 "Service activities relating to drinking water and wastewater – Guidelines for the management of wastewater utilities and for the assessment of wastewater services" (ISO/DIS 24511, 2006) and

ISO/DIS 24512 "Service activities relating to drinking water and wastewater – Guidelines for the management of drinking water utilities and for the assessment of drinking water services" (ISO/DIS 24512, 2006)

These standards do not only focus on the management of water and sanitation systems and the service to users, but also on their assessment.

According to the business plan of the three standards, they *"will contribute towards:*

1) facilitating the dialogue between the users, the authorities and the service suppliers responsible for the water supply and sewerage system services so that

user expectations are better taken into account and so that the management of services by the relevant authorities is more transparent;

2) contributing to a better operation and management of the assets of the services, and respecting the water resources, in proposing a list of requirements to fulfil, quality assessment criteria and related performance indicators;

3) defining objective service quality assessment criteria and related performance indicators enabling to measure the results of the services delivered and to compare them with the objectives agreed upon between the interested parties, knowing that the quality of service may be appreciated according to users' satisfaction and respect of environment;

4) facilitating the monitoring of the progress accomplished within a same water supply service and a possible benchmarking between different water services." (ISO, 2004)

The standards specifically exclude:

- The design and construction of water supply and wastewater systems, or maintenance techniques
- The limits of acceptability for drinking water quality and wastewater discharged in the receiving body
- Analytical methods

Currently, these standards are in the draft international standard state, meaning that after public and internal inquiry and approval, they are going to be published as international standards.

3.3. Contents of the reviewed draft international standards

The three draft international standards have much of their content in common. For copyright reasons, only a brief and general outline is given. The draft international standards can be purchased from the International Organization for Standardization ISO.

The first parts of the three standards are quite identical: an **introduction** talking about the "Millennium Development Goals", the implications of water and

sanitation on virtually all activities of society, sustainable development and the importance of performance indicators for assessment. In the **scope**, a short description of what is included and excluded in the standards is given (see chapter 3.2). As **normative references**, only the other standards of this series are indicated. In the **terms and definitions** chapter, definitions are given for about 50 basic terms.

The contents of the following chapters differ slightly, with the general succession of topics being: **components**, **objectives**, **management** (ISO/DIS 24511 and 24512 only), **guidelines**, **assessment** and **performance indicators** related to the service to user respectively the water and sanitation systems and their management. These chapters follow a logical hierarchy. They present parts of a system and define their related objectives, from which guidelines are deduced. These guidelines then are broken down into measurable criteria which finally exemplary performance indicators are given for.

These main chapters are followed by considerable **annexes** of informative character only.

3.3.1. Contents of ISO/DIS 24510

The draft international standard ISO/DIS 24510 "Service activities relating to drinking water and wastewater – Guidelines for the improvement and for the assessment of the service to users" describes the service components to users and provides with tools for service quality assessment.

The contents of the first chapters is similar to the other two standards (see chapter 3.3.).

In the next following chapter, three essential **components** of service to users are defined as:

- Provision of the service
- Contract management and billing
- Promoting a good relationship to users

These components are split into various sub-categories, ranging from the "Application for service" to the "Participation of the users".

Without previous announcement, "Relationship with the environment" is listed as additional component, formulated in the briefest and most general way possible.

In the next chapter, "**Objectives** for the service in respect of users´ needs and expectations", the components presented before are amplified by the components "Access to water services" and "Safety and emergency management".

The chapter "**Guidelines** for satisfying users´ need and expectations", specifies what the aspects of all the above components (now 6 components in total) should look like in order to meet users´ need and expectations. Corresponding assessment criteria introduced in the following part "**Assessment** criteria for service to users".

The chapter "**Assessment** of service to users" presents general considerations and recommendations to assessment. Similarly, the final chapter "Introduction to **performance indicators**" explains the use of performance indicators.

Annex A gives notes and guidance for evaluating the sustainable development components of water and wastewater services, defining environmental, economic, social and institutional aspects of sustainable development and quoting the Bellagio Principles. **Annex B** outlines examples for performance indicators and **Annex C** mentions confidence grading schemes. All annexes are informative only. They represent about one third of the size of the document.

3.3.2. Contents of ISO/DIS 24511

The draft international standard ISO/DIS 24511 "Service activities relating to drinking water and wastewater – Guidelines for the management of wastewater utilities and for the assessment of wastewater services" defines management components of wastewater utilities and provides with tools for their assessment.

The contents of the first chapters is discussed in chapter 3.3.

The fourth chapter, "**Components** of wastewater systems", introduces four major components of centralised/decentralised and on-site-systems and gives examples:

- Collection
- Transport
- Treatment
- Disposal/reuse

In chapter 5 "**Objectives** for the wastewater utility", the principal objectives for wastewater utilities are defined as:

- Protection of public health
- Protection of the natural environment
- Protection of the built/public environment
- Promotion of sustainable development

Chapter 6 "**Management** components of wastewater utilities" presents the various aspects of management that utilities have to integrate:

- Activities
- Resources
- Assets
- Customer relations
- Information
- Environment
- Risks

Now follows chapter 7 "**Guidelines** for the management of wastewater utilities", defining aspects of the management for the following components and their sub-categories:

- Organisation
  - General
  - Organisational structure and responsibilities
  - Organisation of work flow
  - Operational documents and records
- Planning and construction
- Operations and maintenance
  - General requirements
  - Technical activities (with further sub-categories)
  - Support activities (with further sub-categories)

The chapters 8 **"Assessment** of wastewater services" and 9 "**Performance indicators**" give introductions and recommendations to the respective topics.

Annex A shows "Schematics of wastewater systems". **Annex B** indicates "Possible actions related to wastewater utility objectives and possible actions related to the management of wastewater utility" referring to chapter 5 and 6 respectively. **Annex C.1 and C.2** give "Examples of service assessment criteria related to the wastewater utility" respectively "Performance indicators related to assessment criteria" according to chapter 5. **Annex C.3** indicates "Examples of assessment criteria related to service functions" as shown in chapter 4. Finally, **Annex D** gives examples of confidence grading schemes for performance indicators. All annexes are informative only. They represent more than half of the size of the document.

3.3.3. Contents of ISO/DIS 24512

The draft international standard ISO/DIS 24511 "Service activities relating to drinking water and wastewater – Guidelines for the management of drinking water utilities and for the assessment of drinking water services" defines management components of water utilities and provides with tools for their assessment.

The contents of the first chapters is similar to the other two standards and described in chapter 3.3.

The fourth chapter, "**Components** of drinking water supply systems", defines four components:

- Water source
- Intake and transport
- Treatment
- Storage, transport and distribution

Even though not mentioned before, "Disposal of residues" appears as additional component at the end of the chapter.

In chapter 5 "**Objectives** for the drinking water utility", the principal objectives for water utilities are introduced:

- Protection of public health
- Meet users´ needs and expectations
- Provision of services (under normal and emergency situations)
- Sustainability of the water utility
- Promotion of sustainable development of the community
- Protection of the environment

The **chapters 6 to 9** are de facto identical with the respective chapters in ISO/DIS 24511 for wastewater systems (see chapter above), with the only difference being the focus on drinking water systems.

Annex A shows "Schematics of drinking water supply systems". **Annex B** indicates "Possible actions related to achieve drinking water utility objectives". In **Annex C** "Further guidelines for the management of drinking water utlities" further specifications related to chapter 7 are given. **Annex D** gives "Examples of objectives, related assessment criteria, performance indicators and service components of a drinking water system" for the objectives defined in chapter 5. **Annex E** gives an example for a confidence grading scheme for performance indicators.

All annexes are informative only. Their size is about one third of the whole document.

4. Logframe analysis of water supply and sanitation systems

4.1. Introduction

The logframe analysis, or logical framework approach (LFA), is an instrument for objective-oriented planning of projects, which can be used throughout the entire project management cycle for different purposes such as planning, implementation, evaluation and assessment. This instrument was created in 1969 by the U.S. Agency for International Development and is now being used by many international development agencies as a core technique for managing entire projects (WORLD BANK, 2000).

The strength of the logframe analysis derives from its ability to structure different elements of projects and their interdependence. This is not only reflected by the clearly structured contents but also by its presentation in diagrams and the final matrix, which are rapidly and intuitively understandable. Another key feature is the direct link between the objectives and verifiable indicators, allowing for clear assessment of project progress (ÖRTENGREN, 2004).

The use of the logframe approach differs between different organisations. They may propose different steps for conducting the logframe analysis or use different names for the structure elements. What they have in common is the logframe matrix, a table that gives an overview of the project: its objectives, purposes, results and activities, and the related indicators, sources of verification and assumptions.

4.1.1. Structure of the logframe analysis

As stated above, the logframe analysis is used in different ways by many different organisations. In this case, the template of the World Health Organization WHO is applied (WHO, 2006).

The logframe development involves the following steps:

- Problem analysis
- Objectives analysis
- Strategy analysis
- Logframe matrix

The **problem analysis** reveals the problems of water and sanitation systems in a hierarchical way, following the order of events, therefore indicating means, and resulting ends. The **objective analysis** is a reformulation of problems into desirable and realistically achievable positive situations, leading automatically to the objectives of the system. In the **strategy analysis**, the interventions that are most likely to bring about the desired results are selected. In the last step, the data for the **logframe matrix** is completed. This matrix consist of four columns, each for intervention logic, objectively verifiable indicators, sources of verification and assumptions, and four lines for overall objectives, operation purpose, results and activities respectively.

Applying the logframe analysis to the water and sanitation sector on a global scale requires some defining and structuring in order to assure clarity and comprehensibility. This is done in the following chapters.

4.1.2. Water supply

Water supply systems provide water for different domestic purposes and small-scale industries. The quality requirements orient themselves in human needs, leading to the term of "drinking water", meaning that consumption of this water does not cause hazards to human health. Drinking water in general is good enough to meet domestic quality demands and requirements of small-scale industries. National authorities define requirements for drinking water quality, sometimes using international guidelines established by the World Health Organization WHO or multilateral institutions. The term "water supply" is used in this work, in contrast to "drinking water" as it appears throughout the reviewed standards, because it is not primarily focused on a qualitative statement.

Water supply does not consider the water demand of agriculture and large industries, which may have separate supply systems. Water for these users is called "productive water" and may have specific requirements with quality levels above or below drinking water standards.

The actual use of water depends on its availability to users: as soon as the basic human need for water consumption (about 3 litres per person a day) is met, water is used for other domestic and small-scale industries´ purposes.

Use of water for domestic purposes and small-scale industries:

- Consumption
- Food preparation
- Personal hygiene
- Flushing and rinsing
- Cleaning
- Washing
- Watering of plants and gardens
- Institutions (hospitals, schools, etc)
- Commerce
- Tertiary activities
- Recreation
- Energy production (on water mains)

4.1.3. Sanitation

Traditionally, the term "wastewater" has been used for liquid and dissolved residues that are generated in domestic and non-domestic activities, related to the usage of (drinking) water for their transportation. The dilution and mixture of residues with water has several disadvantages: large, complex and expensive systems for transport and treatment, such as sewer networks with central wastewater treatment plants are needed, creating sludges and residues, which in many cases are hazardous waste. In order to reduce expenses and to close cycles of matters, the minimisation of water consumption and the separation of matters (urine, faeces, greywater) became important issues. With the development of safe and comfortable high-grade sanitary technologies, which need no or very little water for flushing, the term "wastewater" started to become too narrow.

In a reference document of various international institutions, the term "sanitation" has two meanings (UNEP/WHO/HABITAT/WSSCC, 2004):

- Control of physical factors in the human environment that could harm development, health, or survival
- The study and use of practical measures for the preservation of public health

For wastewater, the following definition can be found:

- Water carrying waste from homes, businesses and industries that is a mixture of water and dissolved or suspended solids

Obviously, sanitation has a broader meaning than wastewater. Sanitation reflects the reason why we worry about wastewater, urine and faeces: they can harm humans and their environment. Wastewater, however, is the result of supplied (drinking) water and its use.

In this work, "sanitation" is the overall expression for the handling of wastewater, urine and faeces with the purpose to protect humans and their environment from hazards. Sanitation is linked to the usage of water for purposes that are listed in chapter 4.1.2. Sources for urine and faeces are low or no-flush toilets with or without separation of faeces from urine, and low or no-flush urinals.

4.1.4. Phases of water supply and sanitation systems

Water and sanitation systems have their history and therefore the reasons for problems faced in the present, very often lie in previous decisions and circumstances. It is the only purpose of the systems to reach desired results in the operation phase. In this phase, efficiency and effectiveness of achievement are assessed in parallel through evaluation. Prior to operation, or in case of necessary adjustments, the systems go through the phases of situation analysis, planning and design and implementation (see figure 1).

The four principal phases of water and sanitation systems:

- Situation analysis
- Planning and design
- Implementation
- Operation

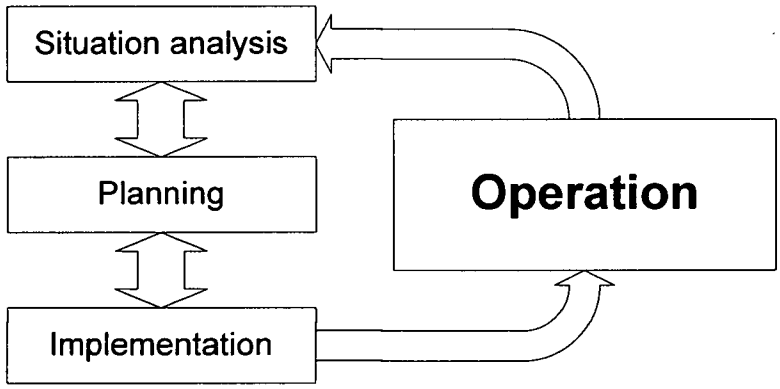

Figure 1: Process cycle

In the technical literature, process phases are systemised in many different ways. In the case of this general work, four principal chronologic phases are sufficient.

The **operation phase** is the goal of all other phases and therefore it will be treated as "results" in the logframe matrices (see chapters 4.2.4 and 4.3.4). Operation is not limited to the simple operation of the system itself, but includes many other activities such as monitoring, evaluation and maintenance. If monitoring and evaluation detect the potential for improvements, the adaptation process starts with situation analysis again, running in parallel with full or partial operation.

4.1.5. Aspects of water supply and sanitation systems

Water and sanitation systems are complex systems with many different aspects connected through various correlations. It is difficult to structure these aspects thematically in a simple and efficient way. The technical literature applies several different classifications (e.g. BRIKKÉ, 2000 and UNEP/WHO/HABITAT/WSSCC, 2004). The aspects proposed in this work try to include all relevant aspects in such a way that the main characteristics of the systems easily assessable.

Aspects of water and sanitation systems (also see figure 2):

- Stakeholder
- Institutional aspects
- Economic aspects
- Environmental aspects
- Technical water supply and sanitation system

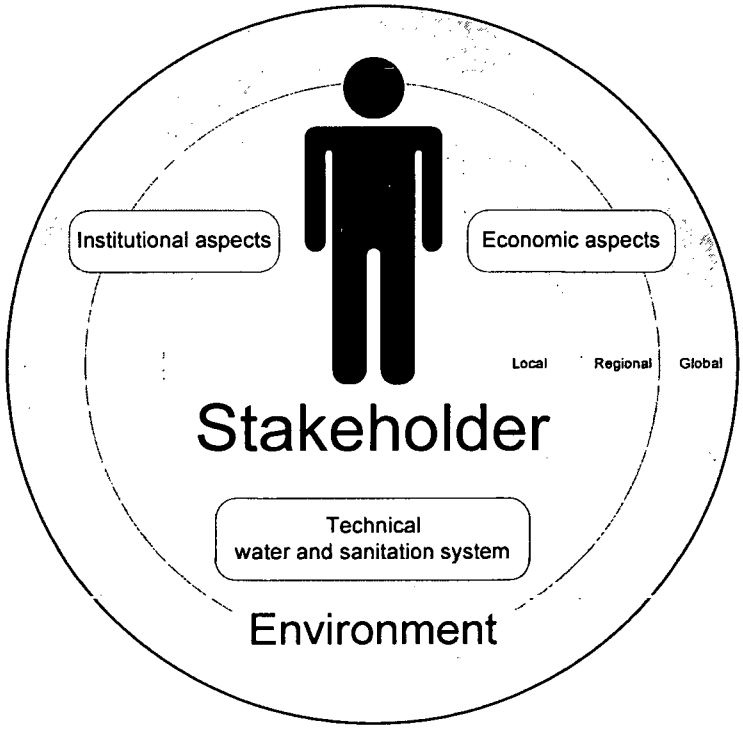

Figure 2: Aspects of water supply and sanitation systems

It is important to notice that every single aspect has connections with all others. Consequently, changes in one aspect have influences on all other aspects.

Some of the aspects are discussed in separate chapters: see chapter 4.1.6 for **stakeholder**, chapter 4.1.7 for **institutional aspects** and chapter 6 for **technical water supply and sanitation systems**.

All institutions are stakeholders too. What makes the difference are the roles they play. As stakeholder, they have specific involvements and mandates. The institutional set-up defines the structures and mechanisms through which they act.

Economic aspects deal with the financial relations between the different aspects through benefits, subsidies, salaries, health costs, environmental costs, grants, loans, production costs, costs for planning, implementation and operation, etc.

Environmental aspects deal with all aspects of the stakeholders' living space and the greater natural environment in general.

4.1.6. Stakeholder

Many different stakeholders are involved in water and sanitation systems at different stages. It is very important to note that all persons in a community are stakeholders of these systems in one or more ways. Virtually all local residents are influenced by the water and sanitation systems: this can be through taxes financing different parts of the systems, or due to the pollution of the environment caused by the use of water sources or the disposal of residues. Other residents might be affected by impacts on public health or economic development. Most members of the community are domestic and non-domestic users of the systems, and many of them work as employees of related institutions or private sectors companies.

These stakeholders on local or community level can be distinguished from stakeholders at regional, national and international level, which in general are working in the water and sanitation sector without being direct users of local water and sanitation systems.

In many situations individuals are affected at regional or even higher levels by local over-use of water sources, and the pollution of aquatic bodies, etc. In this case they become stakeholders too. Possible stakeholders on local and non-local level are presented below.

Community (stakeholders at local level):

- Users from different economic sectors: domestic, public, commercial, industrial, tertiary activities, agriculture
- Residents paying taxes, searching for recreational activities at aquatic bodies and in the environment in general etc
- Non-residents such as tourists, visitors, businessmen etc, using the water and sanitation systems
- Local relevant authorities
- Local responsible bodies
- Water and sanitation utilities
- Private companies (contractors, sub-contractors, consultants, banks, investors, manufacturers and suppliers, etc)
- Non-governmental organisations (water associations, civic action groups, environmental groups, consumer associations, etc)

Stakeholder at regional, national and international level:

- Relevant authorities
- Responsible bodies
- International organisations (WHO, UNDP, World Bank, etc)
- Bilateral development cooperation agencies (ADA, GTZ, DEZA, etc)
- Private companies (contractors, sub-contractors, consultants, banks, investors, manufacturers and suppliers, etc)
- Non-governmental organisations (development organisations, health organisations, environmental groups, etc)
- Persons influenced by local water and sanitation systems in economic, environmental or other ways

The actual composition of the group of stakeholders depends on the specific situation.

4.1.7. Institutional aspects

Institutions are the background of any activity in the water and sanitation sector and the importance of institutional aspects cannot be overestimated. Definitions for institutions align to different aspects. In this work, the definition of three basic institutions and their functions follows the definitions given in the reviewed standards.

Institutions and their functions

- Relevant authorities: policy making
- Water and sanitation utilities: operation
- Responsible bodies: compliance control

Relevant authorities are part of the public administration. This corresponds to the basic principle that water and sanitation are of fundamental importance for any society (see chapter 1.3). Accordingly, public institutions need the principal power of decision and as such, should establish rules and structures for the sector. Precisely speaking, they should be preparing the legal and institutional background, initiating planning and implementation, defining strategies, general policies and related compliance control systems and enforcements.

The **water and sanitation utilities** are operating the water and sanitation systems and giving the service to users, collecting revenues, appointing staff or responsible persons, undertaking maintenance and adaptation work, etc. They can be organised as public administrations, private companies or non-governmental organisations such as user associations.

Responsible bodies have the overall legal responsibility for providing the water and sanitation services in a certain area. They may operate the water and sanitation utilities directly, but this limits the separation of compliance control and operation. Responsible bodies can be public or private.

According to the chain of responsibilities, the compliance with agreed requirements is proved by the water and sanitation utilities to responsible bodies and by responsible bodies to relevant authorities also.

In technical literature, the institutional background very often is not considered and there seems to be little consensus about the aspects that should be included in this term. Unfortunately, this can cause severe problems when professionals from higher developed countries are designing systems for less developed countries, assuming that either institutional conditions are of little importance, easy to adapt or very similar to what they know from where they are coming.

Proper functioning of the institutions needs a clear definition of their cooperation with the help of policies, legislations and regulations.

Important aspects of cooperation between institutions:

- Duties
- Responsibilities
- Coordination structures
- Information flows
- Control mechanisms
- Enforcements
- Funding and conditions of payment
- Ownership

It has to be pointed out that the necessity to clearly define all aspects of cooperation is very high in general, but even increasingly so when outsourcing competences to private companies (GTZ, 2004).

The roles institutions are playing depend a lot on the actual phases. For example: when water and sanitation systems are initiated during a very first situation analysis, national relevant authorities, local user associations, international governmental and non-governmental organisations or even single politicians and officials can have important influences. Their roles may be very different in other phases.

4.2. Logframe analysis for water supply systems

4.2.1. Problem analysis for water supply systems

The problem analysis for water supply systems is the first fundamental step in the logframe analysis. It is necessary to know what is not working and why it is so, before we design new strategies and frameworks.

In technical literature, many problems arising in the sector are discussed in general terms. For this work, findings presented in BRIKKÉ (2000) and UNEP/WHO/HABITAT/WSSCC (2004) provide an informative basis. Their basic ideas have been adapted and reformulated in order to fit the structure of this problem analysis. It is challenging to allocate problems to single aspects and phases in the problem analysis, as they may have be relevant for several different ones. Therefore, an additional sub-category, called "general problems" is created for general problems and overlapping topics within one phase. Moreover, the cause-effect relationships can be difficult to detect. In general, one single effect can have causes in and results on different precedents and following phases and aspects.

The problem analysis is structured in the four chronological phases of water and sanitation systems (see chapter 4.1.4) as main categories and the aspects as sub-categories. To facilitate the overview, table 1 includes a separate index for the problem analysis.

The four principal phases of water supply systems:

- Situation analysis (A)
- Planning and design (B)
- Implementation (C)
- Operation (D)

Due to the cyclic process, all causes and results are linked throughout the different phases. Any existing system will already have gone through those processes several times, as every human being and society needed and needs to organise their water and sanitation situation.

The connections between the phases are strong. For example, problems detected during operation and situation analysis are overlapping: problems in the operation phase become the starting point for improvements and therefore appear in the situation analysis as well. To keep the problem analysis as clear and short as possible, specific problems are assigned to only the most relevant phase. They may be reflected in other phases through similar of more generalised problems.

A SITUATION ANALYSIS 29

A.1 GENERAL PROBLEMS 29
A.2 STAKEHOLDER 29
A.3 INSTITUTIONAL ASPECTS 29
A.4 ECONOMIC ASPECTS 30
A.5 ENVIRONMENTAL ASPECTS 31
A.6 TECHNICAL WATER SUPPLY SYSTEM 31

B PLANNING AND DESIGN 31

B.1 GENERAL PROBLEMS 31
B.2 STAKEHOLDER 33
B.3 INSTITUTIONAL ASPECTS 33
B.4 ECONOMIC ASPECTS 34
B.5 ENVIRONMENTAL ASPECTS 35
B.6 TECHNICAL WATER SUPPLY SYSTEM 35

C IMPLEMENTATION 36

C.1 GENERAL PROBLEMS 36
C.2 STAKEHOLDER 36
C.3 INSTITUTIONAL ASPECTS 37
C.4 ECONOMIC ASPECTS 37
C.5 ENVIRONMENTAL ASPECTS 37
C.6 TECHNICAL WATER SUPPLY SYSTEM 37

D OPERATION 37

D.1 GENERAL PROBLEMS 37
D.2 STAKEHOLDER 38
D.3 INSTITUTIONAL ASPECTS 38
D.4 ECONOMIC ASPECTS 41
D.5 ENVIRONMENTAL ASPECTS 41
D.6 TECHNICAL WATER SUPPLY SYSTEM 41

Table 1: Index of the problem analysis for water supply systems

A Situation analysis

A.1 General problems

- The situation analysis is not recognised as the essential starting point for any further action
- The situation analysis is not comprehensive and impartial
- The main focus of the analysis is not based on the common public interest
- Needs for participation are not assigned to appropriate stakeholder
- Problems and their correlations in the current system are not assessed
- Needs for improvements (e.g. simple strengthening of existing situation or more rigorous reforms) are not assessed
- Analysis methods are not simple and efficient

A.2 Stakeholder

- Different segments of society each with their different knowledge, priorities, incentives, practices and needs are not identified
- Situation of community is not assessed: e.g. actual water and sanitation systems, socio-economic situation, cultural and gender situation
- Different needs of community for drinking water are not assessed
- Key stakeholders are not identified and involved
- Poor stakeholder capacities and visions due to lack of knowledge and formation
- Stakeholder visions are limited to certain aspects and lacking a holistic perspective
- Stakeholders have unrealistic expectations
- Situation analysis is initiated and executed by non-locals, failing to sufficiently assess local situation

A.3 Institutional aspects

- Existing institutions are not integrated sufficiently in situation analysis
- Necessary institutions are nonexistent or not functioning properly according to their policies
- Institutions are affected by particular interests, corruption, injustice, slow bureaucracy

(Institutional aspects: continued)

- Institutions are lacking of resources, capacities, stability and power
- Relevant policies, legislations and regulations for institutions are missing
- Non-compliance with law is not enforced
- Conditions of cooperation between institutions are not clearly defined and realised
- Institutions are not focused on improved services, efficiency and effectiveness
- Insufficient political effort to establish an integral national policy for well-functioning, sustainable water and sanitation systems
- General objectives and policies of water and sanitation systems, like water and sanitation demands of private households, public institutions, businesses sector, agriculture are not assessed sufficiently
- Absence of related political planning (public health, protection of the environment, land and urban planning, water resource management, economic development, energy production, etc)
- Relevant authorities representatives are not capable or willing to investigate and meet the common public interest
- Current organisational structures of relevant authorities are not assessed: responsibilities and authorities, levels of collaboration with other institutions, strengths and weaknesses, gaps and overlaps
- Political reactions to past health and environmental hazards associated with water supply systems were weak

A.4 Economic aspects

- Stakeholders are lacking of sufficient funding for a comprehensive situation analysis
- Necessary financial structures like public finances, taxes, subsidies, investment policies etc are non existing or not working
- The political will and commitment towards cost-effective systems is weak
- General local and national economic situation is difficult (developing country, unemployment, recession, catastrophes, etc)

A.5 Environmental aspects

- The public opinion puts little emphasis on the protection of the environment
- The environmental impacts on virtually all human activities are not considered
- The environmental situation is precarious (sensitive eco-systems, scarce resources, etc) and foreseeable risks and hazards are not assessed
- The long-term and long-range effects of the environment on human livelihood are not recognised and integrated sufficiently

A.6 Technical water supply system

- Features of actual water supply system are not assessed thoroughly (SWOT: strengths, weaknesses, opportunities and threats, framework conditions, etc)
- Potential of the actual water supply system for improvements at little effort is not investigated sufficiently

B Planning and design

B.1 General problems

- The planning process is not assessed and initiated according to the situation analysis (responsibilities for planning process, funding, stakeholder participation, etc)
- Overall vision, purpose and objectives are not clearly formulated
- No definition of quality standards and service requirements
- Planning does not integrate stakeholder, institutional, financial, environmental and technical aspects on the local, regional and national level
- Planning does not integrate relevant sector policies: public health, protection of the environment, land and urban planning, water resource management, economic development, energy production, etc
- Planning attaches too little importance to non-technical aspects
- International cooperation within river catchments is not promoted
- No focus on potentials for minimizing the consumption of water through handling habits and technology
- WHO and FAO guidelines are not applied in the case of non-existent national regulations
- Water and sanitation are not regarded as linked issues, opportunities for their integration are not thoroughly investigated

(General problems: continued)

- Definition of boundaries and zones (for different systems, technologies and institutions) are only focused on single areas, technologies and groups
- Too narrow definition of planning horizon
- Poor planning and scheduling of planning and design, implementation and operation phase
- Planning methods are not simple and efficient
- Demographic and socio-economic projections are not realistic and do not consider the effects of changes in the water and sanitation system on urbanization, income, water quality and quantity demand, etc
- Possible risks and obstacles are not integrated in the planning process
- In case of uncertainty in assessment results, the precautionary principle has not been applied and full transparency in not ensured
- Preliminary planning imposes limitations on further planning process (too narrow project definition, insufficient allocation of funds, limitation to a small range of solutions, etc)
- No alternative situation planning
- Alternatives do not integrate stakeholders, institutional, financial, environmental and technical feasibility
- Alternatives are not discussed with all stakeholders
- Step-wise selection approach, starting with the most simple alternative, only opting for the most expensive and complicated solution if all other options fail, is not followed
- No clear definition of responsibilities for managing the planning phase and for taking decisions
- Poor decision-making tools
- Biased decision-making led by particular interests
- Objectives are not defined in a clear, easily measurable and verifiable way
- Objectives are not weighted and bedded into a decision-making structure
- Not every relevant objective of the drinking water system is considered
- Flexibility in planning, implementation and operation is not allowed for
- Any involvement of the private sector is not planned step-by-step in order to mitigate risks and adapt contracts to changes in the local situation

B.2 Stakeholder

- Stakeholder have insufficient capacities, knowledge and experience in assessment and planning
- Planning is not tailored to needs of different segments of the community
- Relevant professional skills and private sector potentials for the implementation and operation of a water supply system are not taken into consideration
- Local experience and expertise are not utilised to help identify problems and formulate solutions
- Community and other stakeholders are not involved in planning, impeding the rise of their awareness and participation
- No support for community to participate in planning
- Cooperation among stakeholders is not solution-oriented
- External consultants are not sufficiently independent
- Opportunities, like collaboration with important stakeholders (big water clients such as companies and institutions, etc) are not considered
- Awareness raising and education campaigns targeting different potential users in specific ways are not planned

B.3 Institutional aspects

- No adequate definition of the role of different stakeholders in the planning process: local/regional/national administration, users, responsible bodies, utilities, banks, donors, private sector, consultants, international governmental and non-governmental institutions
- Future institutional structure including policies, legislations and regulations are not assessed thoroughly regarding the improvement of services, the rise of efficiency and effectiveness and the need for adjustments
- No commitment to the common public interest
- Insufficient institutional capacities and resources
- The potential for enforcement is not considered while formulating regulations and standards
- Incentive schemes for staff to improve the quality of their work is not designed
- The important role of local government is not acknowledged
- Responsibilities and participation in planning, decision-making, supervision and evaluation are not sufficiently defined and established

(Institutional aspects: continued)

- Project administration scheme is not able to guarantee good results
- Insufficient definition and planning of authorities service requirements, strategies, policies and related general institutional, economic, technical and environmental aspects
- Insufficient resources for monitoring the compliance with policies
- Delegation of responsibilities and authority to lowest appropriate management levels is not intended
- Policies for responsible body are not planned
- Utilities knowledge and capacities are not considered
- Planning does not focus utilities' duty on the service to users

B.4 Economic aspects

- National, regional, local and individual economic capacity and related development plans are not sufficiently reviewed
- Communities financial capabilities are over-estimated and financial solutions turn out to be unsuitable in following phases
- Current financial situation with resources originating from complex financial flows is not assessed
- No calculation of total costs (including estimations for indirect costs like degradation of the environment etc) over projected lifecycle
- Insufficient financial resources for sound planning
- Financial feasibility study for all alternatives is not made
- The most cost-effective option is not selected
- Co-financing is not encouraged and promoted by the government
- Different possibilities for cost recovery in the context of the three inter-related issues of quality of service, investment cost and tariffs are not evaluated
- The principles of "user pays", "polluter pays", " equity" and "solidarity" are not applied while formulating the cost recovery system
- The need for tariff flexibility at local level, related to changing exchange, interest and inflation rates, is not acknowledged
- Investments are not adapted to needs and resources of users, to obtain tariffs which are acceptable for users

(Economic aspects: continued)

- A clear investment procedure is not proposed, considering the range of options from traditional grants to more innovative solutions, such as revolving funds, and following a step-by-step approach
- Long-term commitments from national and multilateral institutions to secure funding are not obtained
- Local funding sources are not used as much as possible to respond to the need for local flexibility and commitment
- Market assessment among potential stakeholders is not made
- Sufficient funding can not be guaranteed

B.5 Environmental aspects

- Capacities and water quality of possible water sources are not assessed
- Alternative water sources (e.g. considering new treatment technologies) are not taken into account
- Sanitation is not integrated into planning
- Capacity of aquatic body in receiving effluents in not assessed
- Most dangerous contaminations of water sources are not identified

B.6 Technical water supply system

- Water supply demand - in terms of quality and quantity - of households, institutions and business sector is not assessed
- Technical options do not consider meeting water demands with reduced amounts of water
- Technical options are not studied carefully before final selection, applying a multi-criteria analysis (environmental soundness, appropriateness to local conditions and regulations, applicability and efficiency in the context of the entire river basin, affordability to those who must pay for the services, technical performance and reliability, by-product management requirements, economies of scale, possibilities for minimising consumption, etc)
- Necessary framework conditions for different technologies and costs for their realisation are not assessed
- Step-wise implementation, adaptation and extension of successive technical systems are not considered

(Technical water supply system: continued)

- Settlement structure and its opportunities for adapted technology choice and zoning are neglected
- Availability of necessary land titles and rights of way is not considered

C Implementation

C.1 General problems

- Staff, funds, facilities and mechanisms are not in place for implementation
- Implementation strategy is not appropriate
- Implementation is not equal to what was planned and designed
- Missing flexibility of implementation programme to adapt to local situation
- Need for redesign as a result of changes during implementation is not assessed
- Increasing capacity does not incorporate all relevant stakeholders and aspects, such as institutional development, community participation, human resources development and strengthening of managerial system

C.2 Stakeholder

- Missing consensus among stakeholders about what has to be implemented and how it has to be done
- Major changes within the community, regarding perceptions, attitudes and behaviour
- Awareness raising and education campaigns fail to change the target groups' knowledge, behaviour and participation
- Community and their contributions are not integrated in implementation
- Communities' awareness of the importance of reducing water consumption is not targeted in specific campaigns

C.3 Institutional aspects

- Existing legal framework including policies, legislations and regulations is not reviewed and adjusted to fit the relevant alternative systems and technologies
- Staffing and required organizational changes are not realised
- New institutions and their policies, staffing and funding are not established
- Capacity building strategies are inadequate and lacking of long-term political and financial commitment to ensure improvements
- Interagency coordination mechanisms between institutions at different levels from local to national are not established

C.4 Economic aspects

- Funding allocation is not prepared
- Investments are not step-wise
- Funds are not flexible enough to adapt to changes
- Cost explosion due to bad planning

C.5 Environmental aspects

- Strong pollution of the environment caused by construction works

C.6 Technical water supply system

- Interruption of service due to construction work
- Low quality of construction works
- Construction work requires high efforts

D Operation

D.1 General problems

- Water supply system is not stable and sustainable
- Alliances between potential service providing partners (institutions, private sector, community, etc) are weak
- Compliance with commitments in the long run, facilitated by local and national institutional stability, is not assured
- Undesirable effects on migration and urbanisation

D.2 Stakeholder

- Stakeholders level of acceptance for water supply system is low
- Low public awareness and participation
- Users are not informed about rules and enforcements
- Rules are not accepted and can not be enforced
- Many people are not provided for
- Water demand is not met
- Inefficient use of water
- Health risks caused by bad service quality and wrong use
- Cultural, social and gender problems in dealing with the water system
- Users have low awareness of their dual role as beneficiaries and polluters
- Arrangements for adequate communication and information exchange among stakeholders are not in place

D.3 Institutional aspects

General institutional problems

- The overall institutional framework does not ensure that quality standards are adjusted and maintained
- Responsible bodies, relevant authorities, utilities and their respective policies, responsibilities and control mechanisms are not defined and executed
- Institutional structure is not flexible enough to ensure integration with other relevant sectors and to allow for most efficient and cost-effective solutions
- Legislation is not appropriate to commit partnerships to maintain agreed performance levels
- Authority and responsibility are not delegated to lowest appropriate management levels
- Relevant legislation and its enforcement is not in place and executed
- Responsibilities among the actors are not assigned by legislation
- Institutional capacities are low
- Regular monitoring and evaluation of all actors and necessary improvement mechanisms are not provided
- Functions of attaining standards are not separated from their monitoring
- Verifiable standards and time-bound performance indicators which are realistic and can be measured against agreed benchmarks are not in place

(Institutional aspects: continued)

- Transparency regarding organisational objectives, targets, performance and financial management in not assured
- Management tools in the form of regulatory, economic or market-based instruments are missing
- Management tools (policy, institutional, technological and financial) are not applied in an integrated way
- Management tools for different institutions are not approved
- Enforcement mechanisms are not approved
- Staffing and required organizational changes are not approved
- The overall institutional framework does not enable use of economic instruments to promote minimization of consumption, pollution prevention and re-use
- Flow of information between institutions does not meet requirements
- Synergies among institutions of different sectors and government levels are not created
- Incentive scheme for members of staff to improve the system is absent
- Institutions are over-staffed and staffs' qualifications do not meet requirements
- Ownership rights to contributed assets and responsibilities in investment, construction, operation and maintenance are not clearly defined
- Private sector participation does not come along with strong public institutions, appropriate control and adaptation mechanisms and sufficient information exchange
- The involvement of private sector does not adapt to changes in the local situation
- Risks are not allocated realistically to reach a fair balance of risks and benefits among parties

Relevant authorities

- Relevant authorities are not strong enough to formulate policy, legislation and regulation for quality control and enforcement
- Low capacity of authorities to enforce the rules
- Interagency coordination mechanisms between relevant authorities at different levels are not established

(Institutional aspects: continued)

Responsible bodies

- Functions of regulation and monitoring of service quality are not separated from functions of attaining standards
- Time-bound performance criteria to ensure quality control have not been established

Utilities

- Inefficient and ineffective operation of drinking water system
- Bad working conditions in utility (health risks, low remuneration, etc)
- Lack of active and pro-active maintenance: long interruptions of service, high costs for repairs, low quality of work
- Reparations are delayed and of bad quality
- Staff are insufficient and under qualified
- Absence of service quality improvement strategies like quality management, monitoring, evaluations, benchmarking
- No sector cooperation (local, regional, national, international) among utilities
- Competition is not stimulated to reach more efficiency
- Communication strategy with differentiation between different stakeholders is not applied
- Operational goals are not set and agreed upon with direct involvement of all stakeholders in the basin
- Mechanisms are not in place through which utilities can be held accountable by the public
- Documentation is incomplete
- Accounting procedures are inaccurate
- Human resources are not managed and developed
- Action plans for emergencies are incomplete or absent
- Protection of labour is not assured and constantly improved
- General administration is inadequate
- Service to users is inappropriate: provision of the service, contract management and billing and the promotion of a good relationship with users

D.4 Economic aspects

- Poor households cannot afford water and financial support is missing
- Tariff structure is not aimed at realistic shares from different users (solidarity among different stakeholders and service levels)
- Tariffs are rising without visible service improvements
- Community does not agree with water tariffs and their range of variation
- Total system costs are not covered through benefits and subsidies
- High unaccounted-for water (high water losses, public institutions do not pay adequately, etc)
- Flexible application of regulations at local level so that local regulators and users can devise the most cost-effective solutions is not possible
- Strong and objective enforcement when making economic benefit from non compliance is not ensured
- Billing system and bills are not clear and easy to understand
- Use of revenues is not transparent
- Corruption and fraud
- Local creation of value is small
- Funding is not to bound to requirements reached
- Financing agency is not advocating the utility

D.5 Environmental aspects

- Water source is not sufficiently protected from pollution and over-use
- Operation and maintenance of water supply system causes high pollution of environment through residues and energy consumption
- Recreational value of aquatic systems is damaged due to water extraction and water pollution related to the water supply system

D.6 Technical water supply system

- Delivered water does not meet minimum quantity and quality requirements
- Low service level (intermitted water supply, long waiting periods, long walking distance to water tap, little flow rates, low water pressure, etc)

(Technical water supply system: continued)

- Water treatment is costly, ineffective, unstable and environmentally hazardous
- Water supply system is sensitive to interferences such as wrong handling, accidents and vandalism
- Operation and maintenance of the water supply system is expensive and intensive in terms of labour, materials, energy consumption and management
- Comprehensive monitoring routines for water sources and assets are not in place
- Maintenance works are delayed and of poor quality
- Stockpiling and maintenance of auxiliary equipment is not sufficient
- Adaptation and/or extension of the water supply system to changing demands is expensive
- High transfer losses
- System assets are of poor quality causing high maintenance costs
- Residues from the water supply system are causing problems because of their insufficient management and treatment
- Spare parts are expensive and hard to get
- Coverage only of certain parts of the settlement area
- Bad zoning and no spatial differentiation considering specific physical and socio-economic characteristics

If one or several of the problems mentioned above arise in specific water supply systems, they may cause insufficient or unreliable water supply. As a result, the living conditions of the community may not be sustained.

4.2.2. Objectives analysis for water supply systems

The objectives analysis is the reformulation of all negative situations of the problem analysis into positive ones that are desirable and realistically achievable. The reformulation of all problems found in the problem analysis would consume a lot of space without giving substantially more information, so the objectives are summarised into general objectives for each aspect of a phase.

A Situation analysis

- Stakeholder: All relevant stakeholders, especially the community, are integrated and participating in a comprehensive and unbiased analysis of the situation, with a strong commitment to the common public interest
- Institutional aspects: The situation of relevant authorities, responsible bodies and utilities is considered thoroughly
- Economic aspects: Sufficient funding for the whole process is ensured by long-term commitments
- Environmental aspects: Safe and sufficient water sources are available and the protection of the environment is of particular importance for stakeholders
- Technical water supply system: Adaptation and improvement potentials are assessed thoroughly

B Planning and design

- Stakeholder: All relevant stakeholders are supportive and actively participating in a comprehensive planning process, leading to decisions that integrate the common public interest and a holistic vision in the long term
- Institutional aspects: Institutional adaptations are planned carefully, targeting for efficiency and effectiveness
- Economic aspects: Planning focuses on minimising total costs in the long term
- Environmental aspects: Planning integrates minimised pollution and maximised conservation of the environment on a global scale
- Technical water supply system: Planning consensus for technical solutions that assure attaining required service standards at minimum implementation, operation and maintenance expenses

C Implementation

- Stakeholder: Relevant stakeholders are executing high-quality implementation works, respectively adapting their behaviour to the new requirements
- Institutional aspects: Necessary changes of the institutions' policies, legislations and regulations are achieved
- Economic aspects: Costs stay within projected limits
- Environmental aspects: Minimised pollution of the environment during implementation
- Technical water supply system: Implementation works are of high quality at minimum effort

D Operation

- Stakeholder: Different users' water demands are sufficiently covered and complaints concerning the water supply systems are rare
- Institutional aspects: Institutions are assuring agreed results and commit themselves to constantly improving efficiency and effectiveness
- Economic aspects: Total costs are minimized in the long term, institutions are financially stable and tariffs are accepted by users
- Environmental aspects: Pollution of the environment is minimised and water resources are secured in the long term
- Technical water supply system: Service quality standards are reliably attained at minimum operation and maintenance expenses

What is the **purpose** of all these efforts? They facilitate systems that assure or improve available water quality and quantity for the community in the long term.

In a general sense, and this leads to the **overall objective**, functioning water supply systems contribute to a preservation or improvement of the living conditions of the community. This is the main and basic reason for any activity in the sector.

Unfortunately, there is a certain temptation to focus interests only on the purpose of the systems: the technical water supply system, with its taps or public stand posts as end points. The logframe analysis clearly shows, how many other conditions are necessary, to make water available at these interfaces with users.

4.2.3. Strategy analysis for water supply systems

In this step, the factors that have the most impact on the achievement of the objectives are selected. During the **planning and design** and **operation** phases, all thematic aspects have to be considered as very important. They are integral parts of a comprehensive approach.

During **situation analysis**, the stakeholders and the institutional aspects are of particular importance. Stakeholders comprise all persons that do the analysis and who the analysis is done for. It is up to the different stakeholders to decide to initiate further steps or not. Institutional aspects are tackled too, because they set the legal and financial background and in many cases, they operate an existing system. Institutional aspects play a central role at any stage of the systems, assuring their long-term functionality. Therefore, it is particularly important to assess their initial situation.

Economic, environmental and technical aspects are not selected, as they are part of stakeholders' situation. For example, changes in the system have to adapt to the stakeholders economic situation, no matter how difficult it is. Environmental aspects are somehow part of the stakeholders' situation, perception and values. Technical water supply systems are the initial situation being adapted according to the stakeholders' visions.

The situation is almost the same during **implementation**; only the institutional aspects are deselected, because at this stage they only need realisation according to what was planned. The same is true for economic, environmental and technical aspects. Different stakeholders, such as the relevant institutions, community, associations, consultants, contractors and banks, are responsible for the entire implementation and the quality of the executed work.

For further analysis, the chronological order has to be turned bottom up, so that operation appears as first item in the list and situation analysis as last one. The relatively higher importance of different aspects in water supply systems is displayed in table 2 with the help of greyish colouration.

Strategy analysis matrix for water supply systems:

Phases	Aspects				
	Stakeholder	Institutional aspects	Economic aspects	Environmental aspects	Technical water supply system
Operation					
Implementation					
Planning and design					
Situation analysis					

Table 2: Importance of aspects in different phases of water supply systems

4.2.4. Logframe matrix for water supply systems

The final and central step in the logframe analysis is the filling in of the logframe matrix (see table 3). The findings of the objectives analysis fit exactly with the first column, called intervention logic.

Results are the objectives attained during operation whereas **activities** refer to the most important objectives during situation analysis, planning and implementation as they were selected in chapter 4.2.3. **Overall objectives** and **operation purpose** transferred directly to the **intervention logic** too. **Indicators** and their **means of verification** are formulated accordingly to what is mentioned in the intervention logic. Here, only some possible indicators and sources of verification are listed. Please refer to chapter 5.2 for additional indicators.

Conditions that cannot be controlled directly within the project or system, but which have significant effects on the success, are mentioned as **assumptions**. In the case of this comprehensive analysis of water supply systems, only severe external impacts, such as catastrophes fall in this category. All other minor and foreseeable conditions are considered in the intervention logic. According to the structure applied, these severe external impacts can be found in the activities section because they mainly influence the achievement of the results.

	Intervention logic	Objectively verifiable indicators	Sources of verification	Assumptions
Overall objectives	Improvement of living conditions of community	Improvement of Human Development Index, reduction of water supply related diseases, increase of economic development due to improved water supply	UNDP Human development report, reports from health institutions, surveys of economic development	Substantial external system changes do not happen, such as: climatic and environ-mental hazards, macro-economic disasters, deplorable affairs of state, social instability and war
Operation Purpose	Sufficient water quality and quantity for community in the long term	Water demand met, compliance with water quality standards at point of consumption	Records of utilities, responsible bodies and relevant authorities	
Results	**Operation:**			
	Stakeholder: Users' different water demands are sufficiently covered and complaints concerning the water supply systems are rare	Minimum water amounts consumed (regarding personal health), user satisfied with water supply service, number of complaints	Water demand survey and utilities record of water consumption, sample consumer survey, utilities record of complaints	
	Institutional aspects: Institutions are assuring agreed results and commit themselves to constantly improving efficiency and effectiveness	Levels of efficiency and effectiveness, compliance with quality management requirements, performance in benchmarking initiatives	Records of related institutions, institutional surveys, quality management certificates, benchmarking initiatives	
	Economic aspects: Total costs are minimized in the long term, institutions are financially stable and tariffs are accepted by users	Total annual costs, total system costs for national economy, expenditures for water in poor households	Financial records of utilities, responsible bodies and relevant authorities, sample consumer survey	
	Environmental aspects: Pollution of the environment is minimised and water resources are secured in the long term	Level of environmental sustainability of water supply system, condition of the environment - especially the water bodies	Environmental assessment, records of environmental agencies and NGOs, utilities operational records	

Table 3: Logframe matrix for water supply systems

		Objectively verifiable indicators	Sources of verification	Assumptions
	Technical water supply system: Service quality standards are reliably attained at minimum operation and maintenance expenses	Levels of efficiency and effectiveness, system robustness regarding wrong operation and abuse	Records of utilities, responsible bodies and relevant authorities, institutional and technical surveys	
Activities	**Implementation:**			
	Stakeholder: Relevant stakeholders are executing efficient and effective implementation works, respectively adapting their behaviour to the new requirements	Quality of executed works, adaptations and campaigns, level of efficiency and effectiveness of executed works and campaigns, appropriateness of users´ knowledge and behaviour	Review of implementation strategies, user surveys	
	Planning and design:			
	Stakeholder: All relevant stakeholder are supporting and actively participating in a comprehensive planning process, leading to decisions that integrate the common public interest and a holistic vision in the long run	Community informed about the planning process, community participating in planning process, community satisfied with decisions taken	Sample community survey, membership records of user associations, records of participants in public meetings	
	Institutional aspects: Institutional adaptations are planned carefully, targeting for efficiency and effectiveness	Feasibility of institutional adaptations, compliance of planning process with approved planning tools, consideration of institutional efficiency and effectiveness aspects	Institutional feasibility study, assessment of state of the art planning tools	
	Economic aspects: Planning focuses on minimising total costs in the long term	Planned total costs, consideration of all financially relevant factors	Review of state of the art financial planning tools, estimation of different costs	

Table 3: Logframe matrix for water supply systems (continued)

	Intervention logic	Objectively verifiable indicators	Sources of verification	Assumptions
	Environmental aspects: Planning integrates minimised pollution and maximised conservation of the environment on a global scale	Consideration of potentials for conservation of the environment, consideration of all opportunities for the reduction of water demands	Environmental audits, records of environmental agencies and NGOs	
	Technical water supply system: Planning decides for technical solutions that assure attaining required service standards at minimum implementation, operation and maintenance expenses	Expected level of compliance with requirements, expected O&M expenses, consideration of all technical aspects and impacts	Assessment of compliance with requirements, assessment of operation and maintenance requirements, assessment of state of the art technologies.	
	Situation analysis:			
	Stakeholder: All relevant stakeholders, especially the community, are integrated and participating in a comprehensive and unbiased analysis of the situation, with a strong commitment to the common public interest	Level of stakeholder participation, compliance of situation analysis process with approved management tools	Survey on stakeholders needs and participation, interviews, assessment of state of the art situation analysis management tools	
	Institutional aspects: The situation of relevant authorities, responsible bodies and utilities is considered thoroughly	Institutions contacted and analysed, representatives interviewed	Institutional and financial survey, legislation and management survey	

Table 3: Logframe matrix for water supply systems (continued)

Please note that due to the limited space of the logframe matrix, it only contains a selection of indicators formulated in chapter 5.2. Refer to the respective chapter for more indicators.

4.3. Logframe analysis for sanitation systems

4.3.1. Problem analysis for sanitation systems

The problem analysis for sanitation systems is quite similar to the one for water supply systems. Please refer to chapter 4.2.1 for respective remarks.

Table 4 gives an overview of the problem analysis for sanitation systems.

A. SITUATION ANALYSIS 51

A.1. GENERAL PROBLEMS 51
A.2. STAKEHOLDER 51
A.3. INSTITUTIONAL ASPECTS 51
A.4. ECONOMIC ASPECTS 52
A.5. ENVIRONMENTAL ASPECTS 53
A.6. TECHNICAL SANITATION SYSTEM 53

B. PLANNING AND DESIGN 53

B.1. GENERAL PROBLEMS 53
B.2. STAKEHOLDER 55
B.3. INSTITUTIONAL ASPECTS 56
B.4. ECONOMIC ASPECTS 57
B.5. ENVIRONMENTAL ASPECTS 58
B.6. TECHNICAL SANITATION SYSTEM 58

C. IMPLEMENTATION 59

C.1. GENERAL PROBLEMS 59
C.2. STAKEHOLDER 59
C.3. INSTITUTIONAL ASPECTS 59
C.4. ECONOMIC ASPECTS 60
C.5. ENVIRONMENTAL ASPECTS 60
C.6. TECHNICAL SANITATION SYSTEM 60

D. OPERATION 60

D.1. GENERAL PROBLEMS 60
D.2. STAKEHOLDER 61
D.3. INSTITUTIONAL ASPECTS 61
D.4. ECONOMIC ASPECTS 64
D.5. ENVIRONMENTAL ASPECTS 64
D.6. TECHNICAL SANITATION SYSTEM 64

Table 4: Index of the problem analysis for sanitation systems

A. Situation analysis

A.1. General problems

- The situation analysis is not recognised as the essential starting point for any further action
- The situation analysis is not comprehensive and impartial
- The main focus of the analysis is not based on the common public interest
- Needs for participation are not assigned to appropriate stakeholders
- Problems and their correlations in the current system are not assessed
- Needs for improvements (e.g. simple strengthening of existing situation or more rigorous reforms) are not assessed
- Analysis methods are not simple and efficient

A.2. Stakeholder

- Different segments of society each with their different knowledge, priorities, incentives, practices and needs are not identified
- Situation of community is not assessed: e.g. actual water and sanitation systems, socio-economic situation, cultural and gender situation
- Different needs of community for sanitation are not assessed
- Key stakeholders are not identified and involved
- Poor stakeholder capacities and visions due to lack of knowledge and formation
- Stakeholder visions are limited to certain aspects and lacking a holistic perspective
- Stakeholders have unrealistic expectations
- Situation analysis is initiated and executed by non-locals, failing to sufficiently assess local situation

A.3. Institutional aspects

- Existing institutions are not integrated sufficiently in situation analysis
- Necessary institutions are nonexistent or not functioning properly according to their policies
- Institutions are affected by particular interests, corruption, injustice, slow bureaucracy

(Institutional aspects: continued)

- Institutions are lacking of resources, capacities, stability and power
- Relevant policies, legislations and regulations for institutions are missing
- Non-compliance with law is not enforced
- Conditions of cooperation between institutions are not clearly defined and realised
- Institutions are not focused on improved services, efficiency and effectiveness
- Insufficient political effort to establish an integral national policy for well-functioning, sustainable water and sanitation systems
- General objectives and policies of water and sanitation systems, like water and sanitation demands of private households, public institutions, businesses sector, agriculture are not assessed sufficiently
- Absence of related political planning (public health, protection of the environment, land and urban planning, water resource management, economic development, energy production, etc)
- Relevant authorities representatives are not capable or willing to investigate and meet the common public interest
- Current organisational structures of relevant authorities are not assessed: responsibilities and authorities, levels of collaboration with other institutions, strengths and weaknesses, gaps and overlaps
- Political reactions to past health and environmental hazards associated with sanitation systems were weak

A.4. Economic aspects

- Stakeholders are lacking of sufficient funding for a comprehensive situation analysis
- Necessary financial structures like public finances, taxes, subsidies, investment policies etc are non existing or not working
- The political will and commitment towards cost-effective systems is weak
- General local and national economic situation is difficult (developing country, unemployment, recession, catastrophes, etc)

A.5. Environmental aspects

- The public opinion puts little emphasis on the protection of the environment
- The environmental impacts on virtually all human activities are not considered
- The environmental situation is precarious (sensitive eco-systems, scarce resources, etc) and foreseeable risks and hazards are not assessed
- The long-term and long-range effects of the environment on human livelihood are not recognised and integrated sufficiently

A.6. Technical sanitation system

- Features of actual sanitation system are not assessed thoroughly (SWOT: strengths, weaknesses, opportunities and threats, framework conditions, etc)
- Potential of the actual sanitation system for improvements at little effort is not investigated sufficiently
- The structure of the settlement area and its opportunities for specific technology mixes are not taken into account

B. Planning and design

B.1. General problems

- The planning process is not assessed and initiated according to the situation analysis (responsibilities for planning process, funding, stakeholder participation, etc)
- Overall vision, purpose and objectives are not clearly formulated
- No definition of quality standards and service requirements
- Planning does not integrate stakeholder, institutional, financial, environmental and technical aspects on the local, regional and national level
- Planning does not integrate relevant sector policies: public health, protection of the environment, land and urban planning, water resource management, economic development, energy production, etc
- Planning attaches too little importance to non-technical aspects
- International cooperation within river catchments is not promoted
- No focus on potentials for minimizing the amount of sanitary wastes and wastewater through handling habits and technology
- Most serious contaminants for human health and environment are not identified

(General problems: continued)

- No focus on areas where most positive impacts can be expected
- WHO and FAO guidelines are not applied in the case of non-existent national regulations
- Water and sanitation are not regarded as linked issues, opportunities for their integration are not thoroughly investigated
- Definition of boundaries and zones (for different systems, technologies and institutions) are only focused on single areas, technologies and groups
- Too narrow definition of planning horizon
- Poor planning and scheduling of planning and design, implementation and operation phase
- Planning methods are not simple and efficient
- Demographic and socio-economic projections are not realistic and do not consider the effects of changes in the water and sanitation system on urbanization, income, sanitation quality and quantity demand, etc
- Possible risks and obstacles are not integrated in the planning process
- In case of uncertainty in assessment results, the precautionary principle has not been applied and full transparency in not ensured
- Preliminary planning imposes limitations on further planning process (too narrow project definition, insufficient allocation of funds, limitation to a small range of solutions, etc)
- No alternative situation planning
- Alternatives do not integrate stakeholders, institutional, financial, environmental and technical feasibility
- Alternatives are not discussed with all stakeholders
- Step-wise selection approach, starting with the simplest alternative, only opting for the most expensive and complicated solution if all other options fail, is not followed. The logical order being: pollution prevention, waste minimisation, water demand reduction – on-site sanitation – off-site wastewater and storm water transportation and collection – natural treatment systems combined with re-use, centralised high-tech wastewater treatment
- No clear definition of responsibilities for managing the planning phase and for taking decisions
- Poor decision-making tools

(General problems: continued)

- Biased decision-making led by particular interests
- Objectives are not defined in a clear, easily measurable and verifiable way
- Objectives are not weighted and bedded into a decision-making structure
- Not every relevant objective of the sanitation system is considered
- Flexibility in planning, implementation and operation is not allowed for
- Any involvement of the private sector is not planned step-by-step in order to mitigate risks and adapt contracts to changes in the local situation
- Impact of wastewater (quality and quantity) from industries and small enterprises that is mixed with domestic wastewater is not sufficiently assessed
- No distinction between cheaper on-site sanitation and more complex and expensive off-site collection and treatment is made
- Solid waste, storm water and flood management and their relation to sanitation remain unconsidered
- Detailed inventories of the local situation to assess health risks and environmental impacts of the various technology options for disposal and re-use are not made
- Private sector participation related to servicing on-site technologies is not assessed

B.2. Stakeholder

- Stakeholder have insufficient capacities, knowledge and experience in assessment and planning
- Planning is not tailored to needs of different segments of the community
- Relevant professional skills and private sector potentials for the implementation and operation of a sanitation system are not taken into consideration
- Local experience and expertise are not utilised to help identify problems and formulate solutions
- Community and other stakeholders are not involved in planning, impeding the rise of their awareness and participation
- No support for community to participate in planning
- Cooperation among stakeholders is not solution-oriented
- External consultants are not sufficiently independent

(Stakeholder: continued)

- Opportunities, like collaboration with important stakeholders (big sanitation clients such as companies and institutions, farmers, etc) are not considered
- Awareness raising and education campaigns targeting different potential users in specific ways are not planned
- A detailed survey among stakeholders with specific emphasis on perceptions on re-use of matters is not made
- Market assessments, which can be used to advocate re-use of matter, are not carried out

B.3. Institutional aspects

- No adequate definition of the role of different stakeholders in the planning process: local/regional/national administration, users, responsible bodies, utilities, banks, donors, private sector, consultants, international governmental and non-governmental institutions
- Future institutional structure including policies, legislations and regulations are not assessed thoroughly regarding the improvement of services, the rise of efficiency and effectiveness and the need for adjustments
- No commitment to the common public interest
- Insufficient institutional capacities and resources
- The potential for enforcement is not considered while formulating regulations and standards
- Incentive schemes for staff to improve the quality of their work is not designed
- The important role of local government is not acknowledged
- Responsibilities and participation in planning, decision-making, supervision and evaluation are not sufficiently defined and established
- Project administration scheme is not able to guarantee good results
- Insufficient definition and planning of authorities service requirements, strategies, policies and related general institutional, economic, technical and environmental aspects
- Insufficient resources for monitoring the compliance with policies
- Delegation of responsibilities and authority to lowest appropriate management levels is not intended
- Policies for responsible body are not planned

(Institutional aspects: continued)

- Utilities knowledge and capacities are not considered
- Planning does not focus utilities' duty on the service to users

B.4. Economic aspects

- National, regional, local and individual economic capacity and related development plans are not sufficiently reviewed
- Communities financial capabilities are over-estimated and financial solutions turn out to be unsuitable in following phases
- Current financial situation with resources originating from complex financial flows is not assessed
- No calculation of total costs (including estimations for indirect costs like degradation of the environment etc) over projected lifecycle
- Insufficient financial resources for sound planning
- Financial feasibility study for all alternatives is not made
- The most cost-effective option is not selected
- Co-financing is not encouraged and promoted by the government
- Different possibilities for cost recovery in the context of the three inter-related issues of quality of service, investment cost and tariffs are not evaluated
- The principles of "user pays", "polluter pays", " equity" and "solidarity" are not applied while formulating the cost recovery system
- The need for tariff flexibility at local level, related to changing exchange, interest and inflation rates, is not acknowledged
- Investments are not adapted to needs and resources of users, to obtain tariffs which are acceptable for users
- A clear investment procedure is not proposed, considering the range of options from traditional grants to more innovative solutions, such as revolving funds, and following a step-by-step approach
- Long-term commitments from national and multilateral institutions to secure funding are not obtained
- Local funding sources are not used as much as possible to respond to the need for local flexibility and commitment
- Market assessment among potential stakeholders is not made
- Sufficient funding can not be guaranteed

B.5. Environmental aspects

- Water supply is not integrated into planning
- Capacity of aquatic body in receiving effluents in not assessed
- Most dangerous contaminations through sanitation are not identified

B.6. Technical sanitation system

- Sanitation demand - in terms of quality and quantity - of households, institutions and business sector is not assessed
- Different available technologies, their requirements and impacts are not assessed
- Technical options do not consider meeting sanitation demands with reduced amounts of water for flushing
- Technical options are not studied carefully before final selection, applying a multi-criteria analysis (environmental soundness, appropriateness to local conditions and regulations, applicability and efficiency in the context of the entire river basin, affordability to those who must pay for the services, technical performance and reliability, by-product management requirements, economies of scale, possibilities for minimising wastes, etc)
- Necessary framework conditions for different technologies and costs for their realisation are not assessed
- Step-wise implementation, adaptation and extension of successive technical systems are not considered
- Urban runoff and the frequency with which urban runoff drains into the wastewater collection and sanitation systems is not sufficiently assessed
- Settlement structure and its opportunities for adapted technology choice and zoning are neglected
- Availability of necessary land titles and rights of way is not considered

C. Implementation

C.1. General problems

- Staff, funds, facilities and mechanisms are not in place for implementation
- Implementation strategy is not appropriate
- Implementation is not equal to what was planned and designed
- Missing flexibility of implementation programme to adapt to local situation
- Need for redesign as a result of changes during implementation is not assessed
- Increasing capacity does not incorporate all relevant stakeholders and aspects, such as institutional development, community participation, human resources development and strengthening of managerial system

C.2. Stakeholder

- Missing consensus among stakeholders about what has to be implemented and how it has to be done
- Major changes within the community, regarding perceptions, attitudes and behaviour
- Awareness raising and education campaigns fail to change the target groups' knowledge, behaviour and participation
- Community and their contributions are not integrated in implementation
- Campaigns, to increase communities acceptance of new technologies, are not promoted
- Communities' awareness of the importance of reducing sanitary wastes and wastewater is not targeted in specific campaigns

C.3. Institutional aspects

- Existing legal framework including policies, legislations and regulations is not reviewed and adjusted to fit the relevant alternative systems and technologies
- Staffing and required organizational changes are not realised
- New institutions and their policies, staffing and funding are not established
- Capacity building strategies are inadequate and lacking of long-term political and financial commitment to ensure improvements
- Interagency coordination mechanisms between institutions at different levels from local to national are not established

C.4. Economic aspects

- Funding allocation is not prepared
- Investments are not step-wise
- Funds are not flexible enough to adapt to changes
- Cost explosion due to bad planning

C.5. Environmental aspects

- Strong pollution of the environment caused by construction works

C.6. Technical sanitation system

- Interruption of service due to construction work
- Low quality of construction works
- Construction work requires high efforts

D. Operation

D.1. General problems

- Sanitation system is not stable and sustainable
- Alliances between potential service providing partners (institutions, private sector, community, etc) are weak
- Compliance with commitments in the long run, facilitated by local and national institutional stability, is not assured
- Undesirable effects on migration and urbanisation
- Health risks and environmental pollution due to communities' wrong handling habits
- Innovative economic instruments used in combination with administrative regulation as an incentive (e.g. tradable effluent permits or loan-based licensing fees), giving polluters more investment and operational flexibility, are not in place

D.2. Stakeholder

- Stakeholders level of acceptance for sanitation system is low
- Low public awareness and participation
- Users are not informed about rules and enforcements
- Rules are not accepted and can not be enforced
- Many people are not provided for
- Sanitation demand is not met
- Inefficient use of sanitation system
- Health risks caused by bad service quality and wrong use
- Cultural, social and gender problems in dealing with the sanitation system
- Users have low awareness of their dual role as beneficiaries and polluters
- Arrangements for adequate communication and information exchange among stakeholders are not in place

D.3. Institutional aspects

General institutional problems

- The overall institutional framework does not ensure that quality standards are adjusted and maintained
- Responsible bodies, relevant authorities, utilities and their respective policies, responsibilities and control mechanisms are not defined and executed
- Institutional structure is not flexible enough to ensure integration with other relevant sectors and to allow for most efficient and cost-effective solutions
- Legislation is not appropriate to commit partnerships to maintain agreed performance levels
- Authority and responsibility are not delegated to lowest appropriate management levels
- Relevant legislation and its enforcement is not in place and executed
- Responsibilities among the actors are not assigned by legislation
- Institutional capacities are low
- Regular monitoring and evaluation of all actors and necessary improvement mechanisms are not provided
- Functions of attaining standards are not separated from their monitoring
- Verifiable standards and time-bound performance indicators which are realistic and can be measured against agreed benchmarks are not in place

(Institutional aspects: continued)

- Transparency regarding organisational objectives, targets, performance and financial management in not assured
- Management tools in the form of regulatory, economic or market-based instruments are missing
- Management tools (policy, institutional, technological and financial) are not applied in an integrated way
- Management tools for different institutions are not approved
- Enforcement mechanisms are not approved
- Staffing and required organizational changes are not approved
- The overall institutional framework does not enable use of economic instruments to promote pollution prevention and re-use
- Flow of information between institutions does not meet requirements
- Synergies among institutions of different sectors and government levels are not created
- Incentive scheme for members of staff to improve the system is absent
- Institutions are over-staffed and staffs´ qualifications do not meet requirements
- Ownership rights to contributed assets and responsibilities in investment, construction, operation and maintenance are not clearly defined
- Private sector participation does not come along with strong public institutions, appropriate control and adaptation mechanisms and sufficient information exchange
- The involvement of private sector does not adapt to changes in the local situation
- Risks are not allocated realistically to reach a fair balance of risks and benefits among parties
- Institutions do not have an adequate monitoring system in place, with capacity to set receiving water quality levels and emission standards and to measure performance and compliance with regulations

Relevant authorities

- Relevant authorities are not strong enough to formulate policy, legislation and regulation for quality control and enforcement
- Low capacity of authorities to enforce the rules

(Institutional aspects: continued)

- Interagency coordination mechanisms between relevant authorities at different levels are not established

Responsible bodies

- Functions of regulation and monitoring of service quality are not separated from functions of attaining standards
- Time-bound performance criteria to ensure quality control have not been established

Utilities

- Inefficient and ineffective operation of sanitation system
- Bad working conditions in utility (health risks, low remuneration, etc)
- Lack of active and pro-active maintenance: long interruptions of service, high costs for repairs, low quality of work
- Reparations are delayed and of bad quality
- Staff are insufficient and under qualified
- Absence of service quality improvement strategies like quality management, monitoring, evaluations, benchmarking
- No sector cooperation (local, regional, national, international) among utilities
- Competition is not stimulated to reach more efficiency
- Communication strategy with differentiation between different stakeholders is not applied
- Operational goals are not set and agreed upon with direct involvement of all stakeholders in the basin
- Mechanisms are not in place through which utilities can be held accountable by the public
- Documentation is incomplete
- Accounting procedures are inaccurate
- Human resources are not managed and developed
- Action plans for emergencies are incomplete or absent
- Protection of labour is not assured and constantly improved
- General administration is inadequate
- Service to users is inappropriate: provision of the service, contract management and billing and the promotion of a good relationship with users

D.4. Economic aspects

- Poor households cannot afford sanitation and financial support is missing
- Tariff structure is not aimed at realistic shares from different users (solidarity among different stakeholders and service levels)
- Tariffs are rising without visible service improvements
- Community does not agree with sanitation tariffs and their range of variation
- Total system costs are not covered through benefits and subsidies
- Flexible application of regulations at local level so that local regulators and users can devise the most cost-effective solutions is not possible
- Strong and objective enforcement when making economic benefit from non compliance is not ensured
- Billing system and bills are not clear and easy to understand
- Use of revenues is not transparent
- Corruption and fraud
- Local creation of value is small
- Funding is not to bound to requirements reached
- Financing agency is not advocating the utility

D.5. Environmental aspects

- Operation and maintenance of sanitation system causes high pollution of environment through residues and energy consumption
- Recreational value of aquatic systems is damaged due to water extraction and water pollution related to the sanitation system

D.6. Technical sanitation system

- Sanitation does not meet minimum quantity and quality requirements
- Low service level
- Sanitation is costly, ineffective, unstable and environmentally hazardous
- Sanitation system is sensitive to interferences such as wrong handling, accidents and vandalism
- Operation and maintenance of the sanitation system is expensive and intensive in terms of labour, materials, energy consumption and management
- Comprehensive monitoring routines for sanitation assets are not in place
- Maintenance works are delayed and of poor quality

(Technical sanitation system: continued)

- Stockpiling and maintenance of auxiliary equipment is not sufficient
- Adaptation and/or extension of the sanitation system to changing demands is expensive
- System assets are of poor quality causing high maintenance costs
- Residues from the sanitation system are causing problems because of their insufficient management and treatment
- Spare parts are expensive and hard to get
- Coverage only of certain parts of the settlement area
- Bad zoning and no spatial differentiation considering specific physical and socio-economic characteristics

If one or several of the problems mentioned above arise in specific sanitation systems, they may cause insufficient or unreliable sanitation. As a result, the living conditions of the community may not be sustained.

4.3.2. Objectives analysis for sanitation systems

Just like for water supply systems (see chapter 4.2.2), the objectives are a reformulation of problems into desirable and achievable situations.

A Situation analysis

- Stakeholder: All relevant stakeholders, especially the community, are integrated and participating in a comprehensive and unbiased analysis of the situation, with a strong commitment to the common public interest
- Institutional aspects: The situation of relevant authorities, responsible bodies and utilities is considered thoroughly
- Economic aspects: Sufficient funding for the whole process is ensured by long-term commitments
- Environmental aspects: Potentials for re-use are high, receiving bodies are capacious and the protection of the environment is of particular importance for stakeholders
- Technical sanitation system: Potential for adaptation, improvement, treatment, re-use and disposal are assessed thoroughly

B Planning and design

- Stakeholder: All relevant stakeholders are supportive and actively participating in a comprehensive planning process, leading to decisions that integrate the common public interest and a holistic vision in the long term
- Institutional aspects: Institutional adaptations are planned carefully, targeting for efficiency and effectiveness
- Economic aspects: Planning focuses on minimising total costs in the long term
- Environmental aspects: Planning integrates re-use of matters, minimised pollution and maximised conservation of the environment on a global scale
- Technical sanitation system: Planning decides for technical solutions that assure attaining required service standards at minimum impiementation, operation and maintenance expenses

C Implementation

- Stakeholder: Relevant stakeholders are executing high-quality implementation works and respectively adapting their behaviour to the new requirements
- Institutional aspects: Necessary changes of the institutions' policies, legislations and regulations are achieved
- Economic aspects: Costs stay within projected limits
- Environmental aspects: Minimised pollution of the environment during implementation
- Technical sanitation system: Implementation works are of high quality at minimum effort

D Operation

- Stakeholder: Users' different sanitation needs are sufficiently covered and complaints concerning the sanitation system are rare
- Institutional aspects: Institutions are assuring agreed results and commit themselves to constantly improving efficiency and effectiveness
- Economic aspects: Total costs are minimised in the long term, institutions are financially stable and tariffs are accepted by users
- Environmental aspects: Pollution of the environment is minimised in the long term
- Technical sanitation system: Service quality standards are reliably attained at minimum operation and maintenance expenses

Similar to water supply systems, the **purpose** of all these efforts are long-term safe and reliable sanitary systems for the community. The **overall objective**, again, is the preservation or improvement of the living conditions of the community. This is the main and basic reason for any activity in the sector.

Similar to the case of water supply systems, there is a certain temptation of focusing interests only on the technical sanitation system, as it contributes to the operation purpose in the most direct sense. The logframe analysis shows for sanitation again, how many other aspects are necessary, to make sanitation systems safe and reliable.

4.3.3. Strategy analysis for sanitation systems

The strategy analysis for sanitation is the same as for water supply (see chapter 4.2.3). The relatively higher importance of different aspects in sanitation systems is displayed through greyish colouration in table 5.

Strategy analysis matrix for sanitation systems:

Phases	Aspects				
	Stakeholder	Institutional aspects	Economic aspects	Environmental aspects	Technical sanitation system
Operation					
Implementation					
Planning and design					
Situation analysis					

Table 5: Importance of aspects in different phases of sanitation systems

4.3.4. Logframe matrix for sanitation systems

The logframe matrix for sanitation (see table 6) is completed similarly to the logframe matrix for water supply (see chapter 4.2.4).

	Intervention logic	Objectively verifiable indicators	Sources of verification	Assumptions
Overall objectives	Improvement of living conditions of community	Improvement of Human Development Index, reduction of sanitation related diseases, increase of economic development due to improved sanitation	UNDP Human development report, reports from health institutions, surveys of economic development	Substantial external system changes do not happen, such as: climatic and environmental hazards, macro-economic disasters, deplorable affairs of state, social instability and war
Operation Purpose	Safe and reliable sanitary systems in the long term	Sanitation needs met, global safety of sanitation system, global reliability of sanitation system	Records of utilities, responsible bodies and relevant authorities	
Results	**Operation:**			
	Stakeholder: The sanitation system meets the community's requirements, hazards to public health are minimised and complaints concerning the sanitation systems are rare	Hazards to public health related to sanitation system, user satisfied with sanitation service, number of complaints	Audit of sanitation impacts on public health, records from public health institutions, sanitation demand survey sample consumer survey, utilities record of complaints	
	Institutional aspects: Relevant authorities, responsible bodies and utilities are assuring agreed results and commit themselves to improving efficiency and effectiveness	Levels of efficiency and effectiveness, compliance with quality management requirements, performance in benchmarking initiatives	Records of related institutions, institutional surveys, quality management certificates, benchmarking initiatives	
	Economic aspects: Total costs are minimised in the long term, institutions are financially stable and tariffs are accepted by users	Total annual costs, total system costs for national economy, expenditures for sanitation in poor households	Financial records of utilities, responsible bodies and relevant authorities, sample consumer survey	
	Environmental aspects: Pollution of the environment is minimised in an integral way	Level of environmental sustainability of sanitation system, condition of the environment - especially the receiving bodies	Environmental assessment, records of environmental agencies and NGOs, utilities operational records	

Table 6: Logframe matrix for sanitation systems

	Intervention logic	Objectively verifiable indicators	Sources of verification	Assumptions
	Technical sanitation system: Service quality standards are attained at minimum operation and maintenance expenses	Levels of efficiency and effectiveness, system robustness regarding wrong operation and abuse	Records of utilities, responsible bodies and relevant authorities, institutional and technical surveys	
Activities	**Implementation:** Stakeholder: Relevant stakeholders are executing efficient and effective implementation works, respectively adapting their behaviour to the new requirements	Quality of executed works and campaigns, level of efficiency and effectiveness of executed works and campaigns, appropriateness of users' knowledge and behaviour	Review of implementation strategies, user surveys	
	Planning and design: Stakeholder: All relevant stakeholders are supporting and actively participating in a comprehensive planning process leading to decisions that integrate the common public interest and a holistic vision in the long term	Community informed about the planning process, community participating in planning process, community satisfied with decisions taken	Sample community survey, membership records of user associations, records of participants in public meetings	
	Institutional aspects: Institutional adaptations are planned carefully, targeting for efficiency and effectiveness	Feasibility of institutional adaptations, compliance of planning process with approved planning tools, consideration of institutional efficiency and effectiveness aspects	Institutional feasibility study, assessment of state of the art planning tools	
	Economic aspects: Planning focuses on minimising total costs in the long term	Planned total costs, consideration of all financially relevant factors	Review of state of the art financial planning tools, estimation of different costs	

Table 6: Logframe matrix for sanitation systems (continued)

	Intervention logic	Objectively verifiable indicators	Sources of verification	Assumptions
	Environmental aspects: Planning integrates minimised pollution and maximised conservation of the environment on a global scale	Consideration of potentials for conservation of the environment, consideration of all opportunities for re-use, adjustment of future impacts to environmental sustainability	Environmental audit, records of environmental agencies and NGOs	
	Technical sanitation system: Planning decides for technical solutions that assure attaining required service standards at minimum implementation, operation and maintenance expenses	Expected level of compliance with requirements expected O&M expenses, consideration of all technical aspects and impacts	Assessment of compliance with requirements, assessment of operation and maintenance requirements, assessment of state of the art technologies	
	Situation analysis:			
	Stakeholder: All relevant stakeholders, especially the community, are integrated and participating in a comprehensive and unbiased analysis of the situation, with a strong commitment to the common public interest	Level of stakeholders participation, compliance of situation analysis process with approved management tools	Survey on stakeholders needs and participation, interviews, assessment of state of the art situation analysis management tools	
	Institutional aspects: The situation of relevant authorities, responsible bodies and utilities is considered thoroughly	Institutions contacted and analysed, representatives interviewed	Institutional and financial survey, legislation and management survey	

Table 6: Logframe matrix for sanitation systems (continued)

Please note that due to the limited space of the logframe matrix, it only contains a selection of indicators formulated in chapter 5.3. Refer to the respective chapter for more indicators.

5. Performance indicator systems

5.1. Introduction

"A performance indicator is a quantitative measure of a particular aspect of the undertaking's performance or standard of service that may be used to compare performance historically, or against some pre-defined target. It assists in the monitoring and evaluation of the efficiency and effectiveness of the undertaking, thus simplifying an otherwise potentially complex evaluation." (ALEGRE et al., 2000)

Performance indicators, if applied correctly, can be valuable tools for the management of water and sanitation systems. They are used for planning, monitoring, evaluation, and acquisition of information, comparisons between undertakings through benchmarking initiatives, and other purposes depending on the stakeholders' interests.

Performance indicator systems should comply with the following requirements (adapted and amplified from ALEGRE et al., 2000):

- They are focused on systems compliance with requirements
- They represent all the relevant aspects of the system performance, allowing for a global representation by a limited number of indicators
- They are suitable for representing those aspects in a true and unbiased way
- They reflect the results of the managing activity of the undertaking
- They are clearly defined, with a concise meaning and a unique interpretation for each indicator
- They include only non-overlapping performance indicators
- They require only measuring equipment that targeted institutions can afford; the requirement of sophisticated and expensive equipment should be avoided
- They are verifiable, which is specially important when the performance indicators are to be used by regulating entities that may need to check the results reported

(Requirements for performance indicator systems: continued)

- They are easy to understand, even by non-specialists – particularly by consumers
- They refer to a certain period of time (one year is the basic assessment period of time recommended, although in some cases other periods are appropriate)
- They refer to a well limited geographical area
- They are applicable to systems with different characteristics and stages of development
- They are applicable to different technologies
- They are as few as possible, avoiding the inclusion of non-essential aspects

In many cases, performance indicator systems are targeting benchmarking initiatives. They favour calculable indicators over qualitative ones. The logframe matrix (see chapters 4.2.4 and 4.3.4) reveals that the qualitative assessment of situations is of fundamental importance, proving general deficiencies and giving contextual information that is difficult to measure accurately by calculated ratios between numbers. As a matter of course, it is possible to convert qualitative indicators into quantitative ones, by simply assigning values to different quality levels.

5.2. Performance indicators for water supply systems

The logframe matrix for water supply systems (see chapter 4.2.4) serves as framework for the formulation of related performance indicators and defines the principal structure and hierarchy. Due to the limited space in the logframe matrix it only contains a selection of the indictors listed below (see table 7).

Some of the indicators presented in table 7 are similar to the indicators in the IWA performance indicators for water supply services (ALEGRE et al., 2000), with the main difference being that performance indicators presented in this work are more comprehensive and do not refer to utilities only. The same is true for indicators proposed by The International Benchmarking Network for Water and Sanitation

Utilities IBNET, a benchmarking platform initiated by the World Bank (IBNET 2006). Performance indicators from other authors (LUX et al., 2005, BRACKEN et al., 2006) have been adapted and integrated in the following table too.

Performance indicators for water supply systems	Units
Overall objectives	
Improvement of Human Development Index	%
Reduction of water related diseases	%
Increase of economic development due to improved water supply	% or monetary units per person per time unit
Operation purpose	
Water demand met	%
Compliance with water quality standards at point of consumption	%
Operation: Stakeholder aspects	
Minimum water amounts consumed (regarding personal health)	Minimum litres per person per day
User satisfied with water supply service	%
Convenience regarding comfort, personal health safety, etc	Qualitative
Number of complaints	Complaints per time unit
Operation: Institutional aspects	
Levels of efficiency and effectiveness	Qualitative
Compliance with quality management requirements	Qualitative
Performance in benchmarking initiatives	Qualitative
Staff' training	Hours per employee per year
Staff' satisfaction with working conditions	Qualitative
Transparency in institutions	Qualitative
Operation: Economic aspects	
Total annual costs	Costs per person per time unit
Total system costs for national economy	Costs per person per time unit
Estimated long-term environmental costs	Costs per person per time unit
Utilities cost coverage through revenues	%
Scheduled costs covered by assured funding (for each relevant institution)	%
User satisfied with water tariffs	%

Table 7: Performance indicators for water supply systems

Expenditures for water in poor households	% and costs per litre
Utilities total O&M costs	Costs per person per time unit (and per litre)
Total annual O&M costs integrating all related institutions	Costs per person per time unit (and per litre)
Balance of transaction costs vs. savings related to outsourcing	Costs/savings per person per time unit (and per litre)
Potential of environmental cost reductions through specific investments	Qualitative
Utilities expenditures for occupational health and safety	Expenditures per workplace per year
Operation: Environmental aspects	
Level of environmental sustainability of water supply system	Qualitative
Condition of the environment, especially the water bodies	Qualitative
Amount of residues produced per cubic meter of water	Kg per m^3
Level of environmental pollution through residues produced	Qualitative
Environmental risks due to residues produced per cubic meter of water	Qualitative
Water source protection areas installed	%
Operation: Technical water supply system	
Level of efficiency and effectiveness	Qualitative
System robustness regarding wrong operation, abuse, etc	Qualitative
Noise exposure of staff at workplace	dB (max. or Σ)
Energy efficiency of water supply system	Qualitative
Used water collected by approved sanitation systems	%
Implementation: Stakeholder aspects	
Quality of executed construction works, adaptations and campaigns	Qualitative
Level of efficiency and effectiveness of executed works and campaigns	Qualitative
Appropriateness of users´ knowledge and behaviour	Qualitative
Planning and design: Stakeholder aspects	
Community informed about the planning process	%
Community participating in planning process	Qualitative
Community satisfied with decisions taken	%
Level of cooperation between stakeholders	Qualitative

Table 7: Performance indicators for water supply systems (continued)

Planning and design: Institutional aspects	
Feasibility of institutional adaptations	Qualitative
Compliance of planning process with approved planning tools	Qualitative
Consideration of institutional efficiency and effectiveness aspects	Qualitative
Planning and design: Economic aspects	
Planned total costs	Costs per person per time unit (and per litre)
Consideration of all financially relevant factors	Qualitative
Planning and design: Environmental aspects	
Consideration of potentials for conservation of the environment	Qualitative
Consideration of all opportunities for the reduction of water demands	Qualitative
Adjustment of future impacts to environmental sustainability	Qualitative
Planning and design: Technical water supply system	
Expected level of compliance with requirements	Qualitative
Expected O&M expenses	Costs per person per time unit (and per litre)
Consideration of all technical aspects and impacts	Qualitative
Requirements regarding stakeholders, institutional, economic and environmental aspects and their adaptability	Qualitative
Possibility to use local competence for implementation and O&M	Qualitative
Complexity of implementation and O&M	Qualitative
Flexibility and adaptability to future requirements	Qualitative
Situation analysis: Stakeholder aspects	
Level of stakeholder participation	Qualitative
Compliance of situation analysis process with approved management tools	Qualitative
Situation analysis: Institutional aspects	
Institutions contacted and analysed	Qualitative
Representatives interviewed	Qualitative
Consideration of all relevant institutional aspects	Qualitative

Table 7: Performance indicators for water supply systems (continued)

5.3. Performance indicators for sanitation systems

Similar to the performance indicators for water supply systems, the logframe matrix for sanitation systems (see chapter 4.3.4) is the framework for the formulation of related performance indicators and defines the principal structure and hierarchy. Due to the limited space in the logframe matrix it only contains a selection of the indictors listed below (see table 8).

Some of the indicators presented in table 8 are similar to the indicators in the IWA Performance indicators for wastewater services (MATOS et al., 2003) and the indicators used in the IBNET initiative (IBNET 2006). The main difference derives from the fact that performance indicators presented in this work integrate more aspects and do not refer to utilities only. Performance indicators from other authors (LUX et al., 2005, BRACKEN et al., 2006) have been adapted and integrated also.

Performance indicators for sanitation systems	Units
Overall objectives	
Improvement of Human Development Index	%
Reduction of sanitation related diseases	%
Increase of economic development due to improved sanitation	% or monetary units per person per time unit
Operation purpose	
Sanitation needs met	%
Global safety of sanitation system	Qualitative
Global reliability of sanitation system	Qualitative
Operation: Stakeholder aspects	
Hazards to public health related to sanitation system	Qualitative
User satisfied with sanitation service	%
Convenience regarding comfort, safety of personal health, etc	Qualitative
Number of complaints	Complaints per time unit
Operation: Institutional aspects	
Levels of efficiency and effectiveness	Qualitative
Compliance with quality management requirements	Qualitative
Performance in benchmarking initiatives	Qualitative

Table 8: Performance indicators for sanitation systems

Staff' training	Hours per employee per year
Staff' satisfaction with working conditions	Qualitative
Transparency in institutions	Qualitative
Operation: Economic aspects	
Total annual costs	Costs per person per time unit
Total system costs for national economy	Costs per person per time unit
Estimated long-term environmental costs	Costs per person per time unit
Utilities cost coverage through revenues	%
Scheduled costs covered by assured funding (for each relevant institution)	%
User satisfied with sanitation costs	%
Expenditures for sanitation in poor households	% and costs per litre
Utilities total O&M costs	Costs per person per time unit (and per litre)
Total annual O&M costs integrating all related institutions	Costs per person per time unit (and per litre)
Balance of transaction costs vs. savings related to outsourcing	Costs / savings per person per time unit (and per litre)
Global balance of savings and costs related to reuse of matters	Costs / savings per person per time unit (and per litre)
Global balance of costs related to disposal of matters	Costs per person per time unit (and per litre)
Potential of environmental cost reductions through specific investments	Qualitative
Utilities expenditures for occupational health and safety	Expenditures per workplace per year
Operation: Environmental aspects	
Level of environmental sustainability of sanitation system	Qualitative
Condition of the environment, especially the receiving water bodies	Qualitative
Amount of resources recovered	%
Amount of residues produced per user	Litres per person
Discharges to fields and water bodies	Qualitative
Level of environmental pollution through reused and disposed matters	Qualitative
Environmental risks related to reuse and disposal of matters	Qualitative
Operation: Technical sanitation system	
Level of efficiency and effectiveness	Qualitative

Table 8: Performance indicators for sanitation systems (continued)

System robustness regarding wrong operation, abuse, etc	Qualitative
Health hazards for staff at workplace	Qualitative
Energy efficiency of treatment system	Qualitative
Ratio of maximum capacities of water supply and sanitation systems	%
Implementation: Stakeholder aspects	
Quality of executed construction works, adaptations and campaigns	Qualitative
Level of efficiency and effectiveness of executed works and campaigns	Qualitative
Appropriateness of users' knowledge and behaviour	Qualitative
Planning and design: Stakeholder aspects	
Community informed about the planning process	%
Community participating in planning process	Qualitative
Community satisfied with decisions taken	%
Level of cooperation between stakeholders	Qualitative
Planning and design: Institutional aspects	
Feasibility of institutional adaptations	Qualitative
Compliance of planning process with approved planning tools	Qualitative
Consideration of institutional efficiency and effectiveness aspects	Qualitative
Planning and design: Economic aspects	
Planned total costs	Costs per person per time unit (and per litre)
Consideration of all financially relevant factors	Qualitative
Planning and design: Environmental aspects	
Consideration of potentials for conservation of the environment	Qualitative
Adjustment of future impacts to environmental sustainability	Qualitative
Consideration of all opportunities for re-use	Qualitative
Planning and design: Technical sanitation system	
Expected level of compliance with requirements	Qualitative
Expected O&M expenses	Costs per person per time unit (and per litre)
Consideration of all technical aspects and impacts	Qualitative

Table 8: Performance indicators for sanitation systems (continued)

Requirements regarding stakeholders, institutional, economic and environmental aspects and their adaptability	Qualitative
Possibility to use local competence for implementation and O&M	Qualitative
Complexity of implementation and O&M	Qualitative
Flexibility and adaptability of future requirements	Qualitative
Situation analysis: Stakeholder aspects	
Level of stakeholder participation	Qualitative
Compliance of situation analysis process with approved management tools	Qualitative
Situation analysis: Institutional aspects	
Institutions contacted and analysed	Qualitative
Representatives interviewed	Qualitative
Consideration of all relevant institutional aspects	Qualitative

Table 8: Performance indicators for sanitation systems (continued)

6. Water supply and sanitation technologies

6.1. Introduction

For water and sanitation, many different technologies are available. They require specific conditions regarding stakeholders, institutional, economic and environmental aspects for proper function. There are three main questions for technology choice: First, can the current situation be adapted to fit the technologies requirements? Second, how big are these necessary adaptation efforts? Third, which efforts does the technical system need to get expected results? These questions are pictured in figure 3.

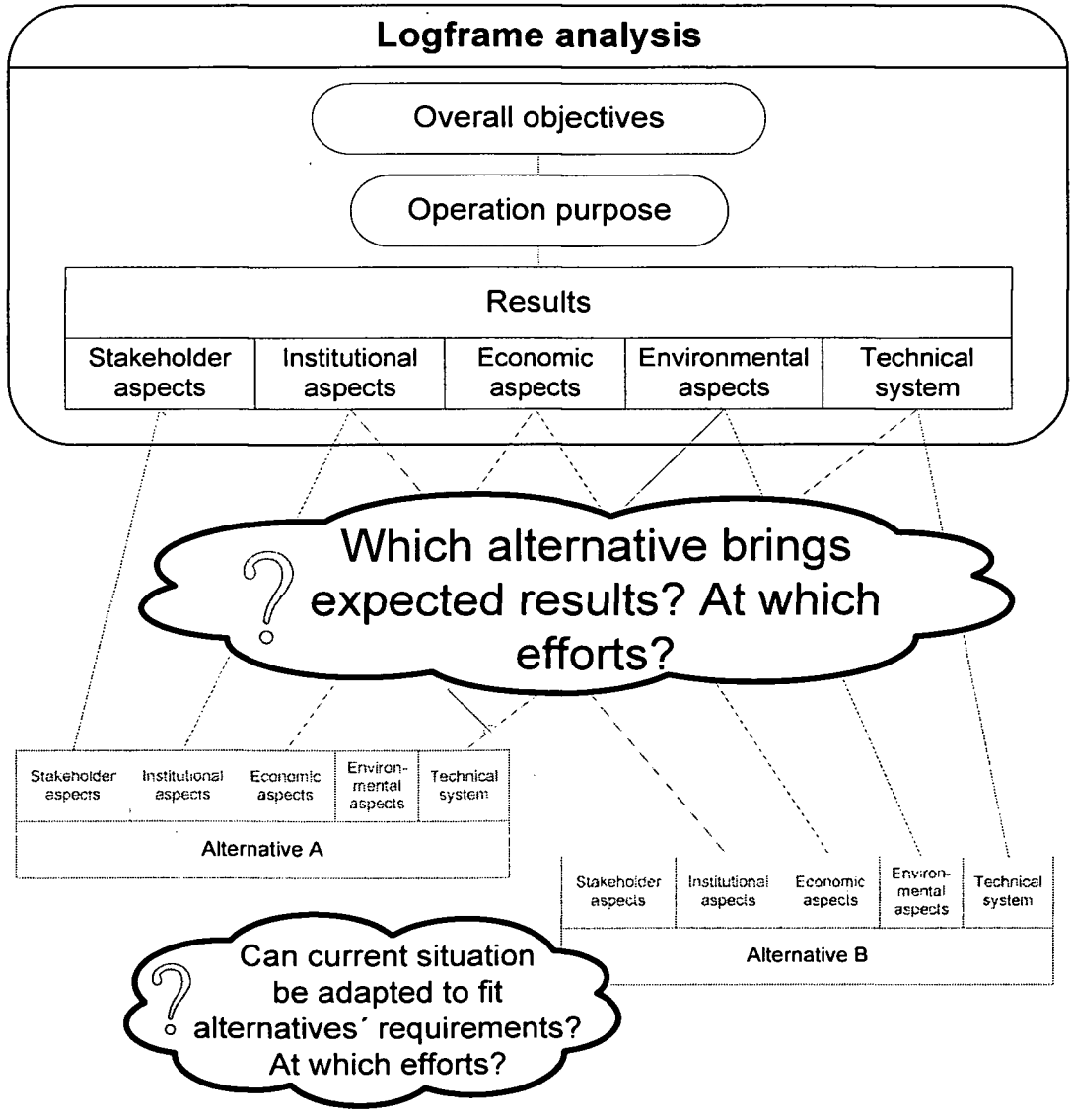

Figure 3: System requirements and choice

For both, water and sanitation systems, the questions of safety, adequacy, reliability and affordability are fundamental. Network systems, provided that they are managed properly, offer safe, reliable and comfortable services at high costs and potentially high environmental burdens. In water supply, this mainly refers to costly piped networks and the over-use of water sources. In sanitation, high costs derive from both, the costly sewer systems and treatment plants. Environmental impacts are related to the water demand for the transportation of residues, and the sludge, which in many cases can only be used for land filling or disposed as hazardous waste because of its mixture of valuable and toxic substances.

With the rise of the public awareness towards the protection of the environment and the reduction of costs, new technologies for water supply and, even more, sanitation are developed. In sanitation, many new technologies are on-site solutions because they have the potential for the re-use of matters by separation at their origin, and by making expensive and water demanding networks dispensable. When comparing the handling risks of technologies, it is important to consider all aspects of the systems. For example, there is little awareness of toxic gases exhausted by sewer systems and recognised occupational diseases of sewer workers and wastewater treatment plant's staff.

Centralised systems require strong institutions and funding mechanisms that are able to manage all the different aspects of the systems. In this case, they are able to deliver constant and controlled service quality. On-site solutions are more difficult to control, but they are safer against breakdowns and terrorist attacks. They also need specific instruments for servicing and quality control, offering considerable potential for private sector participation.

6.2. Water supply technologies

There are different water supply technologies for different components from source to consumption.

Water supply components include:

- Water source
- Water-lifting devices
- Treatment
- Transfer and transport
- Storage
- Distribution

The order, in which these components appear, depends on local requirements. Some components, for example storage, may be found several times in specific systems. Furthermore, some components may not be existent in some systems. Different technologies for these components are indicated in figure 4.

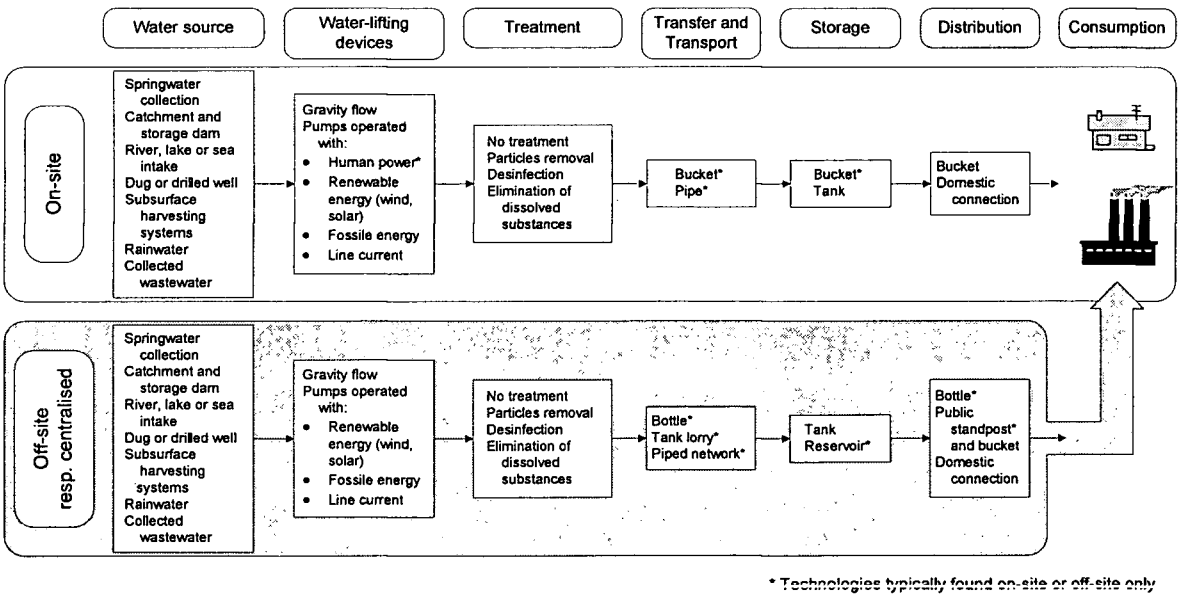

Figure 4: Choice of technical components for water supply systems

Obviously, many technologies are the same for on-site and off-site situations. Only technologies marked with an asterisk (*) are typically found in on-site or off-site situations only.

The technologies shown in figure 4 are general technologies. It would be

unnecessarily complicated to list all existing technologies, mainly those for treatment, in a detailed way. This technological components overview is sufficient to investigate whether all technologies are mentioned in the reviewed standards or not. As all technologies mentioned are commonly known or self-explaining, further explanations are not given.

6.3. Sanitation technologies

Technology choice in sanitation is challenging. The main difference to water supply are the various matters that appear in sanitation, their different health hazards and potentials for treatment and re-use.

Sanitation components are:

- Generation
- Collection
- Treatment
- Transfer and transport
- Re-use
- Disposal

The order in which these components appear depends on local requirements. Some components may exist several times, some components may be non-existent in specific systems. Different technologies for these components are shown in figure 5.

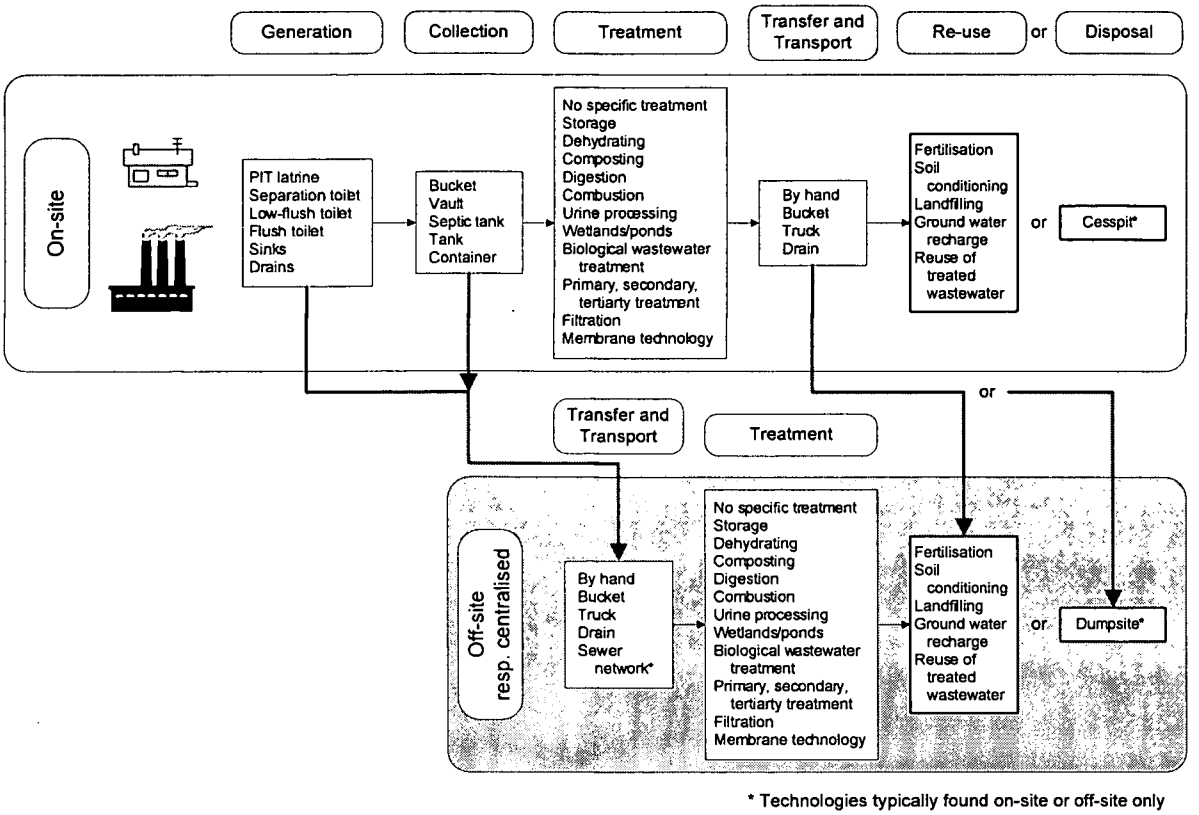

Figure 5: Choice of technical components for sanitation systems

Just like in the case of water supply systems, many technologies are the same for on-site and off-site situations. Only technologies marked with an asterisk (*) are typically found in on-site or off-site situations only. Obviously, the different matters may take different ways from on-site to offside. In on-side situations, they are typically treated before further transportation whereas in order to get to off-side treatment facilities, these matters need transportation beforehand. It is interesting to note that the only technology typically found on-site only (the cesspit) is prohibited in many countries.

The technologies shown in figure 5 are general technologies. It would be unnecessarily complicated to list all existing technologies, mainly those for treatment, in a detailed way. This overview is sufficient to investigate the representation of all technologies in the reviewed standards.

Some persons may not be familiar with sanitation technologies and their characteristics. For this reason, a short description is given below (adapted from WERNER, 2004).

Generation is the place where wastewater, faeces and urine have their origin, in many cases in association with the use of water. Separation technologies keep faeces and urine apart in order to enhance their further treatment and re-use. Sinks can be found typically in kitchens, toilet and bathrooms. Drains are the connection for washing machines and similar wastewater producing machines.

Collection can be for separated or mixed matters, in recipients of different form and dimension.

Treatment offers a wide range of choice. In many cases, several technologies are applied simultaneously or complementary. Storage, depending on the conditions such as time and temperature, has different impacts on wastewater, urine and faeces. Dehydration and composting produce a material that can be further processed to soil conditioners. Digestion is an anaerobic treatment that can be focused on the production of gases such as methane or fertilisers/soil conditioners. Combustion means the incineration of dried substances. Urine processing includes different treatments with the aim to produce fertilisers. In wetlands and ponds, plants or fishes produce biomass from wastewater nutrients. Biological wastewater treatment deal with mixed or partly separated wastewater in natural or intensive systems in order to get cleaned water and sludges or to allow reuse of water and nutrients. Primary, secondary and tertiary treatment refer to wastewater treatment plants meaning mechanical, biological and further treatment respectively. Filtration and membrane technologies are mechanical treatment options.

Transport works with different recipients and means of transport or sewer networks. **Re-use** aims at soils through fertilisers, soil conditioning and land filling, at the re-use of water through ground water recharge, or direct re-use. **Disposal** takes place in cesspits or dumpsites.

7. Discussion of the reviewed standards

Comparing the draft international standards ISO/DIS 24510, 24511 and 24512 with the findings of a comprehensive perspective created with the help of the logframe approach and the analysis of technical systems and performance indicators, one central question arises: **Will these standards be bedded in a comprehensive series of related standards or not?**

If yes, these complementary standards should deal with all aspects relating to water and sanitation systems, except of those subjects treated in the respective standards (namely the service to users, the management of the utilities and their assessment). But even in this case the actual draft international standard will need some review and adaptation to fit in a contiguous series. The complementary standards should deal with the aspects listed below.

Aspects that are not sufficiently incorporated in the examined draft international standards:

- Stakeholder identification and participation
- Assessment of stakeholder needs and expectations
- Management of responsible bodies
- Management of relevant authorities
- Information management between entities
- Ownership management models
- Financing models with a focus on less developed countries
- Tools for environmental assessment and valuation
- Technical standards for several on-site sanitation technologies
- Situation analysis methods and tools
- Quality management of multi-criteria planning and design
- Quality management in implementation of construction works, campaigns and institutional adaptations
- Conditions and adaptations for the application of standards in less developed countries
- Sanitation and hygiene (as only wastewater is explicitly dealt with in the examined standards)

If complementary standards will not be created, a thorough review of the draft international standards is necessary. Special emphasis should be given to the incorporation of aspects from the list above, assuring that the service to users, the management of systems and their assessment consider all aspects and impacts they have on the community, on other stakeholder and their environments.

The revision of the standards should be done following a clearly structured process. A proposal for the revision process is given below.

Possible procedure for reviewing the standards:

- Assure participation of all interested and concerned parties, especially developing countries and their representatives, in the revision process
- Consult organisations and institutions that have experience with innovative solutions for the water and sanitation sector
- Start with a holistic vision: Make a comprehensive analysis of the water and sanitation sector, its aspects, problems, objectives, potentials and their relations
- Define the role that standards play in this system - analyse how the standards can help to improve the global water and sanitation situation. Keep an eye on potential blocking of competition and innovation caused by standards
- Define the limits of standards and according national premises that are necessary to lay the foundations for effective and advantageous application of standards
- Formulate requirements and business plans for a comprehensive series of standards
- Assess which additional standards, e.g. for situation analysis, stakeholder participation, planning, quality management, assessment, monitoring and evaluation, could be necessary or helpful
- Define all aspects of water and sanitation systems and their relations to other sectors and related issues
- Formulate related components, objectives, guidelines, assessment criteria and performance indicators

(Possible procedure for reviewing the standards: continued)

- Check coherence between sector analysis and findings
- Adapt the standards accordingly

The business plan for the standards, and even the introductions to the standards themselves, draw a quite comprehensive perspective of the problems and the needs of the water and sanitation sector. Some of these ideas also appear in the annexes, but with informative character only. The main content of the examined standards is missing this truly holistic perspective, as most of the relevant aspects of water and sanitation systems are not mentioned in a comprehensive and coherent way.

This is especially true for the concepts of reduction of consumption, re-use and the integrated protection of the environment. It is neglected, that these concepts have the potentials to lead to more effective, efficient and easier manageable solutions. It should be stated clearly, that every action taken for the environment is primarily in favour of people living now and their future generations.

The use of the term "drinking water" instead of "water supply" limits the scope of the standards as well as the consideration of "wastewater" instead of "sanitation".

Many points in the standards (for example the utilities relation with responsible bodies and relevant authorities or environmental and sustainability aspects) are described in too general ways, allowing too much space for interpretation.

The standards are focusing on highly sophisticated utilities as they can be found in developed countries and regions where they typically manage piped, centralised systems. Most of the users of water and sanitation systems on the global scale however, are not connected to such systems. It is not adequate for an international standard to limit the consideration of other systems to the following and other similar statements: "*These conditions may limit the achievement of some objectives or restrict the implementation of some provisions of the standards in developing countries.*" (ISO/DIS 24510 (2006), ISO/DIS 24511 (2006) respectively ISO/DIS 24512 (2006)), and: "*Some guidelines may not be applied because of varying degrees of economic development*" (ISO/DIS 24511, 2006).

The examples of performance indicators presented in the reviewed standards do not allow for a comprehensive assessment of water and sanitation systems. Examples for more ample performance indicators should be given (e.g. the reduction of diseases that are related to water supply and sanitation). Qualitative indicators should be considered too, because they have the potential to reveal deficiencies that are difficult to detect with quantitative indicators.

The classification of components for on-site and off-site systems does not follow clear a criterion, leading to misunderstandings about technologies and their applicability. In the standard for wastewater for example, reed beds are mentioned as off-site technologies only.

The standard for wastewater does only mention basic on-site technologies: the single choice between pit latrines and tanks for on-site collection equipment is not adequate. The imprecise definition and non-consideration of other existing technologies can have fatal consequences for the whole water and sanitation sector. Technologies that are not mentioned in the standards have to fear international disrespect, even if they are practical and reasonable. Important innovations could be delayed. Moreover, the sense of sanitation technology mixes and the succession of technologies to fit for different settlement and population structures as well as the institutional, economic and environmental situation and their development, is not considered sufficiently.

It has to be clearly stated, that in many cases, equal levels of service quality can be reached with different technologies and efforts. The service to users should not be limited to providing excellent service. It should also consider the efforts that have to be taken and the effects they have on users and other stakeholders living conditions and environments.

The standards under-estimate the importance of institutional set-ups and backgrounds. As they disregard essential related aspects, they make themselves only applicable to well-established institutional systems. To give only one example, the aspects of weak executive authorities and legal systems, impeding the sustainable management of centralised systems, are missing. Clearer definitions for utilities, the responsible bodies and relevant authorities should be made,

including the definition of their functions and policies, statements about their fundamental importance in the water and sanitation sector and the importance of continuous cooperation between these institutions.

The multiple relations between stakeholders and water and sanitation systems are not considered sufficiently in the examined standards. In relation to a utility and its respective institutions and private sector companies, one single resident can be user, taxpayer, employee, and a person whose health and welfare is affected by changes in the environment.

The importance of the user's behaviour for the whole system, and the utilities possibilities to promote the reduction of water consumption, for example by the use of technologies with increased water efficiency, etc, is not sufficiently mentioned.

The standards do not clearly point out their applicability to emergency situations and emergency service supply, even though they could be useful guidelines for such situations.

There is a certain risk in the application of these standards if private companies from richer countries take them as only reference document when operating utilities in developing countries, assuming that their compliance is sufficient for sustainable and long-term functioning of the system. The fact that the initiative for this standard came from France, where the biggest international water and sanitation companies are based, does not set an ease.

The three standards need harmonisation. It is obvious that different groups have participated in their development. Similar contents need similar appearance throughout the standards.

8. Summary and outlook

The International Organization for Standardization ISO is currently developing three standards dealing with the management of water and sanitation systems, the service to users and their respective assessment.

The three actual draft international standards (DIS) are:

ISO/DIS 24510 "Service activities relating to drinking water and wastewater – Guidelines for the improvement and for the assessment of the service to users" (ISO/DIS 24510, 2006)

ISO/DIS 24511 "Service activities relating to drinking water and wastewater – Guidelines for the management of wastewater utilities and for the assessment of wastewater services" (ISO/DIS 24511, 2006) and

ISO/DIS 24512 "Service activities relating to drinking water and wastewater – Guidelines for the management of drinking water utilities and for the assessment of drinking water services" (ISO/DIS 24512, 2006)

The contents of these standards are facing a lot of criticism, mainly arising from NGOs and representatives from less developed countries, saying that in many cases, theses standards are not very practicable and do not lead to favourable solutions. They further criticise that many technologies currently used are not mentioned in the standards and that these technologies could therefore fall under disregard.

These criticisms gave reason to this thorough examination of the draft international standards. It is the aim of this work to detect deficiencies and the potentials for the revision of theses standards. This is achieved through a comparison between the contents of the standards and the findings of a comprehensive approach to the water and sanitation sector.

In a very first step, standardisation in general is discussed. Then the contents of the three draft international standards are presented briefly.

In a next step, definitions for water and sanitation are given. Classifications for phases and aspects of water and sanitation systems, for stakeholder and institutional aspects lay the basis for further investigations.

Three tools are applied, in order to draw a concise but comprehensive sector perspective. The first one is the logframe analysis, or logical framework approach LFA, a very powerful planning and assessment tool. Starting with an ample "problem analysis" of problems arising in different aspects of water and sanitation systems, general objectives and purposes of theses systems are deduced in the "objectives analysis". The logic of how these objectives and purposes can be reached (called "intervention logic") is finally presented in the so-called "logframe matrix", where "activities" lead to "results", which again lead to the "operation purpose" and finally the "overall objectives". The logframe matrix is an intuitively understandable table, where "objectively verifiable indicators" for the achievement of the activities, results, operation purpose and overall objectives and related "sources of verification" are indicated, as well as necessary assumptions are made about external factors that influence their achievement.

In a second step, the set of performance indicators mentioned in the logframe matrices, there called "objectively verifiable indicators", is amplified. The structure of the logframe analysis serves as framework for their formulation and the performance indicators are tailored to reveal the achievement of objectives defined in the logframe analysis. Many performance indicators found are of qualitative nature.

Thirdly, present water and sanitation technologies for different components of water supply and sanitation systems are introduced briefly. This technological overview is needed to assess if all technologies are mentioned in the draft international standards.

Finally, the contents of the standards is compared with the findings of the comprehensive perspective created before (through the logframe analysis, the formulation of performance indicators and the listing of actual water and sanitation technologies), revealing potential for their revision. The revision of the standards would be advisable because (i) many relevant aspects of water and sanitation

systems are not represented in a comprehensive and coherent way, (ii) some parts of the standards are described in too general ways, (iii) they mainly refer to sophisticated and well-established piped systems, (iv) they do not mention performance indicators that allow for a comprehensive assessment of the effects of water and sanitation systems, (v) they do not mention some sanitation technologies currently utilised, (vi) they under-estimate the importance of the institutional background and set-up, (vii) the multiple relations between stakeholders and the systems are not clearly indicated and (viii) harmonisation between the three draft standards is necessary.

Concerning an **outlook** on the topic, a lot of further investigation on all aspects of water and sanitation systems and their relations is necessary, in order to draw a detailed and comprehensive perspective of the sector. Additional discussions about decision support systems, assessment and benchmarking initiatives, private sector participation, integrated water resource management, etc and, finally yet importantly, international standards will contribute to an increasingly comprehensive sector view. The further development of standards for managing purposes rather than for technical specifications will also require a new definition of the responsibilities and duties of standardisation organisations and governments. A lot of effort will still be necessary to find a broad international consensus, including the opinion of less developed countries, about the relevance of aspects and objectives in water and sanitation systems. All stakeholder need to focus on these objectives if they want to carry on innovation, and in this case substantial changes in the sector can be expected.

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