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Planning support for water supply and sanitation in peri-urban areas

Planeringsstöd för vatten- och sanitetssystem i peri-urbana områden

Rebecka Törnqvist

ABSTRACT

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There are billions of people around the world without access to adequate water supply and basic sanitation which are fundamentals for an acceptable livelihood. Large numbers of the unaccounted for these services are living in peri-urban areas at the fringe of the city due to the rapid urbanisation in the developing world. These areas have the characteristics of being inadequately integrated into the city with regard to social and institutional issues as well as for infrastructure services including water supply and sanitation systems. The aim of this report is to suggest a framework for supporting the challenging task of planning for sustainable water supply and sanitation systems in these areas.

Both a literature review and an interview study have been performed for considering this complex issue in a holistic way. The literature study consists of an investigation of the characterisation of the context in focus as well as an inventory of available support in form of models, software tools, frameworks and toolkits for planning is made. The supports found were evaluated with regard to consideration for a set of sustainability indicators for the peri-urban context. The support that was found most suitable for the context was used for developing a planning framework based on *the Strategic Choice Approach* either by contributing with important steps in the planning process or as supporting tools. This suggestion was further modified by considering aspects from interviews with experts in the field of water supply and sanitation in the developing world but yet with different backgrounds and perspectives.

The framework suggested can be seen as a starting point for how to approach the planning process in these intricate areas by showing supportive tools for the different modes of the planning process. The framework consists of five modes; *awareness raising, shaping, designing, comparing* and *choosing*. The first mode was added to the Strategic Choice Approach for better compatibility to the developing world and has the aim to increase the demand for these systems among the users. As the peri-urban areas are hard to define due to their difference in characteristic from one area to another and with time the shaping mode starts with a situation analysis for understanding the context specific challenges and key objectives. Possible alternatives of technology should be looked upon in an open minded way in the designing mode for finding the ones that are technically and socio-cultural feasible and thereby suitable for a specific location. In the comparing mode the feasible alternatives are compared with regard to health, environmental and economic aspects whereas in the final mode one alternative is chosen. The planning approaches and tools found in the literature as well as the experts interviewed, have different focus on the importance of participation and degree of complexity which points at the need for flexibility and the requirement for different tools for different situations. It is of certain importance to take account of the flexibility for the difference in backgrounds and amount of resources by the planners. The supporting tools to choose between are thereby of diverse complexity. One recommended development of this report is the performance of a case study. This could deepen the awareness of the possibilities and limitations connected to the peri-urban context. Hopefully, the report can nevertheless widen the views of the planners in aspect of possible tools to use and activities to perform when planning in the peri-urban context.

Key words: Peri-urban areas, planning support, sustainability, water supply, sanitation

Department of Information Technology, Uppsala University, Box 337, 751 05 Uppsala

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REFERAT

Planeringsstöd för vatten- och sanitetssystem i peri-urbana områden
Rebecka Törnqvist
Det är idag miljarder människor världen runt som saknar tillgång till de basala behoven av vatten och sanitet. På grund av den intensiva urbaniseringen i utvecklingsländerna är det ett vanligt förekommande problem i utkanten av städerna i s.k. peri-urbana områden. Dessa områden karaktäriseras av att vara dåligt integrerade i staden både i avseende på sociala och institutionella frågor såväl som i den urbana infrastrukturen, där vatten och sanitetssystem är en viktig del. Syftet med denna rapport är att ge ett förslag till viktiga steg i planeringsprocessen och verktyg som kan användas i dessa för att erhålla uthålliga vatten- och sanitetssystem i denna komplexa kontext.
En litteraturstudie såväl som en intervjustudie har utförts för att kunna ta hänsyn till många olika aspekter och perspektiv på ämnet. I litteraturstudien studerades problem kopplade till peri-urbana områden, internationella överenskommelser för att förbättra vatten- och sanitetssituationen samt olika typer av stöd för vatten- och sanitetsplanering. De senare utvärderades i avseende på målgrupp och kontext samt utifrån en rad uthållighetsindikatorer för att täcka miljö-, hälso-, sociokulturella, ekonomi- och teknikkriterier. De bäst lämpade planeringsverktygen för kontexten användes för att utveckla en modell för planering utifrån de olika planeringsstegen som rekommenderas i planeringsmodellen *the Strategic Choice Approach*. Förslaget modifierades sedan ytterligare med aspekter som påpekats i intervjustudien av experter inom ämnet men med olika bakgrund och angreppssätt på problemet.
Modellen i rapporten kan ses som en utgångspunkt för hur man närma sig planeringsprocessen i dessa komplexa områden genom att ge förslag på vilka hjälpmedel som kan användas för att ta hänsyn till en rad uthållighetsindikatorer. Modellen består av fem steg; *medvetenhet, formgivning, utformning, jämförande* och *beslutsfattande.* Eftersom peri-urbana områden är svåra att definiera på grund av de stora skillnader som råder mellan olika områden och med tiden, bör planeringen utgå från den lokala kontexten och dess problem i formgivningssteget. Ett öppet förhållningssätt till vilka tekniker som är möjliga bör hållas i utformningssteget, för att hitta lösningar som är tekniskt och sociokulturellt möjliga i ett specifikt område. Därefter bör dessa alternativ jämföras i avseende på hälso-, miljö och ekonomiska aspekter som underlag för att slutligen kunna diskutera och besluta om vilket alternativ som är det mest lämpliga. Stora skillnader i avseende på hur stor vikt som läggs på medverkande av användare samt i grad av komplexitet kunde märkas mellan planeringsstöden och mellan medlemmar i intervjugruppen. Denna mångfald av synsätt på planering pekar på nödvändigheten av flexibilitet och behovet av olika typer av hjälpmedel för olika situationer. Det är av speciell stor vikt att ta hänsyn till skillnader i bakgrund och tillgång till resurser mellan olika grupper av planerare. Modellen tar hänsyn till detta genom att de rekommenderade verktygen är av olika komplexitet och planeraren är fri att välja de som passar bäst till den aktuella situationen. Förhoppningsvis kan denna rapport vidga planerares synsätt på möjliga verktyg att använda och hur planeringsprocessen av vatten- och sanitetssystem i peri-urbana områden kan gå till. En rekommenderad utveckling av rapporten är att utföra en fältstudie för att fördjupa kunskapen om möjligheter och begränsningar kopplade till den peri-urbana kontexten.

Nyckelord: Peri-urbana områden, planeringsstöd, vattensystem, sanitetssystem, uthållighet

Institutionen för informationsteknologi, Uppsala Universitet, Box 337, 751 05 Uppsala
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PREFACE

This master thesis was done for Ecoloop AB and within the Cluster Group on Water and Sanitation in Peri-urban Areas at the Swedish Water House. The master thesis is a part of the M.Sc. Education in Aquatic and Environmental Engineering at Uppsala University and covers 20 Swedish academic credits. My supervisors were Dr. Anna Norström and Dr. Erik Kärrman at Ecoloop AB and my subject reviewer were Professor Bengt Carlsson at the Division of Systems and Control at the Department of Information Technology at Uppsala University.

I would like to thank Ecoloop that has made it possible for me to work with such an interesting and motivating subject as a perfect ending to my university studies. Thank you Anna and Erik for your knowledge, time and inspiration which were crusial for accomplish this report. Thank you Bengt for your suggestions and support.

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Rebecka Törnqvist

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POPULÄRVETENSKAPLIG SAMMANFATTNING

Planering av uthålliga vatten- och sanitetssystem i peri-urbana områden
- en fråga om hälsa, miljö och utveckling
Rebecka Törnqvist

Vatten- och sanitetssituationen är långt ifrån acceptabel i många delar av världen. Så många som en miljard människor saknar i dagsläget tillgång till rent vatten och sanitetssituationen är ett ännu större problem, då 2,6 miljarder människor inte har tillgång till någon typ av toalett. Denna brist på det som vi i vår del av världen ser som vardagliga självklarheter leder till många livshotande sjukdomar och minskar tid för skolgång och arbete. Mycket behövs göras för att förbättra denna situation som hotar att bli än mer omfattande på grund av klimatförändringar och efterföljande naturkatastrofer.

Många av dessa människor utan tillgång till rent vatten och sanitet bor i områden i utkanten av de ständigt växande städerna i utvecklingsländerna, i så kallade peri-urbana områden. Dessa områden glöms ofta bort av staden när arbetet för att få en förbättrad vatten- och sanitetssituation ska diskuteras. Svårigheterna uppstår på grund av dess osynliga läge mitt emellan stad och land och den ofta rådande resurssvagheten bland befolkningen i fråga om ekonomiska förhållanden såväl som brist på legalitet. Utöver detta, leder trångboddhet, dåliga markegenskaper och ständig in- och utflyttning i områdena till att planeringen av infrastruktur blir mycket komplex i dessa områden och förutsätter genomtänkta val av metoder och planeringsverktyg.

I mitt examensarbete har jag utgått från ett antal uthållighetsindikatorer för miljö, hälsa, ekonomi, sociokulturella aspekter samt för teknikaspekter för att komma åt de problem som är kopplade till dessa områden. Utifrån dessa aspekter och med hjälp av olika typer av planeringsstöd som redovisas i litteraturen har jag utvecklat ett förslag till en planeringsmodell för hur man kan närma sig denna uppgift. Till varje moment i planeringsprocessen rekommenderas ett antal hjälpmedel i form av t ex checklistor, databaserade modeller, standardiserade metoder för att undersöka miljö och hälsa men även att utveckla arbetssätt för ett ökat deltagande bland de framtida användarna.

Mitt förslag till planeringsmodell utgår från att de framtida användarna är delaktiga och kan uttrycka en efterfrågan efter en förändrad vatten- och sanitetssituation, vilket kan ses som ett av de viktigaste kriterierna för att uppnå uthålliga system som används och underhålls. Dessutom poängteras vikten av att utföra en ingående situationsanalys över lokalsamhället och dess anknytning till staden för att identifiera vilka förutsättningar för planeringen som råder. Hur ser den aktuella vatten- och sanitetssituationen ut? Äger folk sina bostäder? Hur ser hälsosituationen ut? Finns det kulturell acceptans för alla typer av toaletter? Har folk råd att betala för vatten? Av vilken kvalitet är mark och vatten? Detta är viktiga frågor att få svar på för att kunna göra en bedömning av vilka typer av system och lösningar som är möjliga att välja bland.

Det krävs även att alla som berörs av planeringen har liknande förväntningar på vad för typ av system som kan anses acceptabla. Det kan därför vara till stor hjälp att gemensamt sätta upp kriterier för vad möjliga alternativ ska uppfylla. Det är viktigt att titta på möjliga system på ett öppet sätt för att inte allt för snabbt välja bort sådana som kan anses olämpliga i den rent urbana eller rurala situationen men som kan fungera i ett mer sammansatt peri-urbant område. Olika typer av system måste sedan grundligt undersökas för att bestämma om de är möjliga att

implementera i det specifika området med beaktande av tekniska, fysiska, sociala och kulturella egenskaper. Möjliga system jämförs sedan med varandra utifrån deras konsekvenser på miljö, hälsa och ekonomi. Därefter är det dags för det slutgiltiga beslutet, där det ska bestämmas hur de olika kriterierna bör viktas, för att hitta ett lämpligt alternativ som så många som möjligt av de inblandade är överens om.

Syftet med den modell jag har utvecklat är att vidga planerares synfält på möjliga hjälpmedel som kan stå till buds inför en planeringsprocess av vatten- och sanitetssystem i peri-urbana områden. Olika planeringssituationer kan dock kräva helt olika uppsättningar av hjälpmedel beroende på skillnader i utgångspunkt och resurser. Modellen ska därför ses som ett flexibelt förslag där planeraren ges en färdväg att följa, men är fri att välja och vraka bland rekommenderade hjälpmedel för att hitta en planeringsprocess som passar för det specifika området som ska utvecklas.

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LIST OF ABBREVIATIONS AND GLOSSARY

ADB	Asian Development Bank
AISUWRS	Assessing and Improving the Sustainability of Urban Water Resources and Systems Project
BOD	Biological Oxygen Demand
CEE	Central and Eastern Europe
CHIAT	Chemical Hazard Identification and Assessment
CLTS	Community Led Total Sanitation
CIS	Commonwealth of Independent States
COD	Chemical Oxygen Demand
DEPA	Danish Environmental Protection Agency
DFID	UK Department for International Development
FAO	Food and Agriculture Organization of the United Nations
GWP	Global Water Partnership
HCES	Household Centred Environmental Sanitation
IWA	International Water Association
IWRM	Integrated Water Resource Management
JMP	Joint Monitoring Program for Water and Sanitation
LCA	Life Cycle Assessment
LFA	Logical Framework Approach
MCDA	Multi Criteria Decision Aid
MDGs	UN Millennium Development Goals
MDG 7:10	UN Millennium Development Goal 7 target 10
MFA	Material Flow Assessment
MRA	Microbial Risk Assessment
NAIADE	Novel Approach to Imprecise Assessment and Decision Environments
NRSP	Natural Resource System Program
O & M	Operation and Maintenance
OECD	Organisation for Economic Co-operation and Development
OWP	Open Wastewater Planning
PPP	Purchasing Power Parity
PROMETHEE	Preference Ranking Organisation Method for Enrichment Evaluation
SCA	Strategic Choice Approach
SEESAW	Socio Economic and Environmental Sustainability Assessment of Urban Water Systems
SEI	Stockholm Environmental Institute
SIDA	Swedish International Development Cooperation Agency
SIs	Sustainable Indicators
SIWI	Stockholm International Water Institute
SMART	Simple Multiple Attribute Rating Technique
STRAD	Strategic Adviser
SWARD	Sustainable Water Asset Resource Decision
TOR	Terms of Reference
UNDP	United Nations Development Programme
UN-HABITAT	The United Nations Human Settlements Programme
UNICEF	United Nations Children's Fund
UNCSD	The United Nations Commission on Sustainable Development
URWARE	Urban Water Research Model

WHO	World Health Organisation
WSP	Water and Sanitation Program
WSS	Water Supply and Sanitation
WUP	Water Utility Partnership

1. INTRODUCTION

1.1 BACKGROUND

Water and sanitation are fundamental for human life. Water is an absolute necessity for life and adequate sanitation contributes to a tolerable life situation for many exposed and vulnerable people. In addition do clean water and sanitation hinder occurrence of life threatening diseases like diarrhoea, intestinal worms, typhoid, cholera etc. The United Nations Development Programme, UNDP, publishes an annual report called Human Development Report and the report for 2006 is titled *"Beyond scarcity: Power, poverty and the global water crisis"* and are discussing the subject of the lack of water supply and sanitation in the developing world. This emphasises the international interest for considering this important issue and for making an improvement of the present situation.

Around the world there are about 2.6 billion people who do not have access to adequate sanitation and over one billion who lack access to clean water (UNDP, 2006). UNDP sees a clear connection between this major lack and the ability to step out of poverty. Without a functioning water supply and sanitation system people spend a great amount of time collecting water for survival or being sick, due to inadequate drinking water or lack of water for hygienic purposes, time that would be better spent in labour or in school. This widens the inequity between social classes and gender, since it is often the women's and the young girls' duty to collect water. Quoting Robert N. Gakubia, Acting Director of the Water Services of the Ministry of Water and Irrigation in Kenya: *"You are poor, therefore you don't have water. You don't have water because you are poor"*.

The urbanisation rate is accelerating in many developing countries and the needs for expanded infrastructure services are urgent. If one compares this situation with the urbanisation process that took place in now developed countries during the industrial revolution there are many similarities that can be seen. The water and sanitation systems were then built into already existing cities as solutions for severe health problems like for example epidemics. Yet, during later urbanisation periods the economies in these countries were expanding throughout the process which led to an entirely different planning condition as water and sanitation services became a natural part to take into account when planning new parts of the cities. This is, as mentioned, not the case for many developing countries. Priorities are constantly needed to be done due to lack of resources. which in turn cause difficulties for national and regional governments to plan the growing cities in an adequate way. The consequences of this shortage of infrastructure arrangements are environmental as well as social stress (Biswas et al. 2006). Environmental degradation can affect water supply resources and thereby have an effect on human health as well. From a social point of view, urbanisation leads to major immigration into the cities and many people are thereby forced to inhabit informal settlements. This can contribute to insecure livelihood since the future is uncertain and the government often has no obligation to provide these areas with essential city services like water supply and sanitation.

Peri-urban areas are often major sites for this immigration and therefore strongly affected by this stress and continuous changes. In a simple way they can be described as the zones where the rural areas meet the urban. Systems for water and sanitation are often specifically planned and constructed for either urban or rural situations; the peri-urban interfaces are therefore often neglected or forgotten. Furthermore, as mentioned above, these areas often consist of informal or illegal settlements with inadequate infrastructure and other community services

(Paterson et al., 2006). These factors make the planning of sustainable water and sanitation systems in peri-urban areas an important and challenging issue. It is of great importance to analyse and discuss what aspects should be considered when planning a sustainable water supply and sanitation system in peri-urban areas because of its complexity.

1.2 THE AIMS AND OBJECTIVES OF THE REPORT

The aim of this master thesis is to suggest a framework for supporting the planning process of sustainable water supply and sanitation systems in peri-urban areas of the developing world.

A number of ways to support the planning are identified in the literature. These are used either as references for identifying important steps in the planning process or as tools for accomplish the aim of the steps. The support are thereby of different characterisation in the range of either having the framework characteristics, i.e. a suggestion of important aspects to consider for a successful planning process, to be software tools with the aim to enable the implementation of selected aspects.

There is a wide range of aspects that should be considered when choosing such tools for these intricate areas. To accomplish this in a holistic way, a literature study as well as an interview study is performed.

The framework should be seen as a suggestion for how to look at the planning process and provide the users with a set of tools for taking account of important sustainability aspects.

Key research questions:

- What do concepts like peri-urban areas, water supply and sanitation and sustainability mean in this context?
- Which problems and challenges are connected to planning water supply and sanitation systems in the peri-urban areas?
- Which sustainability criteria and indicators are of certain interest for the peri-urban context?
- What aspects should the planning process take into account and what tools can be used as support?
- In what way are the process for evaluating and choosing an adequate and sustainable water and sanitation system performed in these areas?
- How can one take into account local deviation and stakeholders' variation of resources and interests?
- What kinds of tools exist and what criteria must they include in order to being used in the peri-urban interface? What kind of tools is needed?
- Are there any software tools existing that are explicitly aimed for peri-urban areas? Are there other software tools available not explicitly aimed for these areas but which can nevertheless be applied here?

2. METHOD

2.1 THE WORKING PATH

Figure 1 shows the sequence of work for reaching the aim of the report; a suggestion for a planning framework for sustainable water supply and sanitation systems in peri-urban areas of the developing world. The working path for reaching this goal starts with a literature review for deepening the understanding of the context as well as identifying support for the planning process. The literature reviewed is in the form of articles, policy papers, books as well as information from organisation websites and university websites.

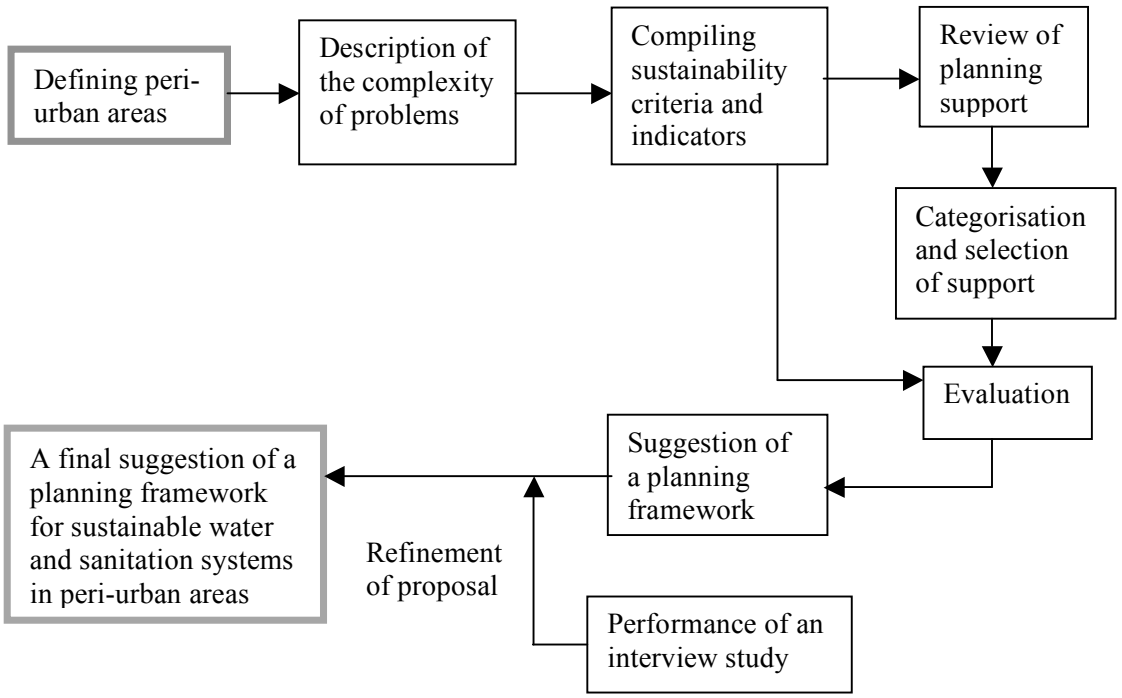


Figure 1: The working path from definition of peri urban areas to a suggestion of a framework for planning sustainable water and sanitation systems in peri-urban areas

After the suggested planning framework were developed, based on the findings in literature, experts in the water supply and sanitation sector in the developing world were interviewed about their views of planning water supply and sanitation systems in peri-urban areas. The new aspects and perspectives gained from the interviews were then used for adjusting the framework for improved suitability for the peri-urban context.

2.2 LITERATURE REVIEW

This project's result is highly dependent of an extensive literature study for insight into the subject and identification of existing planning tools. This study was performed by using university libraries databases and the internets assets in this topic. Policies and reports focusing on this problem from important organisations were reviewed as well as recommendations from researchers in the field.

The database that was used most frequently was *Science direct* which offers the publishing house *Elsevier's* range of periodicals, approximately 1800, in full text versions. Other repeatedly used databases were *Google Scholar, Environmental Sciences and Pollution*

Management and *Scirius*. Search words used in different combinations were peri-urban, urbanisation, water, sanitation, sustainability, tools, toolbox, indicators, criteria, planning, developing world, software tools etc.

2.3 EVALUATION OF PLANNING TOOLS

The evaluation of the planning tools was done in a sequence of steps. Firstly, the tools were categorised to enable the selection of the most suitable alternatives for this context. The selected tools were further analysed with regard to their consideration of sustainability criteria and indicators. This part of the evaluation provided the tools with greatest applicability for the peri-urban areas. Finally, these tools were utilized for developing a suggestion for a planning framework.

2.4 INTERVIEW STUDY

The interview study contained meetings with five experts in the field of focus but with different backgrounds such as WSS-consultants and program officers at development organisations. These were interviewed about their experience and thoughts about the planning of water supply and sanitation in peri-urban areas. The questions asked were not made in an absolute replicated way which implies that the results should be seen as qualitative rather than quantitative. The result were then evaluated and used in order to refine the suggested framework.

3. LITERATURE REVIEW

3.1 INTERNATIONAL PROGRAMMES AND POLICIES

Decision makers interest in the issue and willingness to contribute financial and competence resources for implementing the planning process are fundamentals for even starting the process. It is therefore of great interest to study international programmes and policies for improvements of the matter. These kinds of commitments can hopefully influence the governments in their prioritising of resources to these questions.

3.1.1 The UN Water Decade and the Millennium Development Goals

The decade from 1980 to 1990 was called the International Drinking Water and Sanitation Decade and had the goal to provide safe drinking water and adequate sanitation to all the people of the world by the year 1990. Reasonable access to water was then defined as within 500 meters reach and adequate sanitation as some technology between the pit latrine and the more advanced water flush toilet. The World Bank then estimated that the target group consisted of approximately 3 billion people. The UN Water Decade prioritised the rural population and the crowded urban poor (Schiller and Droste, 1982). The peri-urban residents could be included in the latter group and consequently if the goal was reached there should not be any water or sanitation problems in these areas. This was obviously not the case for this very ambitious but difficultly reached goal. Yet 1.2 billion people got access to water and 770 million people received access to sanitation during this decade. Lessons learnt from this work were the need for country specific work and that more time and more capital were needed for reaching the targets (The Global Development Research Centre, 2007).

Even though the UN Water Decade did not reach its ambitions, it certainly helped towards putting the problem of inadequate water and sanitation on the agenda for international politics (Biswas et al., 2006). In the year 2000 the world's leaders united behind a new international collaboration titled the UN Millennium Declaration with eight goals. The core of this declaration was to reduce poverty and hunger by using sustainable methodologies. Goal number seven target ten focuses specially on water and sanitation and quotes: *"Halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation"* (UN Millennium Project, 2007). There are as many similarities as divergences between the UN Water Decade and the UN Millennium Declaration. Two fundamental differences are the number of people taken into account (all vs. half the population) and the amount of time (a decade vs. 15 years). Another interesting difference is the fact that the newer program did not include sanitation from the beginning (ibid.). The sanitation criterion was first added after the Johannesburg summit in 2002 which can be seen as an example of the low priority that sanitation has compared to water supply.

Summarised, one can say that the MDGs should be an easier assignment to achieve than the UN Water Decade. Yet it is still far from an unchallenging task to reach them. In real numbers this means that, counted from august of 2005, there has to be sanitation improvements in 65 households per minute to successfully reach the goals. It should be emphasised that the urban and peri-urban households are in majority (SEI, 2005).

3.1.2 Water for life

The United Nations General Assembly has declared the years from 2005 to 2015 as the decade for action, named *"Water for life",* for fulfilling the MDG and other water related

international commitments. For reaching this they have set up five targets and proposed ways for reaching those (WHO & UNICEF, 2005).

- *Meeting basic sanitation demand:* Focus should be laid on policy making, legalisation, and regulation and to mobilize financial resources for enabling improvements. There should also be attention towards increased education and information distribution about the issue. When choosing a technology consideration has to be put on costs, gender, equity and environmental aspects.
- *Significantly increasing access to safe drinking water:* For this target emphasis should be laid on affordability, continuity of services and the quality and quantity of the water. It is of great importance to identify the households where most effort has to be done. This can be done by classifying households with aspects of distance to water, volume and quality of the accessible water.
- *Promoting household water treatment and safe storage:* This can be seen as a temporary substitute to centralized water treatment while waiting for a connection. Some appropriate technical alternatives can be chlorination, solar disinfection, filters or combined flocculation-chlorination powders.
- *Ensuring more health for the money:* This means that the investments for improved water supply and sanitation, WSS, should include both initial investments and continuing costs like operation and maintenance.
- *Focusing on changing key hygiene behaviours*

3.1.3 UN HABITAT's Water and sanitation programme

The United Nations Human Settlements Programme, UN HABITAT, Water and Sanitation programme's main intention is: "*improving access to safe water and helping provide adequate sanitation to millions of low-income urban dwellers and measuring that impact"* (UN HABITAT, 2007). The programme is based on two regional programmes for Asian and African cities but with similar key objectives. These are:

- Improved sanitation for the urban poor and community participation in delivery and management of sanitation services
- Pro-poor governance with the aim to give the poor an opportunity to be involved in the decision-making towards improved access of water supply and sanitation
- Urban Catchments Management with the aim to protect water resources
- Water Demand Management with the aim to improve water service delivery
- Water education in schools and communities
- Advocacy, awareness raising and information exchange with the aim to enhance political will and support
- Gender Mainstreaming with the aim to include women at all levels of the water and sanitation improvement process
- Training and capacity building for professionals at different levels in the utilities

The programmes have the MDGs and World Summit of Sustainable Development water and sanitation targets as an over all goal.

3.1.4 Sida's policies

Sida's *Strategy for Water Supply and Sanitation* (2004) should be supporting the decision-making process when working with issues considering water supply and sanitation in the developing world. Their main motive for supporting these issues is the improvement of the

livelihood of the poor that comes in tow with a change in the water supply and sanitation situation (SIDA, 2004). However they also consider other important issues that come in tow with their main objective. These are environmental sustainability, improved health, democratic governance and economic development. Sida focuses its work on certain key areas where water supply, sanitation and hygiene promotion in urban and peri-urban slums is one among them. In this report peri-urban slums are defined as *"dense, informal and unplanned settlements that make up an administrative boundary between municipal and rural zones"* (SIDA, 2004 p.9). They emphasise on the very different aspects for technology choices, investment structures, timetables and institutional arrangements that need to be considered.

Sida's strategy paper discusses a large quantity of principles and approaches that should be considered when making investments in this area. These are of social, economic, environmental, technical, financial and institutional views. Some of the most relevant principles named in the report are:

- Water, sanitation and hygiene should be considered at the same time in the social, spatial and environmental planning in both rural and urban areas.
- Users should be participating in the planning, implementation, management and monitoring procedures of WSS-systems.
- Recycling of nutrients from urine and faeces is considered an important issue.
- There should be a possibility for rural and peri-urban communities to access loan financing from banks and other institutions for improving the water supply and sanitation situation.
- The delivery of these services should reach the slum areas which the city is responsible for.
- Tenure problems should be taken into account when working in low-income communities especially in urban and peri-urban slums as this is affecting the access to WSS-systems.

Sida also has a policy for supporting urban development titled *Fighting Poverty in an Urban World* (2006). In this policy document peri-urban areas are included in the term urban areas. Their over all objective is to contribute to the progress of achieving sustainable cities. To obtain this they will for example support the local governments with tools for planning the urban areas in an efficient way and support them in expanding the infrastructure, including water and sanitation, in a pro-poor and sustainable way.

3.1.5 UNICEF's water and sanitation strategy

UNICEF has a water, sanitation and hygiene strategy for the years 2006-2015. Its main objective is to focus on "*the children's right for survival and development through promotion of the sector and support to national programmes that increase equitable and sustainable access to, and use of, safe water and basic sanitation services, and promote improved hygiene"* (UN Economic and Social Council, 2006, p. 1) . In addition to the MDG 7:10 they emphasise on the importance of adequate WSS services in all schools. Priority should be laid on 60 countries with especially high child mortality (ibid.).

3.2 DEFINITIONS

It is of great interest to study the construction of concepts and variety of definitions for central keywords in order to get a broader understanding of their role in a certain context. In this section an identification of what different actors in the field, like organisations and researchers, mean by three concepts which are both vital and difficult to define: peri-urban areas, water supply and sanitation and sustainability.

3.2.1 Peri-urban areas

There is no universal or consensus based definition of peri-urban areas. The Food and Agriculture Organization of the United Nations, FAO, defines it as the connection between rural and urban areas whereas the United Nations Children's Fund, UNICEF and the World Bank see them as newly urbanised areas at the city fringe (Mbiba, 2002). A peri-urban area is far from a homogeneous area since it is often a patchy area with a widely varying degree of urbanisation in the different sub-areas. This implies great differences in land-use. Some areas can even be seen as an additional part of the city and can have the great opportunity to be connected to the urban infrastructure (McGregor et al, 2006). There are also major variances between different peri-urban areas of approximately the same size. These aspects emphasise the difficulty in defining these areas in an uncomplicated way.

Furthermore, these areas can be viewed in a much wider remark than just considering their spatial location as areas at the fringe of the city. These areas function change with time and are a natural meeting place for inhabitants from both the city and the countryside. They are far from static since they are heavily influenced by dynamic flows of people, natural resources (including water), capital etc. (Ducrot et al.2004). The UK Department for International Development, DFID, has for example defined the peri-urban interface as areas with strong influence of the urban context and with great quantity of labour supply, but at the same time influenced by shortages of land, risk situation from pollution and urban growth in their Natural Resource System Program, NRSR (McGregor et al, 2006). This stresses the functional aspect of the peri-urban concept and considers both economics and social relationships. Several definitions put emphasis on the co-existents of rural and urban areas and activities. Among the spokesmen behind this view, SIDA is an important actor (Farrington et al, 2002).

Iaquinta and Drescher (2000) refer to the broad definition of urbanisation which stresses three major components: one demographic, one economic and one social-psychological. They have seen in their study of definitions of peri-urban areas that these components are of great importance when focusing on proximity to the city when defining the areas. For the peri-urban interface the demographic component will be focusing on the increasing population size and the greater density that occurs in the growing cities in the developing world. The economic component refers to the change from mostly agriculture to non agriculture labour. Finally the social-psychological component illuminates the change in lifestyle that moving into an urban area contributes to. These changes can for example be of attitudes and behaviour.

Finally, in this context and for this report a peri-urban area will be defined in a descriptive way as an area where the residents are dependent of the city's economy rather than rural activities. Even though they can be seen as a labour market for both formal and informal economies in the city, they are not prioritised in means of basic services like water and sanitation. Furthermore these areas are inadequately integrated into the city and the local governments are often not legally obligated or interested to improve WSS-issues.

3.2.2 Water supply and sanitation

For the definition of water supply and sanitation, focus has been laid on the MDGs and associated organisations. There obviously exist broader and more universal definitions of this concept but in this context the MDGs are of great importance because of the many, both developing and developed countries that support them. For example the Stockholm International Water Institute, SIWI, mentions a list of aspects that could be considered when

defining sanitation (SIWI, 2005). Among them are safe collection and treatment of wastewater, management of solid, industrial and hazardous waste, drainage of household water and storm water and treatment of sewage effluents. The definition is of normative type since it may be of greatest interest to focus on what can be seen as tolerable sanitation.

As mentioned in chapter 3.1, the MDG 7:10 states: *"Halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation"* (UN Millennium Project, 2007). The indicators that need to be monitored for successfully reaching the target are:

1) the proportion of population with sustainable access to an improved water source.

2) the proportion of population with improved sanitation.

This should be examined in both urban and rural areas (ibid.).

The World Health Organisation, WHO, and UNICEF have created the Joint Monitoring Program for Water and Sanitation, JMP, and are charged by the UN to be responsible for monitoring the data related to target number ten. They have classified technologies that they consider will lead to improved or not improved water supply and sanitation when used. Their concluded criteria can be seen in Table 1.

Table 1: JMP's criteria for improved respectively not improved water supply and sanitation (Modified from JMP, 2007).

	Improved	**Not improved**
Water supply	Protected dug well Protected spring Borehole Household connection Public standpipe Rainwater collection	Unprotected well Unprotected spring Vendor-provided water Bottled water Tanker truck-provided water
Sanitation	Connection to a public sewer Connection to septic system Pour-flush latrine Simple pit latrine Ventilated improved pit latrine	 Service or bucket latrines Public latrine Latrines with an open pit

The Millennium Project Task Force on Water and Sanitation, which is a symposium of experts in the field, has produced recommendations for reaching the goals. They define safe drinking water as "*water that is safe to drink and available in sufficient quantities for hygienic purposes"* and basic sanitation as "*the low-cost option for securing sustainable access to safe, hygienic and convenient facilities and services for excreta and sullage disposal that provide privacy and dignity while ensuring a clean and healthful living environment both at home and in the neighbourhood of users"* (The UN Millennium Project Task Force on Water and Sanitation, 2005, p. 9). These definitions are in some ways broader since they focus on the functions of the water and are less technical oriented. On the other hand JMP's criteria are easier to implement and monitor, which is the primary aim of defining them in this way.

Nevertheless, in this report it may be more interesting to use the Millennium Task Force definition for water supply and sanitation since it opens up for more flexibility when choosing

a sanitation system. The definition for this report will therefore be that adequate water supply is a quantity of water that covers both drinking and hygienic purpose and that adequate sanitation is an affordable, safe, convenient and cultural accepted alternative that contributes to a good environment both locally and for the surrounding area.

3.2.3 Sustainability

One of the better known and quoted definitions of sustainability, in this case more specific sustainable development, is stated in The Report of the World Commission on Environment and Development (1987), often called the Brundtland Commission and named *"Our Common Future"*. The definition quotes: *"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs"*. This definition has an obvious focus on how we ought to live and think with respect to future generations. The report also points out the importance of using resources in an appropriate way, equity and fighting poverty for achieving sustainable development.

Pierini (2005) has made a literature review on the definition of sustainability. He has noticed that after the Brundtland report the focus has shifted from the future generation and use of resources towards society, economics and environmental issues. Other concepts that have been noticed are institutional, equity, health and technology. SIDA's urban division includes economics, institutional, social and environmental aspects in its approaches, whereas FAO uses the concepts of future generations, use of resources, society, economics, institution and technology (ibid.). In EU's Sustainable Development Strategy there are four key objectives: environmental protection, social equity, economic prosperity and how to meet their international responsibilities. In addition they emphasise the importance of solidarity within and between generations as an association to the Brundtland's definition in their policy guiding principles (Council of the European Union, 2006).

Campbell (1996), at the urban planning department of Rutgers University, USA, discusses the concept of *The Planner's Triangle* with the three pillars of sustainability: economy, environment and social-equity, as corners (Figure 2). This triangle stresses the different and often contradictory issues that must be considered when planning a city or a city-service. The planner gets diverse priorities depending on where in the triangle he or she stands. The goal for sustainable planning is to reach the centre of the triangle where one has a holistic view and where all aspects are taken into account. The sides of the triangle represent the conflict between the different pillars.

- The property conflict stresses the gap between social justice and economic growth. This question could easily be applied in peri-urban areas where a great percentage of the population is living in poverty and in many cases in illegal settlements. In these areas there is no guarantee that the poor inhabitants get any advantages from economic growth due to activities in their neighbourhood. They do not have the opportunity to use the services or capital that comes from the land-use that leads to economic growth.
- The resource conflict emphasises the boundary between the urban and the "unexploited" rural zones. In the peri-urban areas this conflict is of great importance when the city expands, coming with pollution and industries in tow. In these areas there are continuous changes in land-use for agriculture or non agriculture activities.
- The final conflict is about development and is obviously of major importance for these areas. In this aspect there is a great gap between the developing and the developed world. This divergence leads to most complicated questions. What right has the richer part of the world to force the poorer parts to protect the environment instead of letting more people

live a good life? Should the West help the developing world to not commit the same environmental mistakes as they have done? The climate crisis and its stress on reducing the use of fossil fuels is a very good example for this type of questions. On the other hand, social justice can lead to bigger opportunities for poor countries to improve environmental protection. Quoting Campbell: *"Economic segregation leads to environmental segregation"* (p. 299).

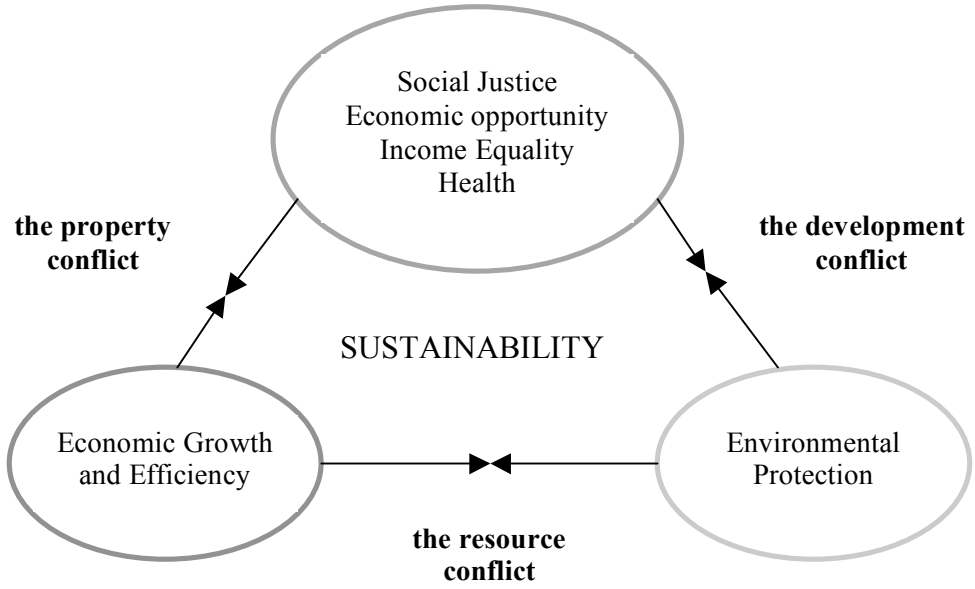


Figure 2: The planner's triangle where the three corners represent the three pillars in sustainable planning and the sides the conflicts between them (Modified from Campbell, 1996).

Addressing the sustainability concept in the peri-urban areas is a difficult task because of the continuous change and need of flexibility. When defining a sustainable water and sanitation system in these areas the three sustainable pillars should be included considering them to be the most used aspects when defining sustainability. Yet the economic aspect may be more focused on the stakeholders and the infrastructure investor's affordability for these services than the economic growth feature. For the social aspect there may be an extension for concerning the cultural and religious norms that are fundamental for the involvement of the communities in handling human excreta as well. Additionally, health and technology aspects are of great importance for these areas. The health aspect is of immense importance for these areas where pathogenic micro organisms from human excreta are frequent and the settlements are crowded with following high infection risks. A sustainable water and sanitation system must consequently be highly health oriented in these areas for reducing numerous human excreta related diseases. Finally the technology aspect should consider all the previous criteria for being functional in these complex areas. It must deal with many challenges like difficult soil and terrain conditions, high population density, poor communities and in many cases working with an area overlooked by the government.

To sum up, in this report the key aspects for sustainability fall within economical, socio-cultural, environmental, health and technical categories. From now on are these named criteria and is the same set as the Urban Water Programme uses (Malmqvist et al., 2006). It should be pointed out that it can be hard to take all sustainability criteria into account when dealing with

this type of a close to crisis situation. For example it can be necessary to overlook the environmental criteria when there are issues concerning life and death. Nevertheless should the overall goal and direction be to include all the features.

3.3 MAIN CRITERIA FOR SUSTAINABLE WATER SUPPLY AND SANITATION SYSTEMS

As mentioned in the previous section, the five criteria that should be taken into account for sustainable water and sanitation systems in peri-urban areas are of environmental, health, economic, socio-cultural and technical character. In this section these criteria will be further explored in order to identify their respective key problems in these areas.

3.3.1 Environmental criteria

In the majority of the peri-urban areas, human excreta and water-used for bathing and washing are directly disposed into the environment. Without any sort of wastewater treatment the wastewater ends up in the rivers, streams, canals and ditches (Hogrewe, 1993). This load of phosphorus, nitrogen, organic compounds and solids can lead to degradation of the aquatic life mainly through depleting oxygen which can harm flora and fauna.

Leaking inadequate sanitation systems can also contribute to contamination of ground water which can be a threat to human water supplies as well. In some areas in Africa, the aquifers are under more severe threat than in developing countries in Asia or South America. This is due to low permeability of the rock in many African countries which leads to shallow and thereby sensitive aquifers. Even though this leaking mainly originates from simple latrines, another source can be septic tanks that are not properly maintained (Formas, 2005).

For example in Ghana, a study by the World Bank showed that Kumasi, a city of 600 000 people, produced 24 100 cubic meters of faecal waste per month and of this 90 % reached the aquifers and streams untreated. In this case the population used, in descending frequency; public latrines, bucket latrines, WCs connected to septic tanks, pit latrines and no sanitation facility at all in this area (Hogrewe, 1993). The environmental effects of inadequate sanitation and lack of wastewater treatment can be a contributing reason for the decision makers to consider this problem as a serious issue that should be solved.

The population growth and the following exploitation and eventual over abstraction of groundwater aquifers can in some coastal areas lead to saltwater intrusion which is the case in Jakarta (Biswas et al. 2006). This is due to the move of saltwater freshwater interface towards land because of removal of freshwater. This can have severe affects on both eco-systems, where freshwater is a fundamental component, as well as to human water supplies (Domenico-& Schwartz, 1998).

3.3.2 Health criteria

There are numerous diseases connected to insufficient and unsafe WSS-systems. Micro-organisms in human excreta can contaminate drinking water due to inadequate sanitation whereas other diseases caused by bacteria or parasites can originate from lack of access to water for hygienic purposes. This emphasises the importance of both sufficient quality and quantity of water for improving health affects (Poverty Environment Partnership, 2006). UNDP (2006) has shown strong correlations between improved WSS and improved health. This relationship varies between countries and the standard of WSS-systems, e.g. flush toilets improve the health more than pit latrines. For the case of diarrhoea piped water in the house reduces the hazard by about 40% in Vietnam and by 70% in Ghana.

As mentioned above the untreated wastewater is disposed into the rivers which often are used as drinking and bathing water. This obviously leads to great health risks. Another risk characteristic of the peri-urban settlements is the dense population pattern which can contribute to hasten spreading of diseases, often in the form of epidemics like cholera. In these areas the density is often greater than 400 people per hectare (Hogrew, 1993). One of the most frequent sanitation linked infections is diarrhoea which causes 5000 deaths every day (Poverty Environment Partnership, 2006). Most of the deaths are among young children caused by shigella, known as bloody diarrhoea. This type of the disease is cured by antibiotic that often is too expensive for the poor. Other common WSS-connected diseases are typhoid, internal helminths, hepatitis A, E and F, legionellosis, cholera, trachoma, schistosomiasis, yellow fever and many more (Poverty Environment Partnership, 2006 and UNDP, 2006). Diseases that are frequent especially in poor urban settlements are coupled with intestinal parasites like roundworm and whipworm (Hogrew, 1993).

3.3.3 Economic criteria

For economic sustainability the WSS-system must be affordable for the stakeholders in aspect of the everyday water-use and for the providers in the installation, maintenance and operational phases. The latter aspect can favourably be secured by full cost recovery. If this is the main approach the providers must consider an appropriate way for making it affordable for everyone. There are different ways of achieving this by using subsidies and tariffs.

Subsidies that can be used in this context can be targeted for special low-income groups or be of cross-subsidies type. One important first step for the success of these two concepts is an adequate identification of the poor households. The concept of the first alternative is that the water-consumption is financed by the government for the poorest 20%, for example. The second idea is based on the shift of subsidies from wealthier to poorer households. The aim of these cross subsidies can be to extend the population with water connection. Yet there is a risk that the poorest are overseen because of legalization problems (UNDP, 2006). Some guidelines to consider when deciding target groups and activities for the subsidies can be to maximise the health benefits and spreading of the services by using a low basic standard and to gather information and survey what people in the area want and are willing to pay for (SIWI, 2005).

Regulation of tariffs is commonly used by the governments to improve equity. The idea behind block tariffs is that the cost of water mounts with increased consumption. The structure of the tariff system may vary between countries; however one pro-poor approach is to use a life line tariff which offers the volume for basic needs for a minor sum or for free. However this tariff system can lead to disadvantages instead of advantages for the poor. Standpipe operators, water vendors and truckers that are the major water suppliers for many peri-urban households buy the water at the highest price since their consumption is large. This leads to that the low-income population without water connection purchase the most expensive water by consequence rendering the intended pro-poor approach far from efficient. Another main problem is that this only benefits the small amount of household with a water connection where the water-use can be measured (UNDP, 2006).

In Lusaka, Zambia, block tariffs are being used. For the low-income peri-urban areas the cost is 21 600 Kwacha[1]/month whereas in the high income households the cost is 115 600

[1] One euro equals 533 000 Zambabwian Kwacha (2007-02-22).

Kwacha/month, the assumed consumptions are then 30 m^3/month for the former and 120 m^3/month for the latter. The service in the Lusaka peri-urban areas are paid for by cross-subsides from wealthier residential areas and commercial and industrial customers. This revenue system meets the maintenance and operation costs but not the cost for new connections. Like in many other peri-urban communities the households that buy water from the kiosk pay about five times as much as the richest households (Mwandawande, 2005).

3.3.4 Socio-cultural criteria

There is a wide range of issues that can be characterized as social or cultural. These can be seen as limitations for choosing a special WSS-system. By considering the issues, this can lead to three outcomes:

1. avoiding the system
2. adjusting the system
3. trying to persuade the consumers to change behaviours in favour of the system

For reaching social sustainability everyone within a society should have access to a WSS-system. This leads to questions about the settlements' legality from the government's state of view. If the peri-urban households are considered illegal, they may not qualify for formal services by the current laws and regulations. From another point of view a government can lack interest in improving the WSS-system for these areas as this can be a "proof" of legality of the housings (Mwanawande, 2005). The equity between income groups is questionable when they possess different opportunity grounds for being a part of the society and use its services. This tenure problem may also contribute to the low-income settlements' small interest in improving their WSS-situation as the households can not be sure whether they can stay for a longer time or not.

Cultural and religious aspects must be considered when dealing with such a sensitive and taboo connected issue as human excreta. A WSS-system that the stakeholders refuse to use or maintain is clearly unsustainable. It is of great importance that the sanitation systems are built with respect of social and cultural norms otherwise the residents of the community can simply reject using it. For example in India it is of tradition members of the lowest caste that should take care of this "dirty" task (Nationalencyklopedin, 1993). Another example is the Islamic religion that emphasises on cleanliness and avoidance of contact with human excreta. This taboo makes it hard to talk about the issue especially for women (Nawab et al., 2006).

This leads us to another important issue, the gender problem. It is often the woman's duty to collect water and she is also the main domestic water-user. Additionally it is often the women that in greatest extent prioritise the improvement of sanitation. Yet it is often men that are in charge of money and planning and the needs and priorities of the women can thereby often be overlooked. In addition it can be hard to talk about the subject of sanitation and excreta with men. In Pakistan it is a consensus based taboo that women should not talk about excreta and sanitation with men, not even within the family.

3.3.5 Technology criteria

When choosing a sustainable technology for these systems the issues in 3.3.1 to 3.3.4 must be taken into account. In this section there will mainly be an overview of pro-poor technologies that can be of interest as alternatives for peri-urban areas. The choice of technology is in many ways an important step for further planning of water and sanitation systems. Depending on the technologies, requirements for a functioning infrastructure and municipal services lead to different planning strategies. It is certainly a big challenge to find a WSS technology that is

suitable for the difficult physical conditions, the high concentration of people, the low-income majority of inhabitants and the reluctance by the government in improving the infrastructure for poor and illegal settlements.

Sanitation

The cities of the western world are mainly using sewages for their sanitation purposes. These systems are highly effective in removing excreta in a safe way and improve household hygiene which leads to a reduction in health hazards. During their historic progress these systems have gone from mainly being a health improving installation to taking environment into account as well. In the developing world, especially in the peri-urban areas, these systems are not found to the same extent. This is often due to the high costs, both for investments and maintenance. In strictly urban zones sewerage systems are more common. There are also some external costs connected to sewerage like the use of flush water when water is in scarcity and the loss of potential nutrient in excreta (Schiller & Droste, 1982).

Paterson et al. (2007) also agree that conventional sewerage is not a pro-poor sanitation technology due to the cost and requirement for big amounts of water. They highlight the simplified sewerage system as the only suitable alternative for peri-urban areas with aspect to economical and technical feasibility. These are sewerages with pipes with smaller diameter, shallower depth and flatter gradients than the conventional ones. Some difficulties that accompany the installation and operation of sanitation systems in the peri-urban areas are irregular arrangement with narrow streets, the frequency of informal or illegal settlements, the dynamic changes of the areas and their location on the most unattractive parts of the area with rocky and unstable ground. They discuss different on-site sanitation technologies that evidently can be pro-poor but often not suitable for these high density areas with inappropriate soil conditions. The advantages of using simplified sewerages instead of conventional are the reduced dimensions in pipe diameters and depths, the flexibility of the sewer network, reduced water requirement and the contributing low-cost.

If sewerages are too expensive or if the area lacks required infrastructure for sewerage, on-site systems can be an option, i.e. technologies that do not remove the excreta from the defecation-site. These systems are less expensive and require low degree of involvement from institutions and can thus be an interesting choice for peri-urban areas (Hogrewe et al., 1993). These low-cost technologies can be considered more or less satisfactory when it comes to health aspects and convenience. Some conventional and commonly used systems are simple pit latrine, vented improved pit (VIP) latrine, communal latrine, pour flush toilets and septic tanks. In the dense peri-urban settlements the two first options may be less suitable from a spatial point of view. These can also possess great health and environmental hazards as the excreta may contaminate closely situated wells, aquifers and groundwater (ibid.).

Communal latrines need less space, are inexpensive and need a small amount of water i.e. suitable properties for peri-urban areas. Yet it is not defined as improved sanitation by the JMP. This is due to the risk to become health threatening and pass on diseases when not being maintained properly. This leaves pour flush toilets and systems connected to a septic tank the two remaining and less inappropriate options. These alternatives are more expensive and water requiring than the formal on-site technologies but on the other hand safer in health aspects.

Ecological sanitation, often called Ecosan, is dividing the sanitation process with human excreta into three steps: containment, sanitization and recycling. The objective of this

approach is improvement in health and environment (SEI, 2005). In *"Ecological Sanitation. Revised and Enlarged Edition*" (SEI, 2004) a list of criteria that a sustainable sanitation system should meet can be found. The criteria are: disease prevention, environment protection, nutrient recycling, affordability, acceptability and simplicity. These systems adjust physiochemical factors, like temperature, pH and dryness, and biological factors, like adding other organisms to create good conditions for sanitizing human excreta. There are different Ecosan alternatives for systems in rural and urban areas and there are also different systems for the pathogen extinction: dehydration, composting and soil composting. For poor and high density areas in the city, and probably for peri-urban areas as well, the double vault dehydrating toilets are found to be suitable from case studies where Hermosa Provinca in El Salvador served as an example (ibid.). These toilets are based on instant separation between urine and faeces. The urine can then be used as a fertilizer directly while the small amount of faeces is stored for 6-12 months while being treated with ash, lime and urea. One difficulty when implementing Ecosan systems is the widely spread taboo of dealing with and talking about human excreta. This approach is largely depending on the users' involvement in the operation and maintenance of the system and therefore promotion and education can be of great value. In addition, there must obviously be an interest for the local agriculture sector to use the excreta as fertilizer. Otherwise, the recycling approach will be of small importance and contribute to no or little ecological improvement. There is yet a trend in peri-urban areas to use wastewater for irrigation in the agriculture. This is mainly due to economical reasons in areas were water is a scarce and expensive resource but the value of the nutrients is another important reason. However is the water most often untreated which is a serious health issue and for minimising this could ecological sanitation be appropriate to use (Parkinson & Taylor, 2003).

Water supply

Peri-urban residents often choose between several different water supply options since in-house connections are rare. The preferred alternative can be changed from day to day depending on price and access (Urbanicity, 2007). For example in three peri-urban areas in Lusaka in Zambia the most common alternatives were public standpipes (when existing), buying from neighbour and individual or shared yard tap (Mwandawande, 2005). Water vendors or water kiosks are other commonly used suppliers in peri-urban areas (Hogrewe et al., 1993). These alternatives are not recommended by JMP because of the high costs and often bad water quality.

An optional water supply technology is rainwater harvesting. This technique is based on the storage and collection of rain from roofs or land surface in different types of tanks. When roofs are used as collecting areas their construction material and cleanliness is essential for the water quality (The Global Development Research Centre, 2007). There are simple ways of improving the quality when needed, for example by boiling the water or by chlorinating it. Improvements can also be reached by sealing the tanks and keeping them as dark as possible to complicate the breeding of mosquitoes and the life of bacteria (Urbanicity, 2007).

3.4 CRITERIA AND INDICATORS

An important angle towards sustainability is how to actually measure it and improvements towards it. One way for achieving this is to use Sustainability Indicators, SIs, which are qualitative, but more often quantitative a sample of information which can be used to measure Sustainable Development and progress towards it (Lundin, 2003). The indicators should give a measurement of fulfilment to the criteria that they are connected to where criteria can be defined as aspects to use for evaluate the relative sustainability of different alternatives

(Ashley, 2004). In this report the indicators are going to be selected from the literature and will be used in the subsequent evaluation of the planning tools.

3.4.1 Indicators in literature

Pierini (2005) has made a comprehensive study of sustainability indicators in literature including organisations like WHO, UNSCD and OECD as well as several research projects from a range of countries. The sets of indicators which were 30 altogether were analysed and a set of indicators especially suitable for water and wastewater management were chosen, Table 2.

Table 2: The sustainability criteria, sub-criteria and indicators chosen by Pierini (Modified from Pierini, 2005)

Criteria	Sub-Criteria	Indicators	Units
Health and Hygiene			
Risk of infection	Access to safe drinking water and basic sanitation	Population with access to safe drinking water and basic sanitation	%
		Drinking water quality monitoring tests performed	Number of tests / (yr, connection)
	Protection of water resources	Protected water resources	Qualitative
Environment and use of resources			
Water bodies	Withdrawal of water	Intensity of use of water resources	%
		Non-sustainable water production index	%
Impact on environment	Impact on receiving waters	Oxygen consumption potential	kg O_2 / (p, yr)
	Emissions to air	CO_2, SO_2, NO_x emissions	%
	Emissions to soil	Sludge quality	%
		Percentage of sludge re-used	%
Use of natural resources	Use of energy	Energy use for wastewater treatment	kWh / m^3
		Energy use for water supply	kWh / m^3
		Use of electricity and fossil fuel	%
		Energy recovered	%
	Recycling of nutrients	Recycling of P and N	%
	Re-use of water	Re-used water	%
Land-use		Land area use	m^2 / p
Economics			
Population	Affordable and price-worthy WSS management	% of familial income devoted to water service	%
Utility	Costs and revenues	Financial performance	%
		Public expenditure on water service	%
Institution, society and culture			

Legislation	Legislation allows for sustainable solutions	Existence of sustainable development strategies	(yes, none)
		WDM strategy	(yes, none)
Governance	Political system allows a fair and open decision-making process	Ability to address awareness and information needs	Qualitative
		Possibilities for participation of the end-users	Qualitative
End-users	End-users minimum requirements on delivery	Consumption of water	litres / (p, day)
		Water system coverage	%
Society	Cultural changes	Cultural acceptance	Qualitative
		Service complaints	number / (connections, yr)
		Easy to understand for users	Qualitative
	Labour	Number of employees	number / (connected pop)
		Complexity of construction and O&M	Qualitative
	Future trends	Population growth rate	%
		Service interruption	h / (cap, day)
Technology			
Risk of failure		Flexibility/adaptability	Qualitative

Vleuten-Balkema (2003) has also made a literature review over indicators that are being used for comparing wastewater treatment systems in her thesis *Sustainable wastewater treatment: developing a methodology and selecting promising systems* where 15 different research projects have been studied. The comparing process has been done in different ways, like for example by using Life Cycle Assessment, LCA, studies or sustainability indicators / factors / criterion. The entire list of used indicators can be found in Table 3.

Table 3: An overview of indicators for wastewater treatment systems that are being used in literature (Modified from van der Vleuten-Balkema, 2003)

Criteria	**Indicator**
Economical	Costs Labour
Environmental	Accumulation Biodiversity/land fertility Desiccation Export of problem in time and space Extraction Integration in natural cycles Land area required/space Odour/noise/insects/visual Optimal resource utilisation/reuse: Water Nutrients Energy Raw materials Pathogen removal/health Pollution prevention Emissions: BOD/COD Nutrients Heavy metals

	Others Sludge/waste production Use of chemicals
Technical	Durability Ease of construction/low tech Endure shock loads/seasonal effects Flexibility/adaptability Maintenance Reliability/security Small scale/onsite/local solution
Socio-cultural	Awareness/participation Competence/information requirements Cultural acceptance Institutional requirements Local development Responsibility

Further in her thesis she chooses a set of indicators suitable for developing a methodology for selecting sustainable wastewater treatment systems. These are divided into the four indicator categories as presented in Table 3, with the exception that she calls the technical category functional instead of implying the systems' function for treating wastewater. The indicators that are of interest in this context with a brief description and measurement used are summarised in Table 4.

Table 4: Vleuten-Balkema's set of indicators (Modified from Vleuten-Balkema, 2003).

Indicator	**Description**	**Expressed**
Functional		
Adaptability	Indication of flexibility	Qualitative
Maintenance	Maintenance needed	Qualitative
Reliability	Sensitivity to malfunctions	Qualitative
Robustness	Sensitivity to chock loads, toxic substances etc.	Qualitative
Waste	Indication of reuse versus waste	m^3
Economical		
Cost	Investments, operation and maintenance costs.	Euro
Environmental		
Land area	The total land area required	m^2
Quality of space	The possibility to integrate the system in green areas	Qualitative
Fertiliser	Nutrient suitable for reuse	kg
Soil conditioner	Stabilised unpolluted organic matter	kg
Total water-use	Sum of different water-use	m^3
Discharge	Treated water can be discharged	m^3
Domestic use	Treated water suitable for domestic reuse	m^3
Drinking water	Amount of drinking water-used	m^3
Household water	Amount of household water-used	m^3
Infiltration	Treated water suitable for infiltration	m^3
Irrigation	Treated water for irrigation	m^3
Rainwater-use	Amount of rainwater-used	m^3
Socio-cultural		
Acceptance	Cultural changes and impacts: convenience and correspondence with local ethics	Qualitative
Expertise	Indication whether the system can be managed locally or only by expertise	Qualitative
Institutional requirements	Efforts needed to control and enforce the existing regulations and embedding of technology in	Qualitative

	policymaking	
Participation	Possibilities for end-user participation	Qualitative
Sustainability behaviour	Stimulance in the design to behave sustainable	Qualitative

Lundin et al. (1999) have proposed a set of SIs for urban water systems with drinking water, wastewater, freshwater resources and by-products as sub-criteria. In the peri-urban context the drinking water criteria and the wastewater criteria are the most interesting. Their sub-criteria and connected indicators are summarised in Table 5.

Table 5: Lundin's SIs for drinking water and wastewater in urban water systems (Modified from Lundin, 1999).

Criteria	Example indicator
Drinking water	
Water consumption	Use per capita per day (litres per person and day)
Treatment	Degree of treatment required
Distribution	Leakage (unaccounted water/ produced water, %)
Distance	Distance from water source or treatment facility
Quality	Coli-forms count
Reuse of water	Reused water/Water consumption
Wastewater	
Production	Wastewater production per day
Treatment performance	Removal BOD_5, P, N (%)
Loadings to receiving water	Loadings of BOD_5, P, N
Resource use	Chemical use per P removed
Energy use	Energy use per BOD_5 and N removed

3.4.2 The selected set of indicators

Lundin (2003) has stated a guiding list of criteria that indicators preferably should inhabit.

- ♣ The indicators have to be of relevance for the users.
- ♣ They should be easily understood and used.
- ♣ The data needed should be reasonably easy to measure or gather and be reliable.
- ♣ The indicators should be predictive and thereby give warnings of negative trends

Following this guide a set of sustainability indicators from the literature, suitable for WSS-systems in peri-urban areas has been chosen, Table 6.

Table 6: The selected set of indicators used for measurement of sustainability of WSS-systems in peri-urban areas in this report.

Criteria	Indicator
Environmental	Annual withdrawal of freshwater/annual available volume Water consumption Reuse of water and nutrients Land area required Quality of land required Emissions of BOD, COD, N, P and heavy metals
Health	Leakage of faecal coli-forms to water source Pathogen removal Risk of infection Occurrence of insects Water supply per day
Economical	Costs for: Investments

	Operation and maintenance Affordability Identification of financial structure
Socio-cultural	Population with access to safe water and basic sanitation Distance for consumers to safe water and basic sanitation to Cultural acceptance Convenience Gender equity Institutional requirements Participation Future urbanisation Land tenure situation Legal acceptability of on-site possibilities
Technical	Flexibility Reliability and robustness Maintenance needed Competence requirements Distribution efficiency Infrastructure needed

For environmental aspects there are many examples of indicators for WSS-systems in the literature. Among those a set has been chosen for the peri-urban context. With regard to water scarcity and the protection of drinking water aquifers, 'Annual withdrawal of freshwater/annual available volume', 'Reuse of water and nutrients' and 'Water consumption' have been chosen. Because of the low quality land and the dense settlements that often are found in peri-urban areas are 'Land area required' and 'Quality of land required' appropriate indicators. 'Emissions of BOD, COD, N, P and heavy metals' are important indicators for the surrounding environment.

There is not a great amount of indicators explicitly for the health aspect found in the literature. However example indicators from the environmental category can also be suitable for this one instead. For direct spreading of infections, 'Leakage of faecal coli-forms to freshwater', 'Risk of infections' and 'Pathogen removal' are adequate indicators. For the indirect spreading of micro-organisms and diseases, 'Occurrence of insects' is the chosen indicator. Additionally one indicator called 'Water supply per day' that measures water for hygienic purposes is essential for the health aspect.

The indicators for the economical aspect are actual costs for, 'Investments' and 'Operation and Maintenance'. These costs must be within the stake holder's means, 'Affordability' and 'Identification of financial structure' are therefore chosen as additional indicators.

The socio-cultural aspects are of great importance for taking into account the differences between countries and cultures. Therefore 'Cultural acceptances', 'Gender equity', 'Participation', 'Legal acceptability of on-site possibilities' and 'Institutional requirements' are suitable indicators. Additional fundamental equity indicators for this category are 'Convenience', 'Population with access to safe water and basic sanitation' and 'Distance from safe water and basic sanitation'. For peri-urban areas 'Future urbanisation' and 'Land tenure situation' are also central indicators.

For the technical aspect the indicators 'Maintenance needed' and 'Competence requirements' are needed to evaluate if the technology matches the context in aspects such as the willingness to be involved in the maintenance of the system and competence for doing this by the users.

‘Flexibility’ for upgrades and modifications in these changing areas, ‘Distribution efficiency’, ‘Infrastructure needed’ as well as ‘Reliability and robustness’ for example of failure, droughts and flooding is also essential for peri-urban areas.

3.5 REVIEW OF SUPPORT FOR PLANNING

There is a range of different types of support for planning found in the litterature. Some are presented as strategic planning methodologies which can be defined as long-term planning approaches that should reach overall goals. Some are more concrete models and terms of references for planning WSS-projects. Yet others are frameworks that can be seen as an approach for viewing the structure of the issue in a holistic way. Finally there are toolboxes that are collections of different types of tools which can support the planning in various ways.

3.5.1 Strategic planning methodologies

1. The Mugabi et al. methodology

Mugabi et al. (2007) propose a strategic planning methodology for urban water utilities in developing countries, Figure 3. Strategic planning is a methodology for thinking in a long-term perspective and planning towards a common goal. The authors argue that some of the biggest challenges are to improve utilities’ efficiencies mainly by reducing the loss of water, reducing the population unaccounted for water and extend the water service to the poorest households.

Important questions to be answered in a solution-oriented planning structure for water utilities can be found in Figure 3 and quotes (Mugabi et al., 2007):

1. *Where is the utility now?*
2. *Where does the utility want to be?*
3. *How will the utility get there?*
4. *How does the utility ensure* success?

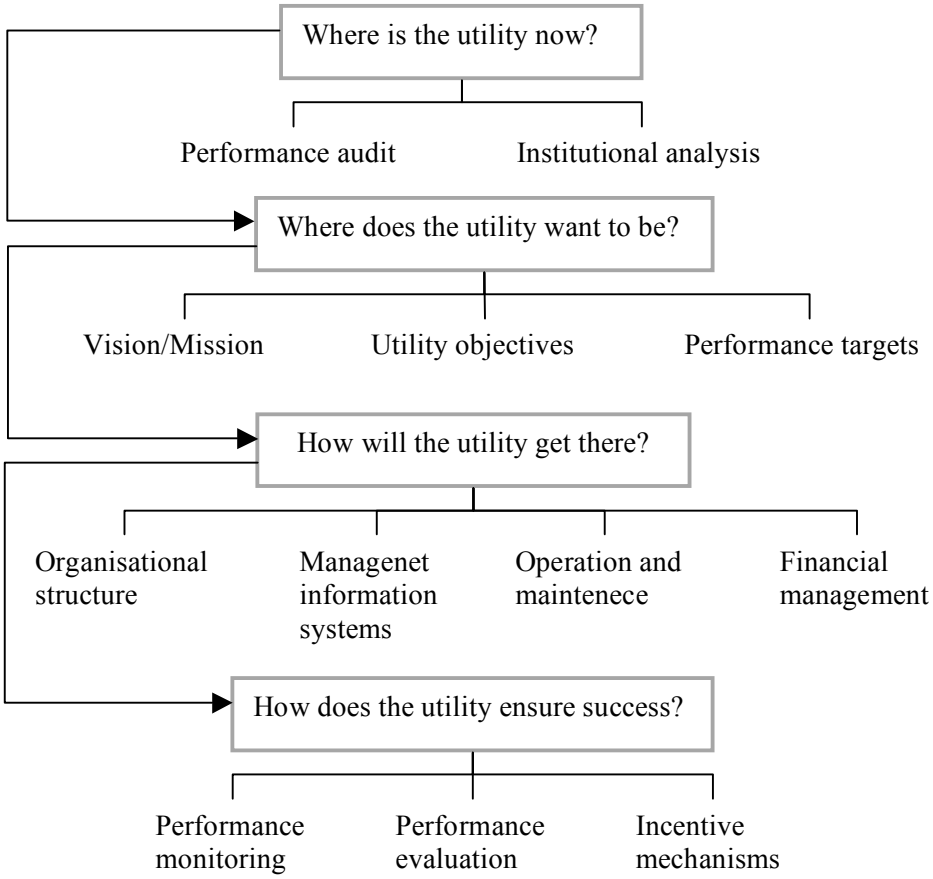


Figure 3: Strategic planning model for water utilities. (Modified from Mugabi et al., 2007).

To be able to answer the first question, a performance and practice audit needs to be done for identifying the existing situation as well as an institutional analysis for identifying current laws, controls and stakeholder responsibilities. For answering the second question at issue, it is of great help if there is a clear vision of the utility objectives and performance targets present. A progressive objective can for example be improvement of current services as well as reaching new customers in the low-income areas. The targets must be as precise as possible and be measurable and time bound. The last two questions concern how to reach these visions by specific actions and how successful monitoring and evaluation should be produced. The actions should favourably be as precise as the targets and cover aspects of organisational structure, management information systems, operation, maintenance and financial management.

2. The UNDP and the World Bank approach

The UNDP's and World Bank's Water and Sanitation Program, WSP, has been the originator of a strategic planning procedure for sanitation (WSP, 1997). The main author of the document is Albert M. Wright who expresses the main goal of a strategic sanitation planning as *"sustainable expansion of sanitation coverage"* (p. 8). For achieving this both the investment part and the operational part must be efficient. The key target group for this

strategic sanitation approach is founders and appliers of urban sanitation programmes, for example governments and donor agencies.

Strategic sanitation has the characteristics of being demand-based and incentive driven. The document stresses the need for a demand-driven approach instead of putting supply in focus. This makes the result of the planning more sustainable since the suggestions of the users are a part of the decision-making process and by that, hopefully, get a sanitation option that they will use and maintain and can pay for. It is vital that all stakeholders share a common vision that includes equity concern, environmental concern and sustainability concern. Especially women is an important group since their approval is central for achieving sustainability as they are often the main users and maintainers of WSS-services. The concept of incentives has the aim to motivate the use of good practice and could be in the form of either rewards or sanctions. These two principles are meant to lead to an enhanced health and environmental situation as well as to affordable and improved sanitation.

For making the sanitation affordable for everyone a suitable financial structure has to be implemented and low-cost alternatives should be used when possible. For the latter one must think about technology options, local situation, level of service and improvement of management efficiency. The technology options should be viewed in a wide manner and consideration of sanitation of different costs and new technologies should be done for choosing the most suitable for an individual location. The author points at the complex sanitation situation in peri-urban areas, with limited area and poor land quality, as well as the need for a comprehensive investigation of the area for finding suitable options. To facilitate this approach there should be an institutional framework for generation of incentives and a demand-based policy.

3. The Choguill model

Choguill at the University of Sheffield (1996) has constructed a ten-principle sustainable infrastructure model for urban areas, where water supply and sanitation are stressed as important issues. The model is based on the idea that decision-making should be decentralised and mainly in the hands of local communities for gaining success. The target group is not explicitly mentioned but can be supposed to be national or regional governments.

The principles are:

1. Emphasis must be made on acknowledging the existence of both formal and informal sectors within a city.
2. The infrastructure must be on a cost-plus recovery basis i.e. the users should cover the cost for the service. When there is a low-income population that can not afford the cost it can be suggestible to use a cross-subsidy programme. The infrastructure services can be operated by either a municipal authority or a private firm.
3. Questions about irregular land tenure must be solved. If the future is unclear, there are no incitements for investments or improvement of one's livelihood.
4. The informal settlements infrastructure should be upgraded, either one step at a time or all at once, so that it eventually can be integrated to the cities service system.
5. The local community must be involved in the planning process and be in control of its own infrastructure services and improvements.
6. The technology should be at such complexity that it is maintainable by the locals.
7. The infrastructure must be affordable for the poor community.
8. The community must find the infrastructure socially acceptable.

9. The government should not only see itself as a provider but also as a supportive and encouraging help.
10. There can also be non-governmental organisations that help the communities with the implementation of services.

4. The Open Wastewater Planning by WRS

Open Wastewater Planning is a planning process that is based on participation of a wide range of stakeholders throughout the process. The methodology was developed by Water Revival Systems, WRS, in the SwedEnviro Consulting Group and has been used in a range of municipalities in Sweden as well as in cities in Eastern Europe. The main target group is planners at project level. The outcome of the course of action should be a sustainable sanitation system that fulfils the objectives from both the decision-makers and the stakeholders in the area. The concept has further been developed to the Open Planning of Sanitation systems approach which has more focus on the developing world and integrates the Ecological Sanitation approach into the planning process by regarding sustainability criteria and sanitation planning tools (Kvarnström & af Petersens, 2004). The process is divided into five steps which can be seen in Figure 4. The first one concerns problem identification. For this part the Logical Framework Approach, LFA, and the Participatory Hygiene and Sanitation Transformation, PHAST, are recommended as useful tools (ibid.).

LFA is used by many donor agencies to gain improvement in planning, implementation, monitoring and evaluation of projects in means of relevance, feasibility and sustainability. The approach is based on objective-oriented planning which implies that the process should start with an identification of the problem and then lead to the objectives and suitable activity alternatives. The approach is divided into nine steps where relevance is supported by analysing the context, the stakeholders, the problems and the objectives. Furthermore, feasibility is taken into account by the construction of an activity plan, resource planning and the use of indicators for measuring the results. Sustainability is considered by doing a risk analysis and assumptions for the external factors. It is central to identify the stakeholders and their roles and responsibilities in the planning process. The approach recommends the performance of a goal Oriented Project Planning workshop as an efficient way to gather information from many stakeholders (SIDA, 2004).

PHAST is a participatory approach that should help communities to improve hygiene behaviour and to motivate communities to change the water and sanitation situation. The approach is doing this by pointing at the linkage between sanitation and health, and encourages the community members to own and maintain WSS-facilities by mounting their self-esteem and sense of involvement. The guide is divided into seven steps with activities and tools. The tools are in the form of drawings or charts and used in workshops. By working with pictures the analphabetic community members could also be participating (WHO, 2007).

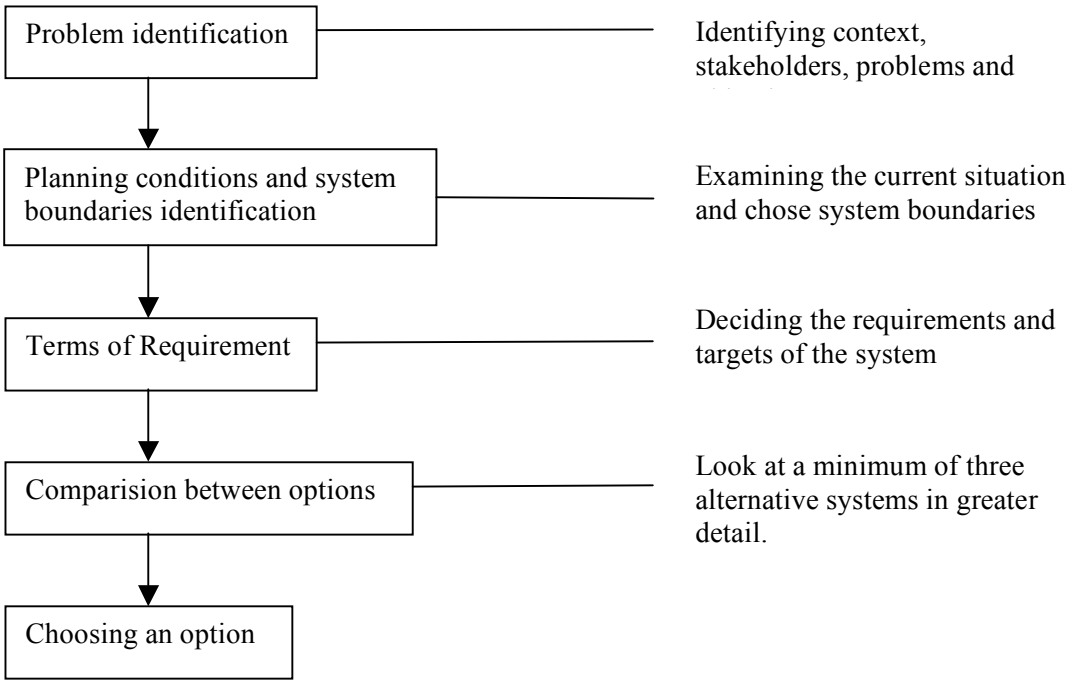


Figure 4: The open planning process of sanitation systems.

In the next step the planning conditions and the system boundaries should be identified. to achieve this an analysis of Strengths, Weaknesses, Opportunities and Threats, SWOT, can be useful. Aspects to consider are for example cultural acceptance, demand for improvements, current system, reuse of nutrients, willingness versus capacity to pay and geophysical characteristics. In the third step the stakeholders should assemble behind a Terms of Requirement, TOR, for the future sanitation system. The TOR should contain criteria that ensure a sustainable alternative. The criteria is divided into two sets, one called primary targets which takes account for external effects like hygiene, environmental protection and resource conservation and one with more focus put on the practical function like reliability and affordability. These two sets of criteria must be considered concurrently. One example of criteria for a low-cost sanitation system can be seen in Table 7.

In the next stage options that meet the terms from the previous step are compared with each other. At least three alternatives should be presented to the community with a comprehensive description of which criteria that are considered and which are not. In the final step the future users should choose one of the alternatives that best suite their preferences.

Table 7: Example of Terms of Requirements for a low-cost sanitation system (Modified from Kvarnström & af Petersens, 2004).

Primary functions	Practical and economical aspects
Hygiene and disease protection High hygienic standards within the toilet, the washing area etc. Excreta must be stored without risk of seepage of pathogens to the groundwater. It must be possible to manage collection and disposal of waste products in a hygienically safe manner. ***Water protection*** Excreta must be stored or disposed so that there is no risk of leachate of nutrients into the groundwater. Surface waters should be protected from nutrients and organic matter originating from toilets and greywater/wastewater. ***Natural resource conservation*** Virtually all nutrients from the sanitary system should be recycled to productive land. The system should be constructed in a way that allows collection and recycling of water.	***Economics*** Investment costs should be reasonable Households should be able to carry out operation and maintenance. ***Reliability*** The technology must be robust, also during extreme weather conditions ***Flexibility*** It should be possible to adapt the technology to varying household sizes. The system should work without electricity. ***User aspects*** The toilets should be inside the house. The systems must be easy to use, including for children, women and elderly. Maintenance should be quick and easy. ***Responsibility*** Responsibilities of households and authorities must be clear. ***Control*** It must be possible to evaluate the system performance.

5. The Household Centred Environmental Sanitation by Eawag

Household Centred Environmental Sanitation, HCES, is a strategic planning approach that is focusing on the household and neighbourhood level as the basis for the planning and decision-making. The approach is being tested in the developing world in both formal as informal settlements and, in addition, both in peri-urban settlements as in small and medium size towns with inadequate infrastructure and water supply and sanitation systems. The Eawag, Swiss Federal Institute of Aquatic Science and Technology Material Flow Analysis, is the originator of the approach and the main target group is municipal planners and civic officers (Eawag, 2005).

The HCES is a multi sector and multi actor approach which thereby should take account for water supply, sanitation, storm drainage and waste management and depends on the participation of all stakeholders for the reaching of sustainability. Additionally, the concept of *zones* and the use of *a circular model* are central in the approach. The approach suggests that the problems should be solved as close as possible from where they derive. For taking this approach an area is divided into zones: the household, the neighbourhood, the community, the city ward, the city and the environment beyond the city. Problems connected to water supply, sanitation, storm drainage and waste management should be managed by the innermost zone as possible i.e. the household zone. If this zone can not manage the problem it should ask the

next zone for help and so on. This should give the household a right to be heard in the decision-making process. The circular system is based on the idea of reuse and recycling waste and wastewater. This minimises the use of natural resources and improves the situation for local agriculture which should lead to affordable and sustainable systems. The Eawag is promoting a Material Flow Analysis, MFA, which is recommended to integrate into the HCES for ensuring the minimising of resource use and environmental pollution in a systematically way (Montanegro et al. 2006). The guideline gives a suggestion of a 10 step planning process which can be related to a conventional project cycle framework, Figure 5.

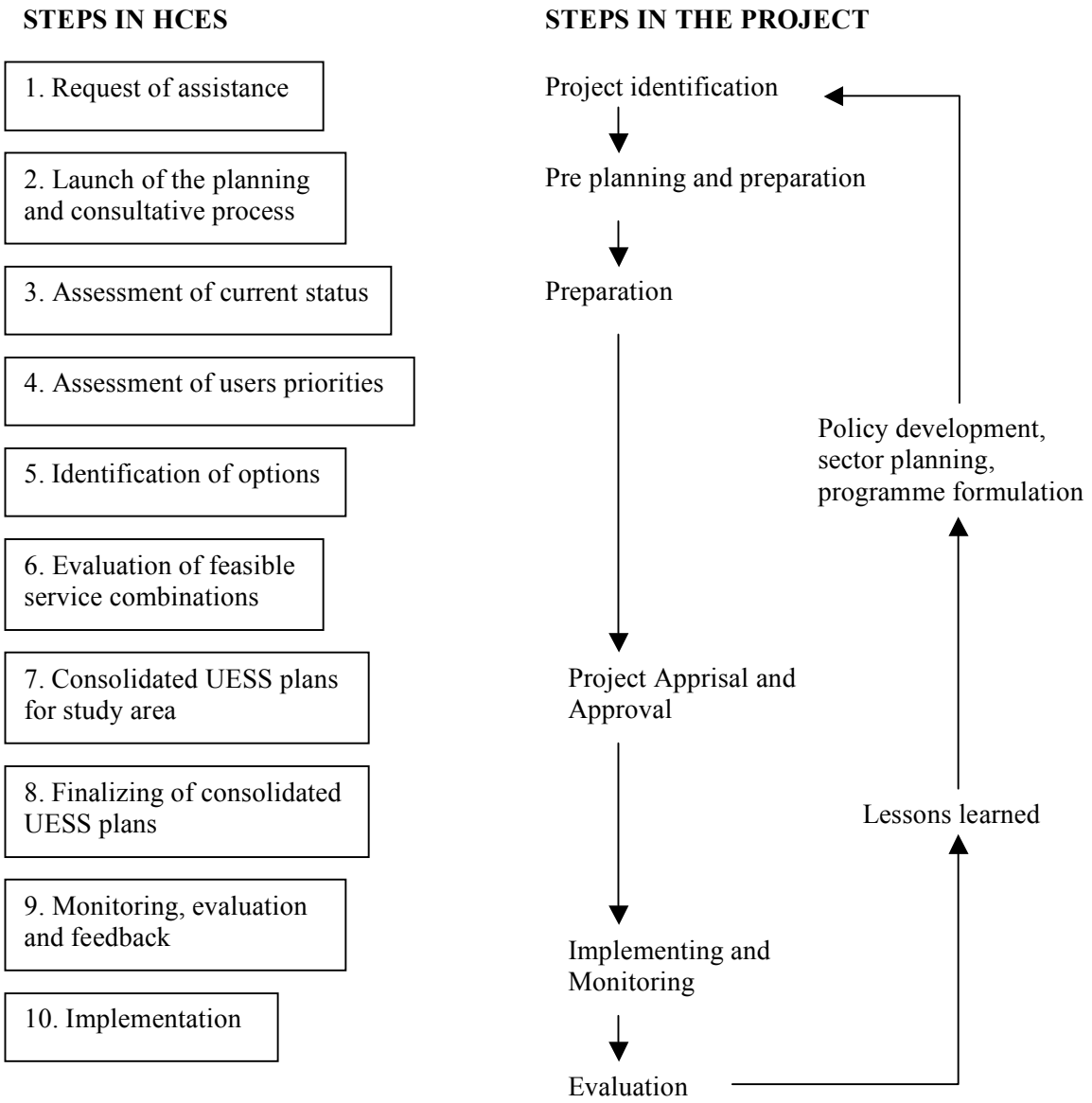


Figure 5: The 10 step approach of HCES in relation to the project cycle framework (Modified from Eawag, 2005).

The process originates from the request of a change by the beneficiaries of the system. In the following step the HCES need to be explained to all participatory stakeholders and the physical boundaries of the programme are decided during a workshop. This are followed by the assessment of current status and user priorities. The service status should be examined on local, municipal and city level and consultation with the stakeholders can be an important source of information. The next two steps are concerning the identification of options and the

evaluation of feasible combinations of them. Here a wide range of technologies, institutions and financial arrangements need to be studied for finding the best options for a certain context. For each option social issues, institutional arrangements, maintenance requirements, technical design and financial costs should be examined. In the next two steps systems are identified for the different part of an area and a combined service plan are made followed by a workshop where the plan is presented. The aim of the workshop is to reach a consensus for what activities that need to be prioritised. The next step involves the decision of indicators that could support the monitoring, evaluation and feedback of the work and is the last one before implementation. This step has the aim to secure the quality of the services.

3.5.2 Models and terms of references for planning WSS-projects.

6. The Schiller & Droste model

Schiller and Droste (1982) from the University of Ottawa have constructed a model of the planning process of a WSS-project in the developing world, with starting point from the World Bank's recommendations of project preparations, Figure 6. The target group of users of the model is the planners of WSS-projects but as one can see there are different co-participants for different stages in the process.

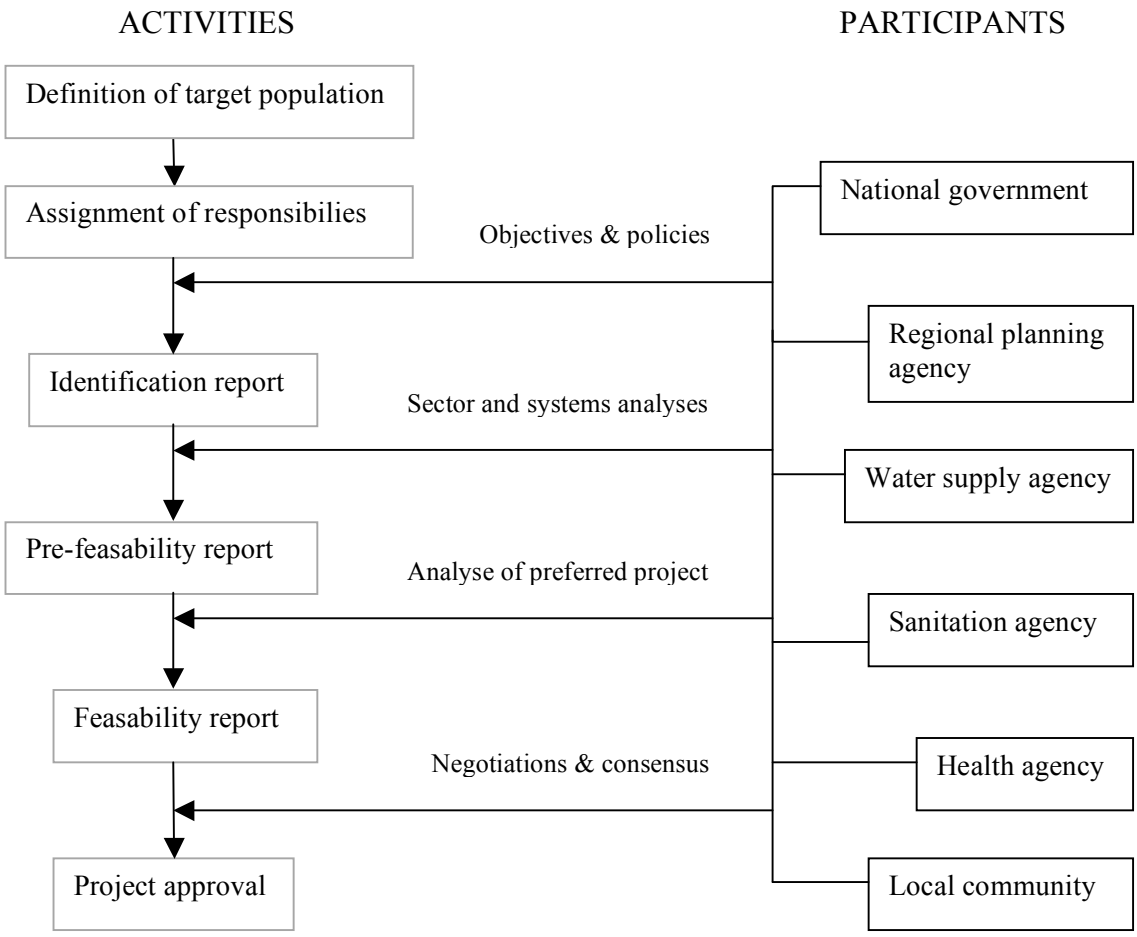


Figure 6: Development stages in Water supply and Sanitation Projects (Modified from Schiller & Droste, 1982)

An initial step for the planning phase is to identify the target population. These groups can be different for the water supply part and sanitation part. Nonetheless is it of great importance that these elements are planned together as they are strongly interdependent when choosing technology, for instance. It is also central to study and understand the target group's current water and sanitation system to be able to decide whether it is an option to upgrade the inadequate systems. There are many institutions that should be involved and interact with each other in the planning process because of its great complexity. Important associations are the national government, the regional planning agency, the water supply agency, the sanitation agency, the health agency and of course the local community. After the identification of target groups and planning participants there are three reports to be written: an identification report, a pre-feasibility report and a feasibility report.

The identification report should illuminate the projects with high priority and how to integrate them in the regional and national development strategies. For doing this, important issues to investigate are institutional responsibilities, policies, present WSS-systems and which resident group that will be mostly benefited by the project. The pre-feasibility report should be a document enabling the screening and ranking of possible alternatives for the project area. To be able to do this in a holistic way an overview of the water supply and sanitation sector must be made. This should include population growth, public health indicators and institutional responsibilities as well as a motivation for the need of a project including existing WSS-systems and future needs. The report should also contain strategic plans for the systems. This should hold aspects of social preferences, quantified improvements objectives, costs, affordability and a review and analysis of technical solutions. The feasibility report is the last stage before approval of the project and concentrates on a certain project option. Here, the chosen alternative is analysed to assure that it is sufficient in social, economical, technical, financial, environmental and institutional aspects.

7. The ADB Terms of reference

Asian Development Bank, ADB, (2007) has constructed a consultant Terms of reference, TOR, for ADB funding project preparation technical assistance. This is a practical model with the objective of contributing to improvements in planning urban sanitation wastewater management in means of offering options to consider and choose from. These are for example between conventional or low-cost alternatives, centralized or decentralized sewerage, on-site sanitation options and sanitation in slums options. The fundamental suggestion is that conventional sewerage systems not always are the most suitable alternative for the urban poor when considering cost, maintenance requirements and organizational obstacles, even though the governments believe that (ADB, 2007b).

Figure 7 illustrates the stepwise guide of the TOR for constructing a sanitation plan. As a starting point a consultation with the stakeholders needs to be done. Here policy and project priorities should be decided for institutional responsibility, service levels, cost recovery and certain focus groups like un-served urban poor or un-served schools. As a next step the current status, both on national as well as project area level, should be examined. The national review should focus on policies, institutional responsibility and legislation connected to the WSS-sector. The project area should be investigated in means of clarifying aspects like existing attitudes, cost recovery structures, health statistics, environmental situation and existing sanitation. For the latter aspects in both quantity and quality should be taken into account.

In this step the preferences and priorities of future users must be investigated and collected for a comprehensive understanding of the situation. After this, possible options should be identified and analysed for determine feasibility. Aspects to have in mind during the analysis are costs, sustainability, new approaches, participation, wastewater as a resource and maximising both human and environmental benefits. Use of existing facilities and services when possible should be a potential solution during this step. Finally, a workshop should be held among the stakeholders for constructing a sanitation plan focusing on the most suitable option.

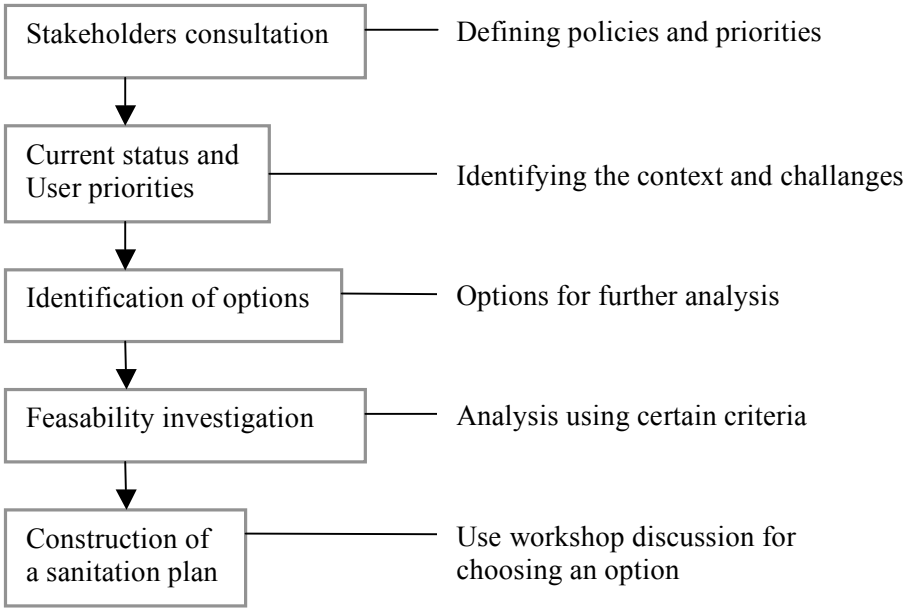


Figure 7: The project planning process recommended by the Asian Development Bank.

For the environmental concerns wastewater, both local and downstream, and groundwater should be collected and the quality should be checked in means of COD/BOD, faecal and chemical pollution. The local health situation as well as the residents' preferences about the WSS-situation should be studied.

3.5.3 Frameworks for planning WSS-systems

8. Sanitation 21 by IWA

The International Water Association, IWA, framework Sanitation 21 (2006) focuses on sanitation planning in low-income areas in poor countries and should be a help for practitioners, designers and planners to recognize the essential objectives and problems. The Sanitation 21 Task force includes engineers, water scientists, technicians and planners. The framework is divided into three parts: the context, the technical options and the likelihood for success.

- *The context:* The city is divided into different spheres; households, neighbourhoods, ward/district, the city and beyond the city which can be seen in Table 8. The purpose for this is to put forward the different levels where the planning process occurs and their diverse preferences that sometimes can be in disagreement with each other. At the household level the degree of interest is due to awareness, priority, access and influence. Yet the primary objectives are of status, cleanliness and convenience whereas health is of

secondary interest. At the city level, on the other hand, the focus has moved towards environmental and economic protection instead and health is of greater interest. In addition, an amount of external factors can be of great weight. On the household level an example is land tenure while beyond the city international commitments like MDG can be an influencing factor. Table 9 displays the main objectives and external factors of the different spheres.

Table 8: The framework's division of the city's domain and their respectively objectives and external factors (Modified from IWA, 2006).

Domain	Interest/Objectives	External factors
Households	**Primary** Status Cleanliness Convenience **Secondary** Health	Levels of poverty Access to service providers Influence on downstream systems Land tenure
Neighbourhood	**Primary** Status Cleanliness Community service **Secondary** Health	Levels of poverty Access to service providers Influence on downstream systems
Ward/district	**Primary** Status Cleanliness Health **Secondary** Environmental protection Economic development	Relations with the city (political and social) Financial structures
City	**Primary** Environmental protection Economic development Formalisation of the city Health Utility cash flow **Secondary** Achieving water/food security Promoting urban and rural development	Decentralisation Economic priorities/profile Strength of external policy drivers
Beyond the city	**Primary** Environmental protection Economic development Achieving water/food security **Secondary** Achieving equity and increasing access Meeting the MDGs	Economic priorities/profile International/regional water sharing issues Political priorities

- *Technical options:* The task force describes a sanitation system as constructed by the following parts: a toilet, a collection mechanism, a transportation mechanism, a treatment process and a disposal/reuse mechanism/process. These sanitation parts can be either conventional networked options or non-networked and thereby more flexible options. The framework describes eight different sanitation systems that are dry, semi-wet or

waterborne and are with or without centralised or semi centralised treatment. Each sanitation system's degree of involvement for maintenance and operation of the different parts by each sphere are considered. This is done for examining if the systems can be dealt with in a proper way in all of the layers of the city.

- *Likelihood for success:* A sanitation system must fit its context and meet its objective for being successful. Furthermore, the required management of the system for each sphere must match their individual capacity for feasibility of a certain alternative. Finally one should try to identify potential problems that can show up in the future.

9. The Sahely et al. framework

Sahely, Kennedy and Adams from the University of Toronto have constructed a framework with the aim to use a minimal proportion of resources (Sahely et al., 2005). Stress is put on feedback mechanisms that will enhance a more sustainable infrastructure. Figure 8 shows the framework for the flow of water in an urban water system and an amount of feedback mechanisms between the different types of sustainability. If starting from the water production, this is dependent of the water resource and investment in water services in forms of external financial resources and the consumer's payment of water tariffs. This area is thereby connected to environmental and economic sustainability respectively. The distribution of water is in turn dependent on service provision and water demand which are linked to engineering and social sustainability. The wastewater that leaves the urban area can have effect on the environmental sustainability. The economic sustainability is reliant on population growth and investment capacity.

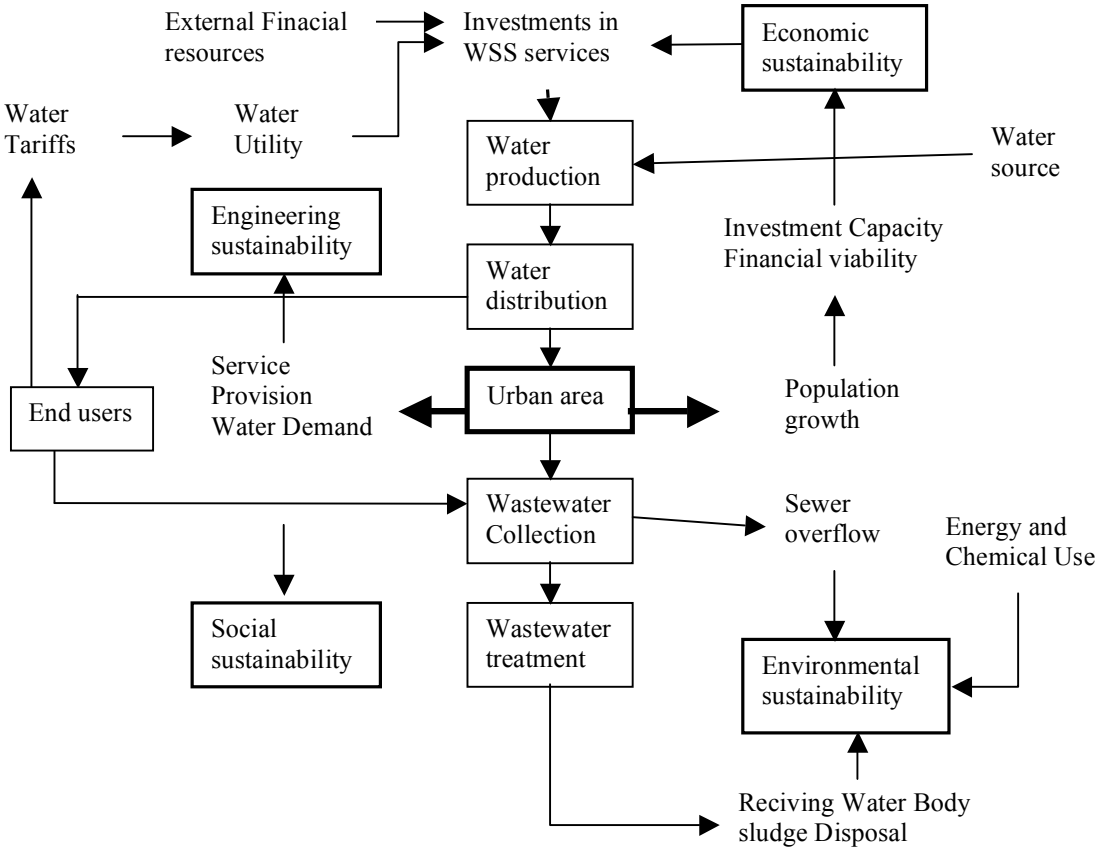


Figure 8: Framework for assessing urban water systems (Modified from Sahely et al. 2005)

The construction of the framework can be divided into three steps based on LCA methodology:

1. Problem definition indicators must be decided
2. Inventory analysis impact assessment
3. Decision analysis

In the first part the overall goals, system boundaries and sustainable criteria must be decided. The system boundaries must be well defined for the use of temporal, spatial and life-cycle approaches. The criteria categories are of economic, environmental, social and engineering type. The frameworks criteria, sub-criteria and indicators for an urban water system is summarised in Table 9.

Table 9: List of criteria and indicators recommended by Sahely et al. (Modified from Saheley et al., 2005).

Criteria	Example indicators
Environmental	
Resource use	Electricity use
Emissions	Chemical use
Water quality	Water-use
	Discharge of BOD, N and P to water
	Sludge disposal to landfill
	Energy recovery from biogas
	Recycling of nutrients to agriculture land
Economic	
Short-term expenditures	Operation and maintenance costs
Long-term expenditures	Extent of reserve funds
Revenues	Research and development investments
	User fees
Engineering	
Reliability	Service interruptions
Resiliency	Water losses-leakage
Vulnerability	
Social	Connection to water and sanitation services
	Incidence of waterborne diseases

10. The SWARD framework

The Sustainable Water industry Asset Resource Decision, SWARD, is a research group with members from the University of Bradford, University of Abertay Dundee, Imperial Collage London and Heirot Watt University. They have constructed a framework for how sustainability can be included into the decision-making process linked to water services and can be used by water service providers and other stakeholders for incorporating sustainability into their activities (SWARD, 2004). The SWARD framework is divided into seven phases, Figure 9.

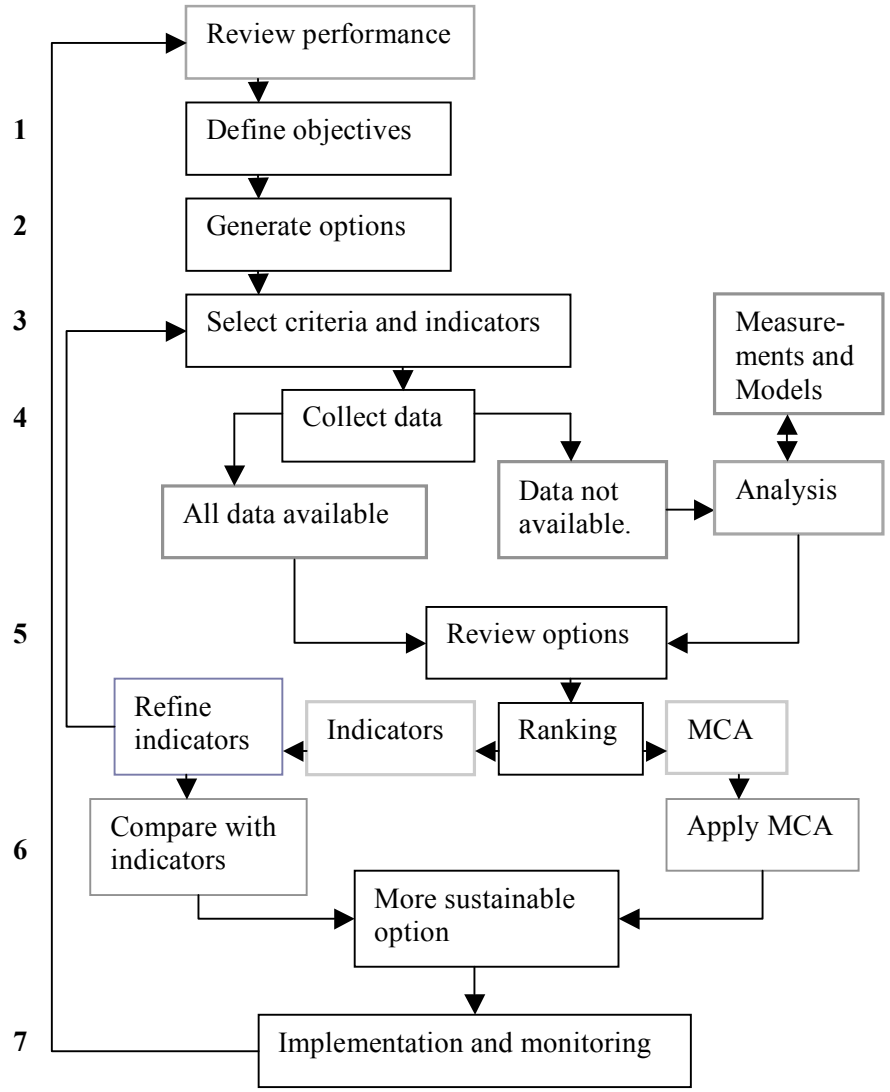


Figure 9: Phases in the decision-making process (Modified from SWARD, 2004).

The seven phases' main principles are described bellow.

1. *Define objectives:* Here, the over-all principles or goals for how the water service will improve its sustainability focus should be decided. Economic, environmental, social and technical criteria must be considered.
2. *Generate options:* In this phase a number of options that adequately cover the objectives should be identified. The generation can be made in very different ways in the range from a mechanic to a creative approach.
3. *Select criteria and indicators:* SWARD has chosen criteria by consultation with water industry partners, review of academic and technical literature and research by the group itself. The general criteria are of economic, environmental, social and technical character. These are conceptualised with primary criteria, secondary criteria and attached example indicators. The primary criteria are listed in Table 10. The water service providers are free to choose among this set of criteria for their special context and enclosed sustainability challenge. For this decision one should have in mind the comprehensiveness, applicability, tractability, transparency and practicability of the criteria.
4. *Collect data and generate information:* In some cases parts of the data needed have previously been recorded and only a small amount of data must be measured, whereas

in other cases the majority of data needs to be measured and a lot of effort has to be put on this step. There are a number of tools to choose between for doing this. For the economic criteria cost-benefit or cost-effectiveness methods are examples of tools to be used. For environmental criteria example tools can be Life Cycle Assessment or Environmental Risk Assessment. Whereas for social criteria, tools can be Social Impact Assessment or Agent Based Modelling. For the latter category household surveys, questionnaires and workshops can be suitable data and information collecting alternatives.

5. *Analyse options:* In this part analytical decision-making tools can be a great support in these complex issues. In SWARD the multi-criteria decision-making methods to choose between are either of aggregated value/utility function methods e.g. Simple Multiple Attribute Rating Technique, SMART, or outranking methods e.g. PROMETHEE.
6. *Selection of preferred option:* This objective of this stage is to emphasise the importance of human judgement in the final decision-making. The decision-makers experience, values and intuitions are then incorporated into the process. Risk and uncertainty of the option must be prioritised.
7. *Post decision phase, Monitoring and Feedback:* This phase aim to verify the decision and to improve the former phases.

Table 10: SWARD's set of primary criteria (SWARD, 2004)

Category	Primary criteria
Economic	Life cycle costs Willingness to pay Affordability Financial risk exposure
Environmental	Resource utilisation Service provision Environmental impact
Social	Impact on risks to human health Acceptability to stakeholders Participation and responsibility Public awareness and understanding Social inclusion
Technical	Performance of the system Reliability Durability Flexibility and adaptability

3.5.4 Toolboxes for planning WSS-systems

11. The Urban Water toolbox

The Urban Water Programme was a research programme that worked with the questions connected to sustainable water and wastewater systems. The researchers came from a range of different fields like engineering, microbiology, behavioural science and social science. In 2006 the programme was transformed to the company CIT Urban Water Management (Urban Water Programme, 2007).

For enabling and guiding the different work of the project, a conceptual framework was made. The system was being regarded as having three sub-systems: users, technology and

organisation, Figure 10. The interactions between these were seen as essential for a functioning WSS-system. Furthermore, five main sustainability criteria were chosen: health, environment, economy, socio-culture and technical function (Malmqvist et al., 2006). These are identical to the ones chosen in this report.

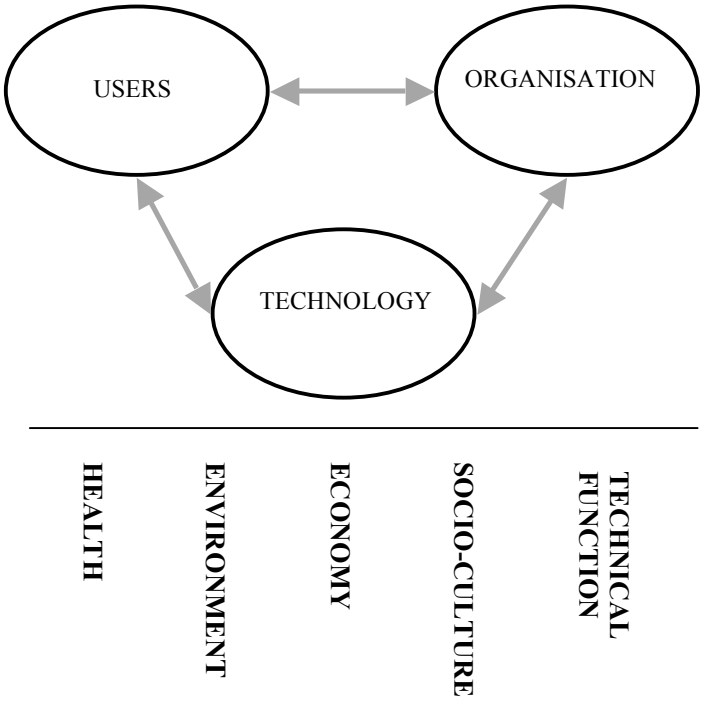


Figure 10: The Urban Water program conceptual framework (Modified from Malmqvist et al., 2006)

The programme has gathered the different tools into a toolbox. These tools are meant to enable the analysis of the central aspects of urban water services and the decision-making part of the planning process. For the environmental and natural resources issue two models are used: URWARE and SEWSYS. The former is a model for substance flow analysis and the latter models substance flow connected to transport and treatment in sewer networks.
For hygiene and health aspects the tools Microbial Risk Assessment, MRA, and Chemical Hazard Identification and Assessment, CHIAT, are used. The former needs data over time, place and frequency of human infections whereas the latter points out substances that can be a risk-factor for human health. For economic aspects the cost calculating database gives for example the total annual cost per: connected person, cubic metre of wastewater and kWh energy used. There are also a set of economic indicators for sustainable water management which considers the different interactions between users, organisations and technical structure. The socio-cultural set of criteria that are being used includes the existence of governmental and political support, a common worldview among stakeholders, access to awareness and capital and communication with users (ibid.).

The programme also stresses the many aspects one will be confronted with when working with the sustainability concept. This can lead to complex decision-making and methods to make this possible can be valuable. The Strategic Choice Approach illuminates the problem with numerous uncertainties in decision-making as well as the difficulty with agreement when many stakeholders are involved. Therefore it can be a helpful tool when deciding in complex

issues like for example water and sanitation planning (Söderberg & Kärrman, 2003). As mentioned above this is a tool that also SWARD uses.

12. The ADB toolkit

Asian Development Bank, ADB, (2007) has produced an electronic toolkit named "*Smarter Sanitation"* which contains both a CD-ROM and a guiding booklet. In the toolkit one can find recommendations, links for further information and the software programme SANEX™ that can be a support when planning sanitation systems. The aim of the toolkit is to open up the eyes of the users for what is possible, get the policies to function, raise the awareness in the communities and change their behaviour and finally to choose the most appropriate technology for reaching the MDG 7:10 (ADB, 2007a).

The CD is aimed as a supportive tool for many different professional groups including national, provincial and local governments, NGOs, civil society, providers of sanitation services and those in advisory roles like university researchers and engineering consultants. The CD's content is divided into four main headings for covering the objectives:

- *Address Attitudes and Misconceptions:* emphasises the need of thinking that improvement of the situation is possible and tries to clarify the misconceptions.
- *Working the Policy:* discusses the need for policies and ways of implementing them
- *Community Approaches:* stresses both on the need of behavioural changes and of mobilizing the communities. For the latter task five models from different case studies can be studied.
- *Technology:* discusses the 3R Initiative: *Reduce, Reuse and Recycle* and the Ecosan strategy, possible technological approaches, how to set standards and how to choose between different options.

For the choosing task one recommended alternative is to use the decision support software SANEX™ which comes within the CD. This is developed by Dr Thomas Loetscher at the University of Queensland and should be a support for identifying appropriate local sanitation technologies. It can also be seen as a communicating link between planners and communities.

13. The WUP toolkit

"Water and sanitation for all" is a toolkit produced by the Water Utility Partnership, WUP, (2007) managed by the Water and Sanitation Program and supported by the World Bank's Africa Infrastructure Unit. The main objective is to provide sector practitioners, policy and decision makers access to information about past experiences and existing trends in WSS-service deliverance to low-income urban areas as a help for making a good planning strategy.

The key issues and aspects that are emphasised are:

- The challenge of having low-income households as customers
- The challenge of unplanned settlements
- The proportion of low-income communities in the service area
- Private sector participation
- The possibility of using alternative service provider
- Appropriate regulatory structures
- National policies on services for everyone
- The possibility of low-income customers to have a voice
- Integration of services
- A tariff structure that does not weakens the poors' situation

- Appropriate standards for both formal and informal settlements

Each aspect is clearly characterised and suggestions are made on how to handle the problems. This list can be a good starting point for identifying the context and the challenge attached. It is stressed that one should get to know the customers and view them as *"the beginning of the service cycle instead of the endpoint"* (WUP, 2007). After doing this properly the institutional roles and responsibilities must be studied, followed by policy building and financial structures. As a last step the most suitable technical option and the level of the service should be decided. This is illustrated in Figure 11.

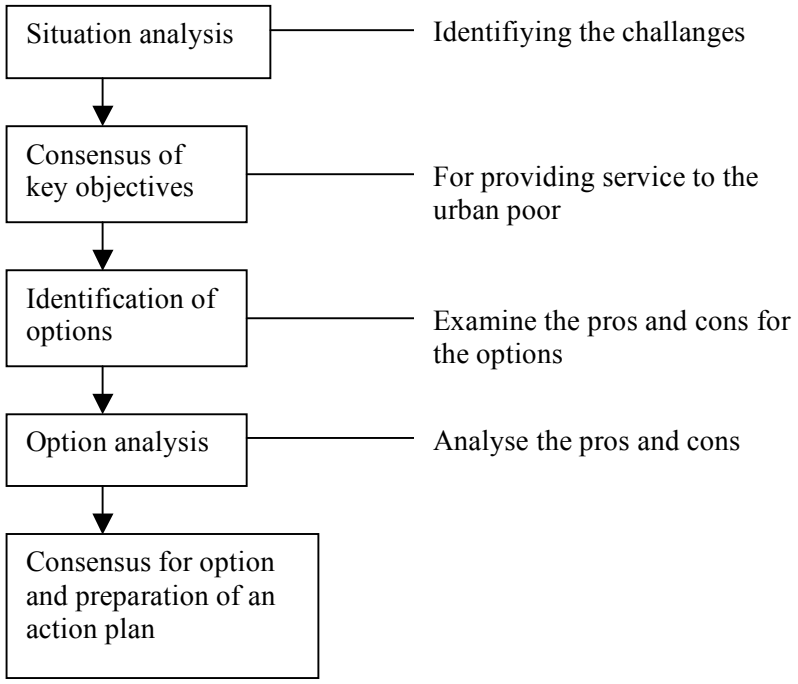


Figure 11: The process needed for development of a good planning strategy.

The technology alternatives' advantages and disadvantages are discussed. Examples are affordability, competence requirements, water consumption, possibilities to monitor water quality, reliability, distance to users, flexibility, occurrence of flies, groundwater contamination, recycling and maintenance required.

14. The GWP toolbox

The Global Water Partnership, GWP, (2007) toolbox for integrated water resource management, IWRM, has a selection of tools suitable for the planning of WSS-services. The concept of IWRM is defined as *"a process which promotes the coordinated development and management of water, land and related resources in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital eco-systems"* (GWP, 2007). Efficiency, equity and environmental sustainability are thereby key aspects. To regard this, adequate policies and goals must be interpreted on national and regional levels.

Tools that are recommended for WSS-planners are divided under the following headings: Financing and incentive structures, Creating an organisational framework, Risk, Environmental, Social Impact and Economic assessment, Social change instruments, Regulatory instruments and Economic instruments. The tools are in form of a characteristics

part and a part of previous experiences and recommendations. For the assessment section there are well known methods used like Environmental Impact Assessment, Social Impact Assessment, Cost-effectiveness analysis and Cost-benefit analysis. Table 11 below shows which tools are attached to the different topics.

Table 11: Tools from the IWRM-toolbox suitable for water supply and sanitation planning. (Modified from GWP).

Tool category	Tool
Financing and incentive structures	Investment Policies Financing Options: i. Grants and internal sources ii. Loans and equity
Creating an organisational framework	Regulatory bodies and enforcement agencies Service providers and IWRM Strengthening public sector water utilities Role of the private sector Civil society institutions and community based organisations
Assessment	Risk assessment and management Environmental Assessment Social Impact assessment Economic Assessment
Social change instruments	Education curricula on water management Communication with stakeholders
Regulatory instruments	Regulation for water services
Economic instruments	Pricing of water and water services Subsidies and incentives

15. The Danish ministry of the Environment toolkit

The Danish Ministry of the Environment, the Danish Environmental Protection Agency, DEPA, Danish Cooperation for Environment in Eastern Europe, DANCEE and the European Bank for Reconstruction and Development (2002) has offered a toolkit for handling:

- the level of WSS-service standard needed
- the future investments in WSS-services needed
- the customers' requirement and willingness to pay i.e. affordability
- the political approval of financial structures

The toolkit is mainly aimed for east and central European countries but could with some adjustments be relevant for dense urban communities in the developing world i.e. suitable for peri-urban areas. The initiators of the toolkit stress the importance of demand analysis in all stages in an investment project to reach cost recovery and sustainability and the tools can be useful for all marketed water services (The Danish Ministry of the Environment, 2002).

The project cycle where the tools should be used is divided into the following parts: a project identification, a pre-feasibility step with investigation of the intuitional and regulatory framework, the budget and technical options, a feasibility step which should lead to recommended approaches for the issues studied in the previous step, an outline design, a detailed design and finally the project implementation. There is a set of tools made for the different objectives which can be viewed in Table 12.

Table 12: Tools designed for a set of categories considering different issues and suitable for different targets groups. (Modified from Danish Ministry of the Environment, 2002)

Tool category and target group	Tool
Approaches for considering service, technical solutions, demand and tariffs ***Target group:*** everyone who uses the toolkit	The integrated approach Proposed Scope of work for inclusion in Terms of Reference
Service level, technical profile and options ***Target group****:* experts within water utility planning	Establishing a technical, service and expenditure baseline The technical profile summary
Customer perceptions and willingness to pay ***Target group:*** consultants who are used to market research	Qualitative research approach Generic top guide Quantitative research approach Estimation of willingness to pay Generic example of survey design
Demand for water services ***Target group:*** the same as the previous category	Data requirements, statistical methods
Household affordability ***Target group:*** experts within water utility planning	Affordability assessments based on macro data: i. Household affordability (qualitative) ii. Tariff design and transfer
Political acceptability ***Target group:*** targets policy analysis experts	Analysis of attitudes of political parties Analysis of attitudes and assumptions Screening of key actors

The tools for surveying household affordability are explicitly recommended to be suitable in larger cities in the developing world as well. One way of analysing affordability is to use macro-data such as average income, inequalities in income-distribution and the households' expenditure-fractions between food, WSS-services and other costs. When there is only little data available another approach is to carry out a household expenditure survey.

16. The Gender toolkit by the World Bank

The World Bank (2007) has designed a Gender Toolkit for World Bank managers working with WSS-services. The main objective of the toolkit is to implement gender awareness in the water and sanitation section in terms of using gender analysis and lessons learned from successful strategies for the issue in projects around the world. The toolkit stresses the importance of a participatory approach in the planning process. Both gender and social analysis should then be considered for involving both women and men and different social classes in the working process. Gender analysis should clarify the women's and men's opportunities for involvement in WSS-projects by examine their different water-use activities, limitations, status and access to capital (World Bank, 2007).

For the planning WSS-projects in a gender sensitive way the planning process must come about in a way that makes it possible for both sexes to become involved. Participatory techniques should be used for gathering the opinions about technology choices and its design and location from both men and women. A central feature of the Gender Analysis is to ensure gender awareness at the project identification stage. Here information about traditional roles, women's preferences, features that support or hold back participation of both men and women, percentage of household with women as person in charge and women organizations

working in the area. For collecting the data reviews of studies from national Women's Bureaus, local offices of international donors and universities as well as interviews with residents and local women's groups for getting newer data can be done.

17. The AISUWRS toolkit

Assessing and Improving the Sustainability of Urban Water Resources and Systems, AISUWRS, (2007) is an EU-project with the aim to develop modelling tools for planning and decision processes in urban areas which are dependent of groundwater as a water supply source. The research group behind the project is connected to the University of Karlsruhe, Germany. The toolkit includes a set of groundwater models for deciding contaminant quantities to ground water where the contaminants originate from sewers or other wastewater pipes. UVQ is an urban water volume and quality model, NEIMO is a network exfiltration and infiltration model, POSI and SLeakl are unsaturated transport models. The program has also constructed a decision support system for comparison between scenarios which focus on different types of improvement.

For environmental water sustainable analysis and socio-economic analysis a model named Socio Economic and Environmental Sustainability Assessment of Urban Water Systems, SEESAW, is used. The model uses a LCA approach for the environmental issues and uses 17 environmental SIs considering groundwater (quantity, quality and protection), drinking water production (availability and efficiency), consumption (sufficiency), wastewater treatment (leakage) and by-products (recycling).

3.5.5 Summary of available support for planning

To sum it up one can recognize that some aspects are more commonly acknowledged than others. Participation of the users of the systems and their affordability are issues that are covered by almost all of the tools. These aspects are seen as central pillars for the planning of a successful and sustainable WSS-system. The demand for an improved system or a new system and economical possibilities for maintaining it is a base from which other aspects can be added. There is much emphasise on the advantage of a demand driven approach rather than a supply driven one for increasing the sustainability of the WSS-systems. Health aspects are the most frequently overlooked issues in the models. However, the current health crisis connection to lack of access to WSS-systems is often pointed out in the introduction or background sections of the articles or programmes as a cause for motivation for taking interest in the issue.

4. EVALUATION OF SUPPORT FOR PLANNING

4.1 CATEGORISATION OF PLANNING SUPPORT

In this section the planning support from section 3.5 are categorised in order to get an overview of their characteristics. The regarded parameters are:

1. The originator of the tool
   - *Researchers from universities or other associations?*
   - *Organisations?*

2. The target group for the tools
   - *Experts?*
   - *Decision makers?*
   - *Practitioners?*

3. Type of tool
   - *For establishing conditions and support for enabling the planning process?*
   - *For performing the planning process?*

4. The aimed context for the tool
   - *Water supply or sanitation or both or infrastructure?*
   - *Developed or developing countries?*
   - *For the urban poor?*
   - *For peri-urban areas?*

The characteristics of the different types of planning support are being summarized in Appendix. Here one can observe some patterns. For example, support for the planning process is the focus for tools that have decision-makers as target groups whereas when focus is laid on the performance of planning, the target groups are planners of the systems. It can also be observed that software tools are mainly included in toolboxes not explicitly aimed for the developing world.

4.2 SELECTION OF SUPPORT

In order to be able to make a selection of tools and models that should be further analysed, delimitation is needed. This will be done by selecting the ones that are as close as possible to the reports objective i.e. finding planning tools for selecting sustainable water supply and sanitation systems in peri-urban areas of the developing world. The selection criteria are thereby the following:

- Planners should be the target group
- The planning process should be in focus
- The tool should be aimed for planning water supply, sanitation or both.
- The main context should be the developing world and the tool must be applicable on peri-urban areas

The result of this selection is summarised in Table 13. Here one can see that tools number 2, 3 and 14 are not suitable for additional survey because of the planning focus is laid on the decision-making level and concerns mainly the support for implementation of the process.

Nor were tools number 9, 10, 11, 15 and 17 selected for further study because of the absence of focus on the developing world.

Table 13: An overview of the outcome of the selection of suitable planning approaches.

No	Name	Selected?
1	Mugabi et al. methodology	Yes
2	UNDP and the World Bank approach	No, tool not applicable
3	Choguill model	No, tool not applicable
4	Open Wastewater Planning by WRS	Yes
5	Household Centred Environmental Sanitation by Eawag	Yes
6	Schiller & Droste model	Yes
7	ADB Terms of reference	Yes
8	Sanitation 21 by IWA	Yes
9	Sahely et al. framework	No, different context
10	SWARD framework	No, different context
11	Urban Water toolbox	No, different context
12	ADB toolkit	Yes
13	WUP toolkit	Yes
14	GWP toolbox	No, tool not applicable
15	Danish ministry of the Environment toolkit	No, different context
16	Gender toolkit by the World Bank	Yes
17	AISUWRS toolkit	No, different context

The remaining tools and models are hence focusing on the planning process of WSS-systems in the developing world. Yet is the degree of suitability for the peri-urban areas of difference. From the simple categorisation in Appendix one can se that tools 5, 8 and 13 are the one with most stress on peri-urban areas followed by 1, 4, 7 and 12 since they focus on the urban poor. Tools 6 and 16 are in contrast not specified to the urban context. All of these eight tools are further analysed in means of deciding their applicability for the peri-urban situation.

This choice of selection resulted in a small amount of software tools. It is actually only the Asian Development Bank's software tool SANEX™ and the Material Flow Analysis tool linked to the Household-Centred Environmental Sanitation approach left. Because of this the rejected tools created by SWARD, the Urban Water Programme and AISUWRS which includes software tools will also be further studied for possible appliance to peri-urban areas. For clarifying the differences between these two categories the non-software tools will be refereed to as planning models from now on.

4.3 SUSTAINABILITY CRITERIA CONSIDERED BY THE PLANNING SUPPORT

In this section the nine selected models' recognition of the five sustainability criteria, i.e. environmental aspects, economic aspects, socio-cultural aspects, health aspects and technical aspects, needed for the peri-urban situation will be examined. This is done by studying if the 26 sustainability indicators generated in section 3.4 have been taken into account. This

evaluation gives an indication of the width of considerations taken by the models and points at where gaps can be found.

4.3.1 The Mugabi et al. methodology

This methodology has the fundamental goal of reducing the number of urban low-income households that lack access to WSS-services. This can only be done by recognizing current situation and institutional arrangements, improving the cost revenues and the distribution efficiency of the services as well as the reliability. The focus is thereby laid on the economic, socio-cultural and technical sustainability criteria whereas the environmental and health aspects are being overlooked. Yet it is aimed at water utilities, which makes the method inappropriate for peri-urban areas where waterborne systems are difficult to implement. In Table 14 the sustainability indicators which are recognized by the methodology are summarised.

Table 14: The sustainability indicators that are considered by the methodology.

Sustainability criteria	**Indicators**
Environmental	-
Economic	Revenues for O & M
Socio-cultural	Institutional requirements Improve the urban poor access to water
Health	-
Technical	Distribution efficiency Reliability

4.3.2 The Open Wastewater Planning by WRS

In this approach the participation of stakeholders is central. For enabling the process, LFA and PHAST are recommended as supportive tools which include suggestion for how to perform workshops with many different groups of stakeholders. Cultural acceptance, affordability, legal acceptability and infrastructure are issues that need to be considered when examining the current status. In one example of a Terms of Requirements for low-cost sanitation systems the considered criteria were leakage of pathogens to groundwater, risk for infections, emissions of nutritients and organic matter, recycling of water and nutrients, cost for investment and O & M, reliability, maintenance needed and competence requirements. Table 15 summarises the sustainability indicators which are recognized by the approach.

Table 15: The sustainability indicators that are considered by the approach.

Sustainability criteria	**Indicators**
Environmental	Emissions of N, P and organic matter Reuse of water and nutrients
Economic	Affordability Costs for investments and O & M
Socio-cultural	Improve the urban poor access to water Cultural acceptance Participation Institutional requirements Legal acceptability
Health	Leakage of pathogens to groundwater Risk of infections

Technical	Maintenance needed Infrastructure needed Reliability Competence requirements

4.3.3 The Household-Centred Environmental Sanitation by Eawag

This approach is putting the household in focus and suggests that the planning should start from there. This stresses the importance of participation for getting feasible sanitation options for a certain context in aspects of affordability, social, institutional, legal and technical appropriateness. For getting affordable alternatives costs for investments, operation and maintenance need to be looked upon as well as considering possible financial arrangements. Technologies should be looked at in a wide way for meeting the requirements and possibilities for a certain location. Maintenance needed, level of infrastructure needed and reliability are aspects mentioned. The environmental aspect of reuse of water and nutrients is central in the approach here called *Circular systems*. The Material Flow Analysis tool that is recommended to use as a supplement to the planning approach estimates the flows of water, N and P in, out and throughout a system. This can be used for analysing the source and sinks of water i.e. the withdrawal of freshwater and water consumption, and emissions of N and P to water bodies. Health aspects are not being explicitly emphasised by the approach. Table 16 summarises the sustainability indicators which are recognized by the approach

Table 16: The sustainability indicators that are considered by the approach.

Sustainability criteria	**Indicators**
Environmental	Withdrawal of freshwater Water consumption Reuse of water and nutrients Emissions of N and P
Economic	Affordability Costs for investments and O & M Financial arrangements
Socio-cultural	Improve the urban poor access to water Cultural acceptance Participation Institutional requirements Legal acceptability
Health	-
Technical	Maintenance needed Infrastructure needed Reliability

4.3.4 The Schiller and Droste model

This model stresses the importance of investigation of public health indicators (not exemplified), affordability and institutional responsibility. This requires the participation of actors from different fields including health agencies and the local community. The chosen alternative should be analysed for social, economical, technical, financial, environmental and institutional aspects. Nevertheless, there is no description of how this should be performed and technical and environmental sustainability aspects remain therefore completely

unexplained. Table 17 summarises the sustainability indicators which are recognized by the model.

Table 17: The sustainability indicators that are considered by the model.

Sustainability criteria	Indicators
Environmental	Should be considered (not specified)
Economic	Affordability
Socio-cultural	Institutional requirements Participation
Health	Use of public health indicators
Technical	Should be considered (not specified)

4.3.5 The ADB Terms of reference

The core of this approach is to consider a wide range of technologies when planning sanitation and wastewater managements for urban poor. When studying the project area existing policies, institutional requirements, occurrence of water borne or related diseases, wastewater quality, groundwater quality and quality of public toilets are aspects to consider. When analysing the existing sanitation the users' comments are central as well as the institutional arrangements, health, environmental and cost recovery situation. For the technology selection process future population increase, centralized or decentralized sewage treatment systems, reuse of excreta, simplified sewers, Ecosan alternatives, on-site options, land area required and cost recovery alternatives are issues that should be recognized. Table 18 summarises the sustainability indicators which are included in the model.

Table 18: The sustainability indicators that are considered by the model.

Sustainability criteria	Indicators
Environmental	Wastewater and groundwater quality Land area required Consider reuse and recycling
Economic	Cost recovery and tariff structure
Socio-cultural	The community's preferances Institutional requirements Future population increase/urbanisation Legal acceptance to on-site sanitation
Health	Faecal pollution control
Technical	Flexibility

4.3.6 Sanitation 21 by IWA

This framework emphasises the need for improving the sanitation situation for the urban poor, especially the residents in unplanned and informal settlements which is common in peri-urban areas. For achieving this, the preferences of different city levels', like households, neighbourhood and the whole city, need to be considered and their participation should be encouraged. For the technology options on-site or off site possibilities, centralised or semi-centralised, dry or waterborne (degree of water consumption), reuse of water and excreta, flexibility and requirements of maintenance are issues that should be recognized. This framework does not consider economical and health aspects. Table 19 summarises the sustainability indicators which are included in the framework.

Table 19: The sustainability indicators that are considered by the framework.

Sustainability criteria	Indicators
Environmental	Reuse of water Water consumption
Economic	-
Socio-cultural	The different city level's preferences Participation Improvement of the urban and peri-urban poor access to water
Health	-
Technical	Management requirements Flexibility

4.3.7 The ADB toolkit

This toolkit should be a help for the planning of sanitation and wastewater systems in the developing world. It emphasises both the need for good policy building and financial structures as many of the aspects to consider when choosing technology as well as the need for community participation. For the decision-making between sanitation technologies the software tool SANEX™ could be used. It has a screening feature that helps to identify possible technologies for a specific situation. This is done as the user gives input data for different criteria like land area space, groundwater table, water supply and street access to house. The tool then shows which technologies that are feasible or not and the user can click to a detailed description of the different options. This option compendium consider hygiene, convenience, upgrading possibilities, cultural acceptance and operational and maintenance aspects for different toilet, collection and disposal alternatives. For treatment and resource recovery options environmental issues are additionally recognized. For hygienic aspects possible occurrence of flies and mosquitoes are discussed as well as the leakage of faecal coli-forms. For convenience, the distance to the sanitation service as well as costs is pointed out for example. For the aspect of cultural acceptance of the technologies much stress is put on the taboos especially for women. Table 20 summarises the sustainability indicators which are recognized by the toolkit.

Table 20: The sustainability indicators that are considered by the toolkit.

Sustainability criteria	Indicators
Environmental	Reduction and recycling approaches Quality of land required Emissions of BOD and N
Economic	Affordability Costs for O & M
Socio-cultural	Community participation approaches Distance to basic sanitation Cultural acceptance Institutional requirements
Health	Occurence of insects Leakage of faecal coli-forms
Technical	Flexibility Maintenance needed

4.3.8 The WUP toolkit

This model should be a support for making a good WSS-planning strategy to extend access for the urban poor. Examples of key issues that must be recognised are the complex situation of unplanned settlements, institutional requirements, low-income residents' possibility of participation, possibility of integration and tariff structures. The technology alternatives' characteristics are discussed in means of affordability, competence requirements, distance to users, water consumption, possibilities to monitor water quality, groundwater contamination, recycling, occurrence of flies, reliability, flexibility and maintenance required. Table 21 summarises the sustainability indicators which are recognized by the toolkit.

Table 21: The sustainability indicators that are considered by the toolkit.

Sustainability criteria	**Indicators**
Environmental	Water consumption Water quality monitoring Groundwater contamination Recycling
Economic	Tariffs and payment systems Affordability
Socio-cultural	Approaches for participation of low-income residents Institutional requirements Distance to users Land tenure questions
Health	Occurence of flies Improved quantity of water for hygenic purposes
Technical	Reliability Flexibility Maintenance required Competence requirements

4.3.9 The Gender toolkit by the World Bank

This model has the aim to implement gender awareness in the WSS-section, including the planning process. This should be done by performing a gender analysis and encourage participation of both sexes. This toolkit is therefore very specific and does not consider any other aspects than the social aspect of participation. Table 22 summarises the sustainability indicators which are recognized by the toolkit.

Table 22: The sustainability indicators that are considered by the toolkit.

Sustainability criteria	**Indicators**
Environmental	-
Economic	-
Socio-cultural	Participation of both men and women
Health	-
Technical	-

4.3.10 Summary

As shown in the previous sections, many of the sustainability indicators are being considered by the different planning models. There was not one superior model compared with the others which regarded all the important indicators. The different models considered different indicators due to their difference in perspectives of the planning process. This implies that for looking at the issue in a holistic way aspects emphasised of the different models can complement each other and a set of models need to be considered when searching for planning support for the peri-urban context.

The WUP toolkit and the Open Wastewater Planning are the models with greatest coverage for indicators from the five sustainability categories. This implies that these two models may be the most appropriate to use when planning in peri-urban areas because of their width in issues considered. However, as already mentioned, these as well as the other models are regarding different sets of indicators and can complement each other for developing a more holistic approach. Important issues to consider that were regarded of the other models can for example be the aspect of land area required that the ADB Terms of References emphasises, the need of consideration of the difference in preferences by the residents from different levels of the city by Sanitation 21 and the Gender toolkit's emphasise on gender structure and participation of both sexes. These aspects are essential for analysing the feasibility of a system in a specific context. Additionally can the SANEX^{TM} tool provided by the ADB toolkit be a support for considering hygiene, convenience, upgrading possibilities, cultural acceptance and operational and maintenance aspects while the MFA tool recommended by the HCES approach could be appropriate to use for studying flows of resources and emissions.

To sum it up, the models can complement each other when constructing a model that considers sustainability indicators central for peri-urban areas. Looking back at the set of indicators recommended in section 3.4.2, the majority of the indicators are taken into account by at least one model. However indicators for emissions of heavy metals and pathogen removal are not regarded by any of the models. On the other hand are a set of indicators, like reuse of water, affordability, participation, institutional requirements and flexibility covered by several of the models. These can thereby be seen as widely recognised which indicates their importance.

4.4 SOFTWARE TOOLS

Software tools can enable the planning of WSS-systems and are frequently used in the developed world. The Urban Water program, SWARD and AISUWRS, which are not focusing on the developing world, have designed or are using already existing software tools for the planning process. The applicability of these tools for this context will be examined as well if there is an actual need for them.

4.4.1 Review of software tools

Urban Water is using Multi Criteria Decision Aid, MCDA, tools for the analysis of the different options. MCDA can be divided into five steps (Söderberg and Kärrman, 2003):

- *The structuring of the Decision-Making Situation:* How the problem is formulated and constructed is important for the outcome of potential options. Therefore the options and their following attributes that describes their characteristics should be defined in this step.
- *The preference articulation and modelling:* Here the decision-makers preferences must be taken into account for deciding the relative importance of the different attributes.

- *The aggregation of preferences:* In this step an evaluation on the whole set of alternatives is performed by including all attributes. This can be done in some different ways. One is to value the criteria according to their weight and then adding the scores for an overall value (linear additive model) or by using an outranking approach.
- *The exploitation of this aggregation:* The aim for this step is to investigate why some options are better accepted than others. A sensitivity analysis can be done for identifying the most significant attributes.
- *The recommendation:* This can be in the form of a ranking list or by a recommendation of the best choice.

The program uses for example the MCDA-tools method, Novel Approach to Imprecise Assessment and Decision Environments, *NAIADE,* and Strategic Adviser, *STRAD.* The former method starts with a pair-wise comparison of alternatives. The relations between two options can be stated as 'Is much greater', 'Greater', 'Approximately equal to', 'Very equal to', 'Less than' or 'Much less than'. Additionally a credibility index between 0 and 1 should be given to the alternatives. The method is based on participants reaching consensus. The STRAD method is also based on consensus-reaching and divides the planning into smaller decision areas. When combining them in different ways diverse system structures are presented which are weighted by the participants.

For analysing environmental aspects the program uses *URWARE* and *SEWSYS*, which are both applied in MATLAB/Simulink. The former is a model for substance flow analysis that can handle 84 substances, like different forms of nitrogen, phosphorus, sulphur and COD/BOD. For using this tool data for the waste water fractions i.e. urine, faeces and grey water is needed. The model is based on a default vector for average Swedish conditions and because of this changes have to be made when using it in another context. The result from the modelling is in the form of substance flows to soil, water and air. Heavy metals to soil, COD and nutrients to water and CO_2, SO_2 and NO_X to air are examples. SEWSYS is a dynamic pollution load model for treatment and transport of storm water and sanitary wastewater in sewers. The tool enables the monitoring of pollutants from source to the location for disposal. The model assumes the system to be constructed of combined or separate sewers connected to an activated sludge wastewater treatment plant (Malmqvist et al. 2006).

For health aspects the program has designed Microbial Risk Assessment, *MRA*, and Chemical Hazard Identification and Assessment Tool, *CHIAT*. The MRA is based on the idea that risk of infections should not go beyond a certain background level for reaching sustainability which can differ between regions and time. The tool compares different water system options' occurrence of infections per month, robustness, critical pathogens and pathways of infection. The tool uses a set of index organisms and study variation in frequency of these due to treatment changes. For considering local water quality and operational maintenance Monte Carlo simulations are used. CHIAT is mainly used for trying to identify which pollutants that should be prioritised when humans, aquatic and terrestrial organisms as well as plant are the receptors. Key aspects to consider are sorption, volatility, persistence, potential for bioaccumulation and aquatic toxicity of the chemicals. The methodology includes 'source categorisation', 'recipient, receptor and criteria identification', 'hazard and problem identification' (for ranking), 'hazard assessment' (for studying effect and exposure) and 'expert judgement' (for trying to reduce numbers of compounds).

Additionally, the program has constructed a *costing model* which is used in Excel in order to estimate annual costs per connected person, cubic meter of waste water, recovered quantity of P, K, N and S, discharged quantity of P and N and kWh used.

SWARD is also using MCDA-tools to enable the decision-making, where *PROMETHEE* and *SMART* are examples. The Preference Ranking Organisation Method for Enrichment Evaluation, PROMETHEE, is an outranking method which evaluates the dominance of one alternative over another based on the stakeholders' preferences for certain indicators. The output is a suggestion for the best option available. This tool is highly mathematical and it can be difficult for the user to understand the functions behind. Simple Multiple Attribute Rating Technique, SMART, may be easier for the user to understand and requires less specialist competence. This is not an outranking method but a weighting method and does not present one option but a set of feasible options. The weighting should be done during a discussion among decision-makers (Asheley et al., 2004).

For gathering information about the environmental aspect of the options SWARD uses a LCA-software tool named *SimaPro* using EcoIndicators99. Life cycle assessment is a method for analysing environmental impact 'from cradle to grave' of different products or systems. This can be helpful for comparing possible alternatives' impact on different environmental issues like global warming, eutrophication and acidification. The tool helps the user to construct a process structure for a basic LCA and can enable the handling of the big amount of data since it provide the user with a database named Ecoinvent which covers 2500 processes (Pré Consultants, 2006). Another life-cycle assessment method, though not recommended by SWARD, is the Tool for the Reduction of Chemical and other Environmental Impacts, TRACI, produced by the US EPA. The tool can be used for evaluating the environmental and human health impact of a system. Categories used are acidification, eco-toxicity, eutrophication, global warming, human health (cancer, criteria pollutants and non-cancer), land-use, smog formation and water-use. Data needed are site-specific data about material components of the systems (Kirk et al., 2005).

For studying technical and hydrological aspect SWARD recommend using *AQUATOR* which is a water resource system model for both natural river systems and water supply networks and using *InfoWork* for identifying cost effective infrastructure improvements. These are mainly applicable for networked WSS-systems and need a great amount of data as well as expert competence.

AISUWRS is mostly focusing on groundwater aspects and have designed a set of groundwater models that can be used for examine groundwater contamination from sewers. *UVQ* is an urban water volume and quality model, *NEIMO* is a network ex-filtration and infiltration model and *POSI* and *SLeakl* are unsaturated transport models. These models needs a great quantity of data and require specialist competence by the users. There is also little relevance for peri-urban areas as leaking sewers are the key objective (AISUWRS, 2005).

Additionally, AISUWRS has designed a socio-economic-environmental tool named Socio Economic and Environmental Sustainability Assessment of Urban Water Systems, *SEESAW*. This tool should be used together with a complementary tool named AISUWRS Deliberator. For socio-economic issues the tool requires performance of household questionnaires and stakeholders interviews for gathering information about willingness to pay, satisfaction of the existing system by using certain indicators and the interviewees' priorities of the indicators. Examples of indicators are water quality and quantity, assurance of future supply and

prevention against environmental factors. Figure 12 illustrates a Quality-Importance-Matrix with possible improvements on one side and importance of improvements on the other. The letters in the figure indicate the different indicators that were posed questions about. This can be a support for ranking and prioritising the considered categories of improvement. In this case the indicators F, I, K, W and H are of highest priority whereas indicator P is of the lowest. This matrix can also be compared to the willingness to pay for the indicators.

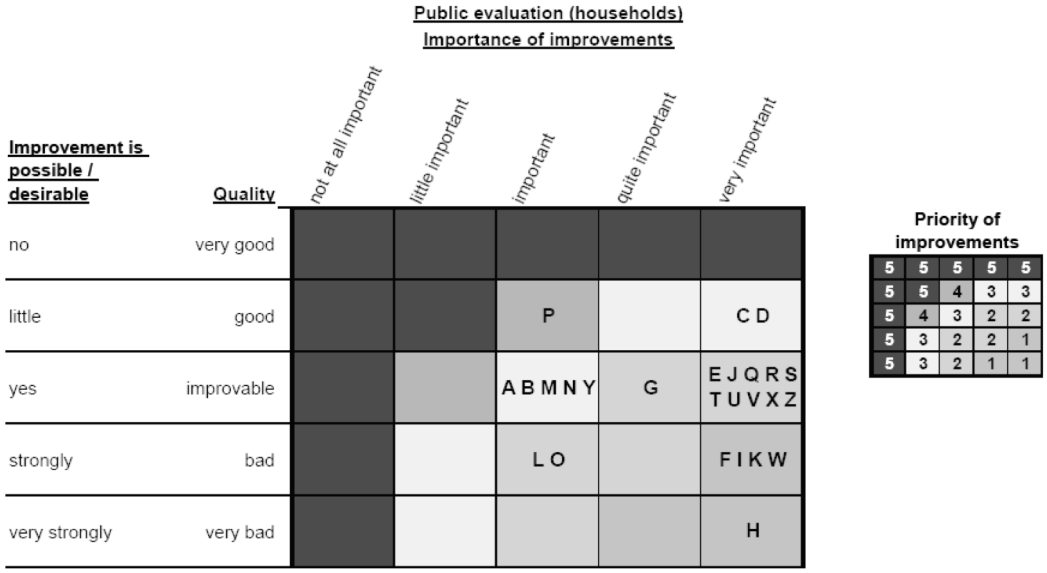


Figure 12: AISUWRS Quality-Importance-Matrix where the boxes marked with 1 imply great importance of aspects and those marked with 5 little importance (AISUWRS, 2005).

The AISUWRS Deliberator tool can be used for assembling the consideration of a diverse stakeholder group for all different scenarios. The tool demonstrates the stakeholders thought and weighting of the scenarios in means of consideration of the indicators. The tool can also give the total weighting of all of the stakeholders which can be a good starting point for consensus discussion.

SANEX^{TM} and *the Material Flow Analysis, MFA, tool* designed by Eawag are the only software tools found that is explicitly designed for the developing world. SANEX^{TM} is divided into three modes: 'Screening', 'Composing and rating' and 'Compare'. The aim of the first mode is to identify technically feasible sanitation technologies. To evaluate the feasibility the user should consider some criteria about the specific project area and give input about the situation. The criteria regards the locations water supply, soil type, infrastructure condition, residential patterns etc. This provides the user with some feasible options for type of toilet, collection, disposal, treatment and resource recovery for systems aimed for households, to be shared or of communal type. In the next mode different combinations of feasible technologies are designed. The tool can also estimate costs for the different systems as this is an issue of concern when choosing an option. Data needed for this estimation is the currency unit, consumer price index for US, Purchasing Power Parity, PPP, factor conversions which can be provided from the World Bank's list of World Development Indicators, the year for the PPP factors, the cost of water and the population size. After considering the costs and description as well as pros and cons of the alternatives which can be found in the compendium enclosed to the CD-ROM the user should rank the combinations. Regarded aspects in the compendium are 'Hygiene Performance', 'Environmental performance', 'Upgrading options',

'Construction' and 'Operation and Maintenance'. After gaining knowledge about the alternatives, one of the three ranking degrees should be selected by the user. In the last mode the user gets a chance to view and compare the rating and costs of all of the alternatives as a support for making a decision.

The MFA tool can be used for identifying central material flows, quantify mass flows, identify weak points in the system and evaluate scenarios. When using it in peri-urban areas in Hanoi, central risk aspects found were groundwater abstraction, water pollutions and the need of using water and nutrition in peri-urban agriculture. The model can analyse the flows of excreta, groundwater, grey-water and organic solid waste between households, sewerage, sanitation installations, landfills and agriculture. Data needed are number of inhabitants, water consumption, type of sanitation system etc. The model could be modified for the concept of zones for getting to be more suitable for the HCES and Sanitation 21 approach (Montanegro et al., 2006).

4.4.2 Evaluation of applicability for peri-urban areas

For evaluating the applicability of the tools for peri-urban areas some questions need to be considered. These can for example be:

- Is the tool relevant for the planning process in peri-urban areas? Is there for example too much focus on the situation in the developed world?
- Is there a fundamental need of the tool?
- How much competence is required for using the tool?
- How much data are needed for using the tool?

MCDA-tools can be suitable to use in the comparing mode of the Strategic Choice Approach, SCA, which will be described in the next section. For this purpose STRAD are further studied as it is recommended by the initiators of the SCA as well as from the Urban Water program. The researcher from the program found STRAD superior to the MCDA-tools REGIME and NAIADE in software flexibility, graphical interface, weighting between quantitative and qualitative aspects, user-friendliness and transparency. On the STRADSPAN homepage a demo version of the program can be downloaded[2].

SimaPro can be a helpful tool for a user with little experience of LCA and its methodology. The tool has a supportive tutorial and is easy to understand and overview. Yet, the approach requires inclusive knowledge about the system and its processes which can be time-consuming to fulfil. The tool provides the user with a database including useful information of processes and system components but the use of it in other regions can be restricted. A demo model is available at the PRé Consultants homepage, who are the developers of the tool[3].

If looking at the environmental tools URWARE and SEWSYS, the former may be seen as the most promising for this context. The SEWSYS is based on the assumption of the use of sewer systems connected to an activated sludge wastewater treatment plant which is seldom the case in peri-urban areas. URWARE may be more applicable in this context but is constructed for Swedish conditions and adaptation for other situations must be made to a large extent. The model is also complex and a model for simplified substance flow analysis may be just as adequate. A substance flow analysis considers the flows to, through and from a system and

[2] http://www.btinternet.com/~stradspan/
[3] http://www.pre.nl/

has the aim to identify the most important emissions and from where they originate. For a simplified version the most important pollutants to regard can be Biological Oxygen Demand BOD, Chemical Oxygen demand, COD, Nitrogen, N, Phosphorous, P and some heavy metals commonly found in the area. These pollutants are relatively easy to measure and consider different kinds of impact on aquatic and terrestrial systems. The BOD and COD account for oxygen depletion and CO_2 emissions, N and P account for eutrophication and heavy metals for toxic contamination (Benedetti et al., 2006). Data needed are for example annual rainfall, water discharge and agriculture activities in the river basin. The MFA tool may be a good option for looking at N, P and water flows but does not consider BOD, COD and heavy metals. The tool is a promising alternative as it has been used in practise in peri-urban areas with good results.

The results given from the MRA tool is presented as number infected persons per year by the different reference pathogens. The health risk for different systems can then be compared which is highly relevant for peri-urban WSS-systems. Quantitative Microbial Risk Assessment is recommended in the "*WHO Guidelines for the Safe Use of Wastewater and Excreta in Agriculture"*. This report emphasise the potential of the tool in aspect of the possibilities to relate the amount of pathogens in the environment to the probability of human infections (Petterson & Ashbolt, 2007). CHIAT may be seen as less relevant as it does not considers health risk attached to faecal pathogens that are most frequent and the biggest problem in these areas.

The costing model from the Urban Water Programme is designed for Swedish conditions and must be modified for other locations. Data needed are for example number of people connected, installation costs, transport requirements, length of pipelines and nitrogen reduction. The effort needed for this modification must be weighted against the usefulness of the result provided from the model. The SANEX™ tool has also a costing function which is more modified for cost estimations for technologies commonly used in peri-urban areas.

The SEESAW and AISUWRS Deliberator tools can be seen as a complement to a MCDA-tool because of its characteristics of being possible to use for identifying the preferences and thoughts about the present situation from diverse groups of stakeholders. Demo versions are available at the Futuretec homepage[4].

AQUATOR, InfoWorks and the groundwater models by AISUWRS do not have too much relevance for the planning process in peri-urban areas. This is due to the focus on networked system and their highly complex technical design that need a great quantity of reliable data and expert competence from the user.

4.4.3 Recommended software tools

There are some tools that could be appropriate to use in the planning process in peri-urban areas. In some cases the tools might need modification for this new context.

- For participatory *decision-making* SEESAW/AISUWRS Deliberator, STRAD and SANEX™ can be useful tools. These can complement each other or be used separately.
- For considering the *health* aspect MRA is a helpful tool. This is recommended by WHO and are used in diverse contexts around the world.

[4] http://www.futuretec-gmbh.de/english/projects/environment.htm

- For the *cost* aspect the SANEX™ feature of estimating costs might be a better choice than the costing model in the Urban Water toolbox as the latter is constructed for Swedish conditions and must be modified for another context.
- For the *environmental* aspect a substance flow analysis, Life Cycle Assessment, LCA and Environmental Impact Assessment, EIA, could be useful methodologies for making a wide Environmental System Analysis where the two latter methodologies are not software based. SimaPro can be a help for getting into the LCA methodology but the database provided from the tool may be difficult to apply in different parts of the world. For the substance flow modelling URWARE can be too complex to use and a simplified version that take COD, BOD, N, P and heavy metals into account could be adequate. One example is the MFA tool produced by Eawag, however it does not consider heavy metals.
- The SANEX™ tool can be used for deciding *technical* feasibility for different technologies.
- For the *socio-cultural* aspects no software tools have been found during the literature review. However for this aspect there may be little need for a software tool and a check-list of important issues to investigate could be more functional.

4.5 A FRAMEWORK FOR PLANNING

In this section a framework for the planning process is being constructed based on the Strategic Choice Approach which is used in the Urban Water Programme. The planning models identified in the previous section are used for adjusting the approach for this context and to consider the sustainability indicators.

4.5.1 The Strategic Choice Approach

The Strategic Choice Approach, SCA, was developed by Friend and Hickling with the aim to enable the decision-making and communication among the stakeholders involved in complex problem situations (Friend, 1992). The SCA is a kind of soft system approach which in contrast to the hard system approach sees the urban infrastructure as a constant changing system with many actors and sub-systems. The system is not constant and a fixed technology to resolve the problem in the best way is not likely to be found. There are uncertainties existing about the future and upcoming actions can not always be known (Söderberg & Kärrman, 2003). The pointing at uncertainties and the changing characteristics of need for WSS-systems by the approach is a suitable basis for planning in peri-urban areas.

The uncertainties can be divided into three groups:

- *Uncertainties about the working environment:* this lack of knowledge about the environment of the system can be improved by further information gathering, investigation and research. Examples are socio-cultural aspects and the physical/environmental situation.
- *Uncertainties about guiding values:* this type of uncertainties requires more comprehensible policies and objectives. One example is national or regional policies.
- *Uncertainties about related decisions:* this calls for wider knowledge about areas with linked problems since some kind of cooperation may be needed. One example is planning of other kinds of infrastructure.

The process is divided into four different modes; shaping mode, designing mode, comparing mode and choosing mode, Figure 13. The figure emphasise that the planning course is constantly shifting between the circles and are far from linear. Reaching a new mode does not

mean that the activities in the former mode is completed, it may be needed to go back a step for complementation (Friend, 1992; Söderberg & Kärrman, 2003).

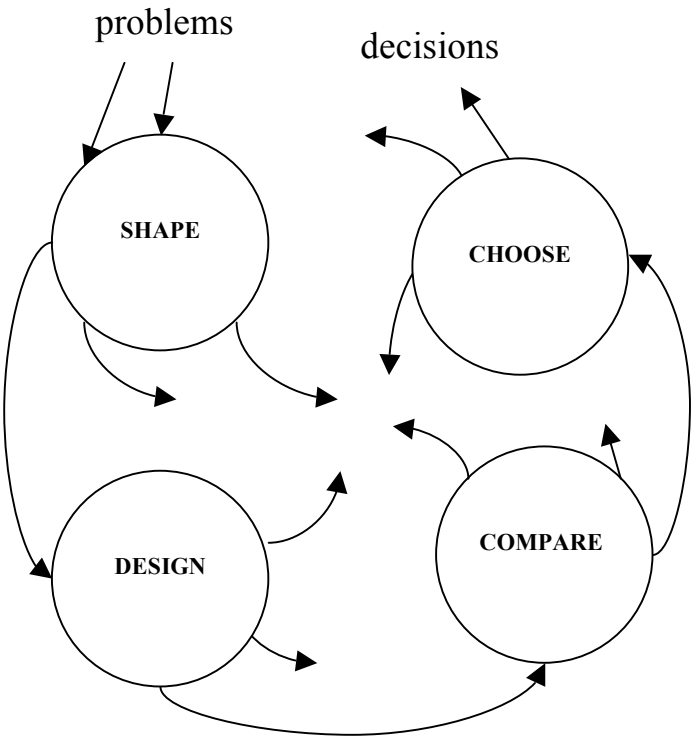


Figure 13: The four modes of the Strategic Choice Approach (Modified from Friend, 1992).

The aim of the *shaping mode* is to reach a common vision of the problem and the challenges that may occur when trying to solve it. The issue should be discussed among spokesmen of different views and agreement should be met for a common definition. The approach recommends viewing the problem as a set of sub-problems called decisions areas. This makes it easier to define the problems as specific questions which in turn can give a clearer direction for the solutions. For sanitation different decision areas can be alternatives for toilets, treatment methods, disposal methods etc.

In the *designing mode* different alternatives of activities for solving the issue is being identified. This step is also a negotiation between different stakeholders for considering a possible option for one group, with specific preferences, a possible option for the others. Here, different combinations of choices for the decision areas, called decision-schemes, can be used to examine the degree of feasibility.

In the *comparing mode* these alternatives are being evaluated against a set of criteria and between each other. The pros and cons for the options should be analysed and evaluated by the participants. The evaluation is highly dependent on the knowledge about the alternatives i.e. their uncertainties. Some uncertainties are central in the decision-making whereas others have little weight for the participants.

The aim of the *choosing mode* is that the group of stakeholders should be in agreement of the most suitable decision. The decision comes in the form of a commitment package which can give four types of output:

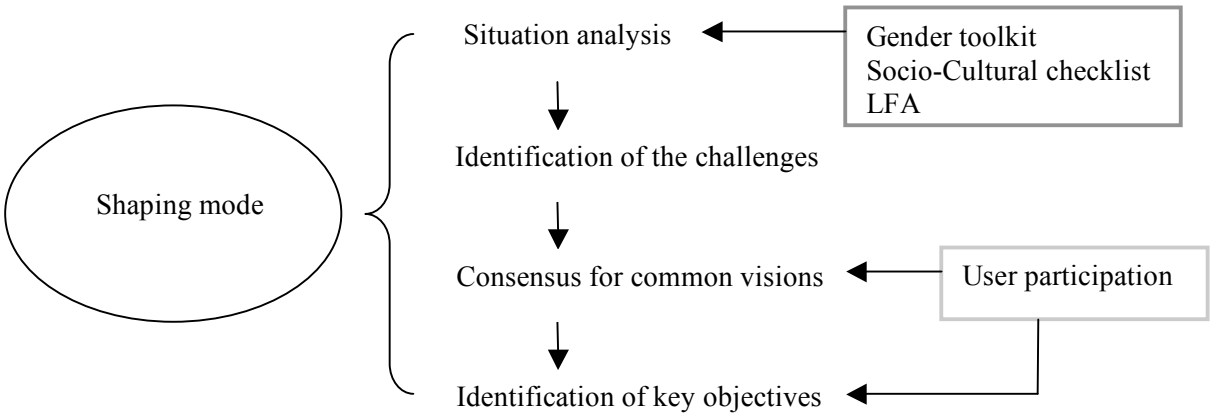
- direct action
- further study of the uncertainties
- decision-making is postponed until reconsideration in the future
- uncertainty plans for expected future actions that can effect the process (ibid.).

The MCDA-tool STRAD is recommended by the initiators of the SCA. For the *shaping mode* the tool gives the user an overview of the issues of concern and for the *designing mode* the tool provides help for regarding the compatibility between two options from different 'decision areas'. In the *comparing mode* different options within a 'decision area' are compared on a scale for one comparison area at time. After this procedure a combined scheme can be presented for comparing all feasible 'decision schemes'. For the *choosing mode* the tool reminds the user of the uncertainties areas remaining (STRADSPAN).

4.5.2 The contribution of the planning models and software tools to the framework

The planning models are used in different ways for the development of a suggestion for a planning process framework. Some of them include step-wise algorithms with more or less similarity to the modes of the SCA and can be used for adjusting the framework for this context, while others may be used as complementary tools together with the software tools for reaching the objectives of the modes with the peri-urban areas in focus. The framework is taking account of many of the sustainability indicators from Table 6 and these will be pointed out by being typed in italics.

If starting with the *shaping mode,* Figure 14, the content of this mode needs to be enlarged for including a comprehensive situation analysis.



Figur 14: The different components of the shaping mode of the planning process. In the darker squares helpful tools can be found.

The importance of such an analysis is emphasised by the ADB TOR, the Schiller and Droste model, the Mugabi et al. methodology, Open Wastewater Planning, HCES and the WUP toolkit. This analysis should inquire characteristics of the target population, unaccounted for WSS, socio-cultural aspects including *gender structure* and *cultural acceptance to different kinds of WSS alternatives*, environmental situation including *groundwater levels and freshwater sources available*, health situation, *future urbanisation*, *affordability for water and sanitation, level of infrastructure, legal acceptance to onsite sanitation* etc. To be able to recognize all socio-cultural issues a checklist could be appropriate to use. Here many indicators for the socio-cultural sustainability criteria in Table 6 are used. Table 23 gives an example of a set of issues to consider for the shaping and designing mode. For the analysis of

the gender structure the Gender toolkit may be of use whereas the Logical Framework Approach, LFA, recommended by OWP can be supportive for analysing the context and stakeholders.

Table 23: A suggestion of aspects to consider in a socio-cultural checklist.

Mode	Issues
Shaping	Study institutional responsibilities Study legal and regulatory basis with special focus on tenure problems and regulations of standards for systems Study financial structure for examine affordability aspects Study regional and national policies Study gender structures Study the amount of people without access to safe water and basic sanitation Study the distance for safe water and basic sanitation for consumers
Designing	Study cultural taboos linked to WSS-issues Acceptance for reusing excreta Acceptance for handling excreta Difficulties for women to use shared toilets

There should also be an investigation of the existing WSS-system, both with regard to quality aspects as well as quantity aspects. This analysis should illuminate challenges coupled to the specific area which can prevent the use of certain technologies or approaches for the different decision areas. This indicates that different part of the system should be viewed like for example what kinds of toilets are used and how the wastewater is treated and disposed etc.

The next step will be to try to reach a common vision for identifying key objectives. These can for example be to set standards for *water supply per day* and level of sanitation. This mode requires consultation with all stakeholders with great emphasis on the preferences and priorities of the users. In this step and for other steps where *participation* is needed the Gender toolkit stress on the use of Gender analysis can be of use as well as studying examples of community mobilization included in the ADB toolkit, Logical Framework Approach, PHAST and the WUP toolkit. Both LFA and PHAST are recommending guidelines to consider when arranging workshops with stakeholders with different levels of knowledge and background. This step may also contain the need for policy making as a way of establishing common visions. Here can both the ADB toolkit as well as the WUP toolkit be of assistance. The ADB toolkit includes a chapter named "*Working the Policy"* including ideas of how to implement policies in a successful way. The WUP toolkit recommends practitioners to review existing policies to study their recognition of international agendas. If this is not the case, they should try to lobby for a reform. This mode takes account for environmental, health, economical and socio-cultural sustainability indicators from Table 6.

The *designing mode* starts with an identification of possible options, Figure 15. This needs to be done with the *participation* of the users for getting options that are adequate for their preferences and thereby can be considered as options. Here a socio-cultural checklist can as

well as a Terms of Requirements including suitable criteria for the context, like the one listed in the Open Wastewater Planning approach, can be useful to take action from.

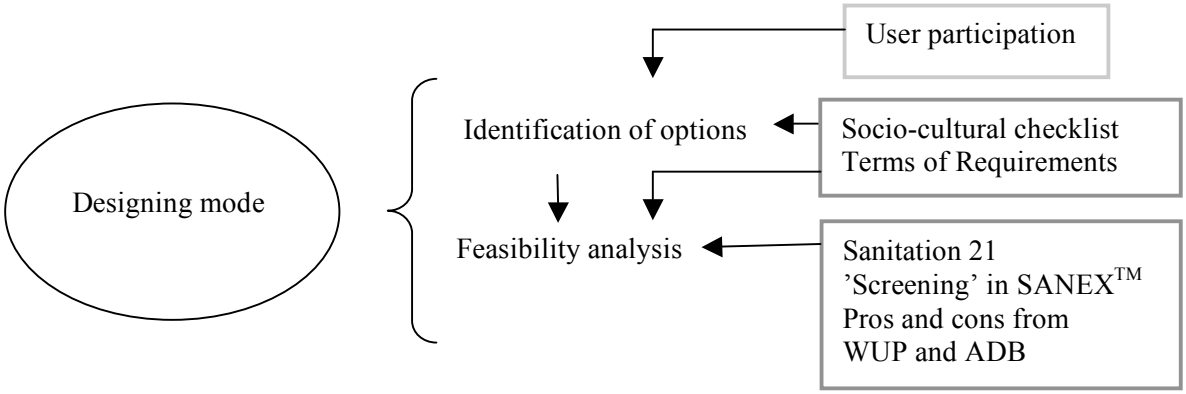


Figure 15: The different components of the designing mode of the planning process. In the darker squares helpful tools can be found.

The ADB TOR gives examples of questions to consider during the identification such as choosing between conventional and low-cost alternatives or centralised and decentralised sewerage. Both the Schiller and Droste model and the SANEX™ compendium point at the alternative of upgrading the system if possible. The HCES approach stresses the importance of viewing possible technologies in a wide way to be able to choose the one which best fit the context.

The next step is to consider the feasibility of the options for a specific location. For this Sanitation 21, the 'Screening' mode in SANEX™ and the pros and cons listed in the WUP toolkit as well as the ADB TOR can be helpful tools. Sanitation 21 can be used for regarding the need for the WSS-system to fit the context and the diverse preferences of the different levels of the city. Much focus is laid on the degree of involvement for *maintenance needed* for different systems. The SANEX™ uses a set of criteria for investigating the feasibility of a range of sanitation systems for a specific location. The criteria are for example *land area available*, *quality of land* and *level of infrastructure*. The WUP toolkit takes the WSS-system's *affordability, competence requirements, distance to users, water consumption*, possibilities to monitor water quality, groundwater contamination, *recycling, occurrence of flies, reliability, flexibility, maintenance required* etc. into consideration whereas the ADB TOR regards *participation, costs, health improvements, convenience*, on-site options, *maintenance requirements, resource reuse*, environmental impacts etc. In this mode many of the technical sustainability indicators from Table 6 are to be found as well as indicators considering health and environmental aspects. The outcome of this mode should be options that are technical and socio-cultural feasible for a specific area.

For the *comparing mode*, where options are compared in aspects of environmental impact, health and costs, software tools can be of interest to use, Figure 16. For evaluating the health and environmental aspects of the options simplified substance flow analysis like for example MFA for examining *emissions of BOD, N, P and heavy metals* and MRA for *investigating leakage of faecal coli-forms to freshwater* and *infection risks* be applicable. Additionally for the environmental aspect can the use of a combination of LCA and EIA be suitable. EIA is a methodology for examine the impact on the environment of a proposed project in a systematically and holistic way. The term environment is here including both the physical environment consisting of air, water, soil, flora, fauna, human beings etc. and socio-economic

environment consisting of labour, demography, housing etc (Glasson et al., 2005). The LCA can complement the more locally focusing EIA by looking at a larger system as well as environmental impacts like acidification and carbon dioxide emissions on the global level. This methodology can be suitable for peri-urban areas since it is appropriate to view the environmental aspects in a wider way as these areas are strongly affected by the activities both in the city and in rural areas. The methodologies also differ in objectives as the LCA is focusing on the whole lifecycle for a product from cradle to grave and is suitable to use for making decisions about product design and choices of products while EIA can be used for deciding location for a system (Kärrman, 2000). For estimating *costs* of different systems SANEX™ can be used.

The MCDA-tool STRAD, SEESAW/AISUWRS Deliberator and SANEX™ can be functional for taking account of preferences and attitudes for the alternatives of different stakeholders in the comparing process. These tools should be a help for investigating what the stakeholders find important and not important in a systematic way and enable the communication process. It can also be seen as a good support for accounting the Sanitation 21 and HCES stress on recognising the difference in preferences between different levels of the city. In this mode are thereby sustainability indicators for environmental aspects, health aspects and costs taken into account.

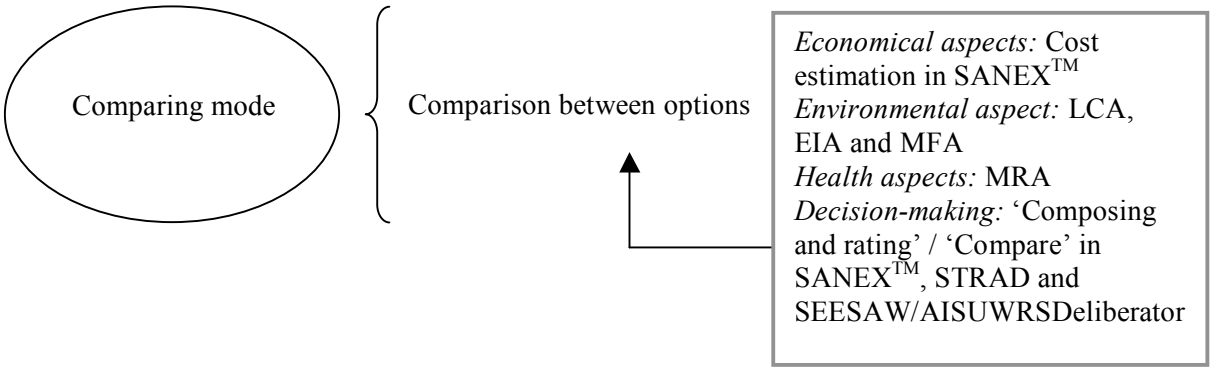


Figure 16: The comparing mode of the planning process with helpful tools in the dark square.

In the *choosing mode* one option should be chosen, Figure 17. For doing this, user participation is essential for reaching a consensus or as close as possible to a common decision. The ADB TOR, Open Wastewater Planning and HCES put workshops forward as a good medium for this discussion. In the HCES approach this workshop should be participated by both planners and residents and should include a review of the plan for citywide urban environmental sanitation service including certain priorities and a timeline. In this step it may be necessary to come to terms with the fact that further investigation needs to be done in the previous steps or that the decision is needed to be deferred to the future for making a successful decision.

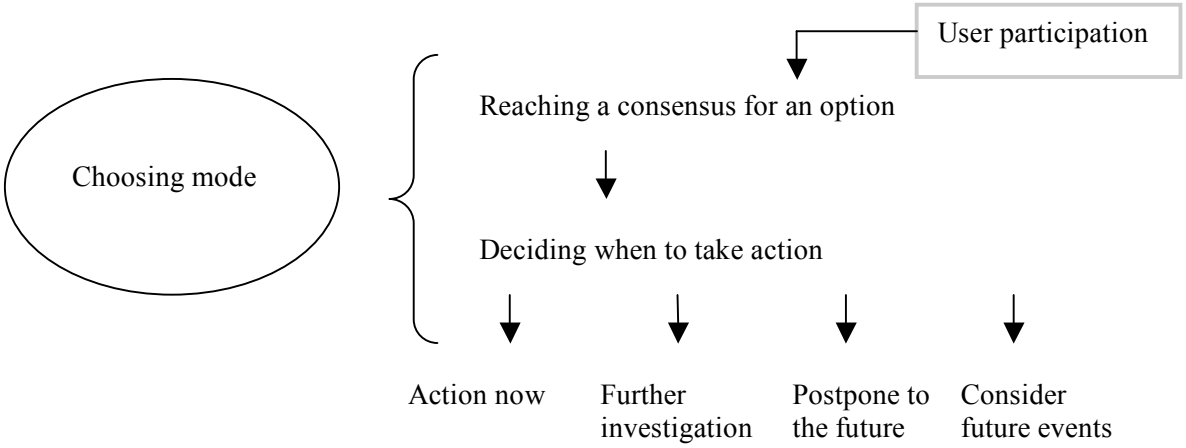


Figure 17: The different components of the choosing mode of the planning process.

5. INTERVIEW STUDY

The aim of the interview study was to improve the understanding of the issue in focus by gathering experiences from persons with much knowledge about it. The interview study took place in the region of Stockholm in May 2007. The interviewees were contacted by e-mail with the suggested planning framework attached as well as the preliminary report. The study was aimed to be of qualitative type and the questions asked were thus not exactly the same at all occasions even though the theme of questions remained unchanged.

5.1 INTERVIEW QUESTIONS

The questions asked with some modifications between different interviews were:

In what way have you been working with water and sanitation in peri-urban areas?

- How would you describe peri-urban areas?
- Can you give example of projects that you have been involved with?
- What problems have you been faced with in your work that could be related to the peri-urban context?
- What have the existing systems looked like?
- How do you choose a certain system?
- What does the planning process look like? Are there certain steps that are important for the results of the process?
- Which actors are important to collaborate with in each step?
- In which part of the planning process are you getting involved?
- How have you been able to take into account sustainability criteria in your work? Have you used any kind of tools for doing this?
- Is there a need for tools for planning and choosing systems?
- What possibilities and what limitations exist for using planning tools?

All of the questions were asked but there were no requirements for answers by everyone due to awareness of differences in relevancy due to backgrounds and experience. The interviewer did not try to push the direction of the discussion very hard for getting answers to all of the questions.

5.2 INTERVIEW WITH ANNA TUFVESSON

Anna Tufvesson works as a programme officer at the division for water at the department for natural resources at SIDA and has previously worked as a consultant in peri-urban areas in the WSS sector in countries like Laos and Uganda. In Laos Tufvesson was responsible for the environmental and sanitation aspects in the implementation phase of infrastructure in small towns and in Uganda her main responsibility was to be a technical adviser for ecological sanitation in collaboration with the Kampala municipality. The African project started with the peri-urban residents as a target group but this was later modified to urban poor unaccounted for sanitation. She has also been working at the division for urban development at SIDA with issues concerning urban planning and city development strategies.

When working with WSS in peri-urban areas she sees institutional issues as one of the greatest obstacles. This can be on different levels; one example is that the households do not consider on-site sanitation as a part of their house and another that the water utility does not see the areas served by on-site sanitation as a part of their responsibility area. There are also vital problems concerned with linkage between urban and rural areas and between the city

water utility organisation and the municipal authority, where the latter is often responsible for building permits and environmental and health concerns in their municipality and thereby also WSS issues. This leads to the consequences of that waterborne systems are discussed completely separately from on-site alternatives and the comparing mode becomes limited. Her opinion is that more collaboration between water utilities and municipal authorities are needed for considering water supply and sanitation at the same time. The systems should be regarded in a holistic way to ensure their functionality in a certain context. This could lead to opportunities for cross financing between the water supply part and the sanitation part which is important as the municipality often lack resources in terms of money, capacity and competence. For the peri urban areas municipal planning is often close to absent and the ignorance of the fact that these areas are not constant but instead ever changing results in a situation where these areas get in between the systems and become overlooked.

She argues that supportive planning tools are much needed in the very beginning of the process because of the risk to start in an inadequate way which may lead the project in an inappropriate direction. There are also great chances for misconceptions between foreign consultants and locals with better knowledge about the existing situation. In Laos she experienced a situation when the planning and the choices suggested by non local consultants before her involvement in the project were inadequately adopted because of misconception about the definition of and treatment of wastewater. The task to take into account already defined environmental criteria thereby became highly complex. Tufvesson considers that it is important to identify strategic occasions when choices can be done in the real planning process. This can often be a difficult task and these opportunities are often passing without being recognised. Designing urban development plans, water utility plans and municipality environmental plans are some examples. This is due to the impact that these strategies have on the levels of standards which are guiding for the planning. Here planning tools can be of great support.

Participation is another key concept for making the planning process successful. For this purpose she recommends PHAST and Household Centred Environmental Sanitation, HCES, as supportive approaches for peri-urban areas which are not dependent on large centralized systems and government from the city. The PHAST is a useful tool for changing attitudes and unsustainable behaviours connected to WSS. The approach is designed for being suitable when working with communities with a high percentage of analphabetic residents and may be needed to be adjusted for another target group so that no one gets offended. The HCES which holds the households at the centre of the planning process could be a good complement to programmes with larger systems as the basis. These approaches depend on smaller communities and the affinity between residents. She also mentions Community Led Total Sanitation, CLTS, which is an approach for mobilising communities to improve their own sanitation situation by stressing the advantages of sanitation defined by themselves, e.g. convenience or other aspects. The major advantages of this approach are that it is the users themselves that are in charge and because they are familiar with the context they will find the most efficient way to build low-cost sanitation systems. This approach is mainly used in rural areas but is being tested at a small scale in urban areas as well.

Her experience from deciding target criteria for projects is the great complexity coupled to the activity. This is mainly due to the diverse objectives of households compared to authorities on different levels of. Her opinion is that in some cases there may be a need to step out of the theoretical sustainability criteria approach for testing and evaluating it in practise by contrast. She stresses the great importance to view sustainability in a wider way in contrast to just

focusing on environmental and ecological sustainability aspects. That the systems can be self-financed, i.e. be working even without means from possible external donor agencies, is a central sustainability criterion. Step-by-step improvements, upgrades and flexibility of the systems are other aspects to have in mind for reaching sustainability. Finally she thinks that it is vital to consider the WSS-system in a holistic way as a system with wide boundaries because of the many aspects that influence it. It is important to be open for many possibilities and also try to take account of water resource management in the WSS-planning.

5.3 INTERVIEW WITH ELISABETH KVARNSTRÖM

Elisabeth Kvarnström works as a consultant part time at Verna ekologi AB and part time at Stockholm Environmental Institute, SEI, and has been working with sanitation issues in peri-urban areas in different ways. Previously she has mainly been working with questions concerning education and project planning at a professional level in developing countries. Right now she is working as a consultant in a project in northern Ghana with the aim to improve the sanitation in three cities. These are of peri-urban type as they are densely populated and lack infrastructure while not being integrated into any water utility system and are in desperate need of improved sanitation system.

Approximately 50 to 70 percent of the populations in these cities do not use a sanitation system and open defecation is therefore a serious issue. In this project she is working together with a social anthropologist and is using a participatory approach as a basis for the planning process and mentions the Open Wastewater Planning approach as a reference. By doing this many of the sustainability criteria will be considered automatically. The project also includes pilot projects of the planning process with the aim to find out in what way this should be performed for best suiting the special context. She stresses the need to put function in focus rather than techniques for making a project successful.

Both the objectives of the users and the municipality authorities are essential to consider as they are equally important but yet can be largely diverse. The policies with legal requirements that the municipality has to work from can be unrealistic with standards far from feasible for these areas both in costs and technical aspects. There are often inadequate structures existing for handling all components of a system as for example the emptying of septic tanks and communal latrines even though the construction of these systems is affordable. The sanitation policies or funding banks often emphasise to skip the step of the sanitation ladder with communal latrines and go directly to the one with household connected toilets. Even though she has seen the problems connected to these, as for example inadequate maintenance and crowded lines outside the latrines every morning, this is a necessary option to consider when centralised systems are unfeasible. These systems are better than no one at all even though health aspects and incentives for using the latrines need to be improved.

There is also a need of some sort of strategies connected to the planning process for changing behaviours and attitudes connected to sanitation. Kvarnström mentions the Community Led Total Sanitation, CLTS, as an interesting approach trying to modify for peri-urban areas as it is easy and cheap but yet a very successful approach for changing behaviours and improve the coverage of basic sanitation. One obstacle for the approach in peri-urban areas can be the standards the municipality or regional policies recommend. Sanitation 21 is a planning approach that she recommends and tries to take action from in her own work as it tries to open up the planners' thoughts about suitable sanitation technologies. Possibly the approach can be

complemented by the use of a set of sustainability criteria[5]. She is partly sceptical to the use of software tools in the planning process as it may narrow the mind of the planners in technology choices. She stresses the importance of having an open mind when choosing technologies, as the central objective is to find one that suits a special context even if standards of the Millennium Goals and other policies are not fulfilled.

Another problem that she constantly is being faced with is the fact that sanitation is not prioritised compared to water supply. Approximately 90 percent of her present project group is working with drinking water while the grey water treatment issue is almost completely ignored. An illustrative example comes from a discussion between Kvarnström and a municipality worker who argued that it is the access to water that is of greatest weight to improve because nowadays there is a good range of medicines to cure sanitation linked diseases. The improvement of the sanitation situation should thereby not be prioritised. The water supply and water resource questions have more status and are easier to talk about than the sensitive sanitation issue. This has to do with the fact that the water is provided to the users in a tap and no one cares were it comes from. But whereas the sanitation part is concerned, this issue is closer to the users and is more dependent on participatory involvement which could be difficult to motivate.

5.4 INTERVIEW WITH OLLE COLLING

Olle Colling has been working in the WSS-sector in the developing world both on behalf of investor agencies as well as a consultant. He has been working as an advisor and overseer in the preparation part of the project cycle for SIDA and in his role as a consultant he has mostly been working with feasibility studies. One example of a project he is working with is expanding sanitation systems in Sri Lanka both for industries, planned and non planned settlements and another one is improvements in piping, quality and capacity of the water supply system in Dahka in Bangladesh. He points at the fact that he does not work explicitly with peri-urban areas but with urban areas in a holistic way. Yet peri-urban areas are sometimes included in the area of work and he describes them as inofficial settlements which are not enclosed in the urban planning and with no connection to the central WSS-system.

The existing WSS-systems in the cities he has been working in are often restricted to the city centre and are remainders from the colonial period. The sewerage is often lacking any treatment facilities which results in that wastewater is disposed directly into water bodies and severe leakages of pipes are common. Therefore they do not cover the necessary service demand in either planned or unplanned areas. However the water utility companies often prioritise the improvement of the existing system for communities with ability to pay for the services and at the same time the path of the expanding process is often pointing from the city centre and outwards. These issues put the peri-urban areas in the very last place of the priority list in which only the projects at the top can be considered due to the often very restricted budget.

The economical perspective from the local water utility is thereby colliding with the donor agencies' poverty reduction and 'bottom-up' perspective. The target group of the water utility is far from the focus group of donor agencies like SIDA which leads to a fundamental diversity in views of priority aspects. Colling argues that reaching the urban and peri-urban poor is an important but at the same time complex task to manage if focusing on small scale

[5] Kvarnström is one of the authors of *Evaluation in sanitation - Review of Three Illustrative Examples* which is discussing the possibilities of using sustainability criteria as a support when comparing and choosing sanitation alternatives.

systems, as for example Ecological sanitation. This is due to the difficulties when upgrading them in a larger quantity something that is required in these rapidly urbanised countries. There is a great risk that these kinds of projects become isolated and get a characteristic of being of pilot type and thereby do not reach a relevant part of the population. He points at the idea that if leakages of water supply system get reduced this leads to increased water volumes for both the poor and the wealthier.

Colling sees demand and economical coverage as the most central aspects for gaining sustainable systems. If the system is required from the community, acceptance is almost automatically gained. For economical sustainability the costs for investments, operation and maintenance need to be covered. This can be made by using different tariffs for different volumes of consumption. Promises from the politicians for free water for all may lead to difficulties. When looking at the planning process he sees an international standardisation of the project cycle and its steps for projects which are externally financed. This has evolved over the years to a more and more holistic approach with a wide span of aspects to consider which has made the decision-making increasingly more difficult. Considering aspects like gender and HIV, which needs much time and competence to investigate, can put the focus away from the basic infrastructure issue which in turn can lead to reduction in the potential of expanding and evolving WSS-systems. He argues that in some cases you may need a more pragmatic view and oversee some of these aspects for being able to construct any system at all.

Tools that he has been working with in the feasibility study are Environmental Impact Assessment as well as handbooks and check lists from organisations like DANCEE, OECD, World Bank and ADB, where the latter can be useful for not overlooking any important aspects. He sees a need for standardised toolkits which are accepted by many actors and are containing tools for each step of the project cycle. This could be a great help for local water utility workers to improve the existing management as well as to expand the service. Possibly there could be a need for different toolkits for different situations like improvements and expansion and different actors like the problem owners, consultants and donor agencies. The decision-making part of the comparing mode could become more systematical and less subjective if some sort of weighting tool that considers technical, socio-cultural, economical and environmental aspects was being used. This might be seen as the last step of the feasibility study which deals with the different priorities of economical sustainability from the water utility, the ecological aspect and the poverty aspect. This could strengthen the dialogue between spokesmen of these diverse views and making the process more professional. Even though a priority list is being identified the planners must beware of the restricting factors which often are linked to the political environment that the project should be applied in.

5.5 INTERVIEW WITH JENNIFER McCONVILLE

Jennifer McConville is a PhD student at the Division of Water Resources Engineering at the Royal Institute of Technology in Stockholm where she works with issues concerning sustainable sanitation. For two years she has worked in Mali as a Peace Corps Volunteer focusing on water and sanitation extensions. The work was located in a rural village named Zambougou-Fouta in central Mali. Her experiences resulted in her master thesis *"Applying Life Cycle Thinking to International Water and Sanitation Development Projects"* which provides project managers with an assessment tool for improving sustainable development of WSS-projects. Examples of projects that she has been working with is repairing hand dug wells and constructing soak pits for sanitation and ponds for rainwater harvesting.

Even though she did not work explicitly in peri-urban areas she noticed that peri-urban areas in Mali have a rather rural characteristic. They are not so dependent on governors from the city and the bottom-up approach in decision-making is central. One of the most difficult aspects of her work was to understand the political environment. As working as a Peace Corps Volunteer she was a foreigner but not a part of a formal NGO. This put her in a rather undefined position with difficulty in collaboration with mayors and other municipality workers. Lack of communication is another potential risk factor which can lead to misunderstandings and can thereby be a serious obstacle in reaching successful projects. One example is that it took her several months to understand that it was considered impolite to say that someone had a bad idea. This led to that every suggestion that she proposed during meetings with the villagers was accepted but no one ever performed the project "agreed" upon. This can be an even greater problem for foreign NGOs with shorter visits in the country which does not include time for gaining any deeper knowledge about local culture. like

The lack of cultural understanding is also a problem within the country but in this case between the urban and rural context. The city governments often lack understanding about the rural context due to class barriers and difference in level of education. This gap can be critical for the peri-urban areas as these areas often have lost the traditional community structure with defined leaders and at the same time are ignored by the city. Clear answers for the questions about who is planning and who is governing in these areas is hard to get. In Malian peri-urban areas it is common that individual families have to come with the initiative of constructing a new sanitation system as no one else will do it.

When looking at planning McConville is convinced that a participatory approach is needed. For doing this she has used tools like Participatory Rural Appraisal and Participatory Analysis for Community Action which is mainly focusing on the rural context. When introducing new technologies much effort has to be put on explaining the systems for the users. One example was the project of constructing the pond for rainwater harvesting. At a start the villagers wanted a water tower and nothing else, yet this was an unfeasible option due to groundwater levels. The engineering group then constructed a pilot project for showing the community how the new technology would work and with time the pond got accepted. In the planning process she finds the life cycle thinking to be a good approach for reaching sustainable systems. She points at the importance of including operation and maintenance aspects in the feasibility analysis and that this is strongly connected to social issues.

She calls for tools with the local planners and community leaders as a target group. She thinks that planning preferably should be done near the area in focus and that tools for teaching the local community how to perform the planning could be useful. It is the future users of the system that should demand improvements and choose a system. She argues that data based tools often are too complex to use at a local level and that other kinds of tools are required. She also sees these tools as a limitation in the choosing step. When applying them in the planning process it is important to use them as a guiding tool and not a tool that automatically will bring the best solution.

5.6 INTERVIEW WITH CECILIA MARTINSEN

Cecilia Martinsen is working at Stockholm International Water Institute, SIWI, with issues concerning Integrated Water Resource Management and Transboundary Water Resource Management. Her previous work focused on putting the issues of water supply, sanitation and hygiene into the centre of attention at the political arena both national and international. She has worked with these questions at the World Bank's Water and sanitation Program office in

Senegal and in Geneva at WHO Water Supply and Sanitation Collaborative Council. In Senegal she worked with issues about support for national and local planning and policy documents in the urban context whereas in Geneva her work focused on support for NGOs. Thereby she has mainly been working with comprehensive planning at a different level than the one where choosing technology is a central aspect.

Martinsen argues that it is necessary to work with questions concerning how to recognise WSS-issues in the policy building process as this will lead to recognition at a local level. This should be the case as these are crucial for the development of a country or a city. She thinks that a central task for putting the issue at the political agenda is to point at the linkage between economics and health, where the latter of course depends on adequate sanitation. It is crucial that people in the WSS-sector interact with other sectors and also discusses more general questions than sanitation technologies. For example, if the department of finances sees the connections between lost labour days and school days due to diarrhoea and societal costs the improvements of sanitation will become an issue of higher interest. It is also vital to put a comma between water supply and sanitation as the sanitation part often falls outside of the decision makers' references. If the city for example reaches the MDG goal for water supply, there is a possibility that the government calls the WSS-target reached and sanitation is ignored. One should have in mind that these two components can be greatly separated, especially in rural and peri-urban areas where dry sanitation is common.

Problems connected to peri-urban areas are the lack of urban planning and issues considering land owning. These areas are hard to define as either slum or a formal settlement. This leads to difficulties in the comprehensive urban planning, for example if the government should try to transform the area to a formal part of the city or not. At the same time the local governments are reluctant to provide these settlements any services as this can be seen as a confirmation of legality and they do not want to encourage more people to move there. They want to improve the WSS-coverage in their city but not in informal areas. The fact that peri-urban areas are located at the boarder between urban and rural areas has often put them in a no mans land concerning research and implementation of pilot projects. Nevertheless one should have in mind that there is a great diversity between peri-urban areas in big vs. small cities.

Martinsen sees an increase in interest by the local mayors in new sanitation technologies. However there is often a lack of strategies from the mayors how to evaluate the many technologies that foreign consultants try to convince them of. She sees a need for planning tools for this target group who often do not know how to perform the complex task of considering all necessary aspects and perform risk and impact assessments when choosing a technology. The tools should preferably make this task less complex and support the users with relevant questions to ask when choosing for considering central aspects and not provide them with solutions from the West. This was often the case in former project which often turned out to be far from sustainable. Martinsen argues that not all aspects could be taken into account. She sees the humanity perspective as the one to have in focus. The health situation should be seen as the most essential in front of technology which is often put into focus very quickly in the discussions. She considers it more important to start with questions like: 'What do people need?' and 'What is the problem?'

6. RESULTS AND DISCUSSION

In this section results from the interview study as well as the literature study are summarised, discussed and compared. The results from the interview study are also used for modifying the framework. Finally, possible applications and developments of the framework are discussed.

6.1 SYNTHESIS OF THE INTERVIEW STUDY

The interviews performed provide the study with many interesting and new views for how to look at the planning of WSS in peri-urban areas. As the members of the group come from different fields of perspective a variety of views and aspects were emphasised. Some of the aspects were largely agreed upon of the interviewees whereas for other issues the views were diverse. This indicates the complexity of the issue and the difficulty to agree on one best practise in these areas. Some interesting outcomes from the interviews are summarised below.

Obstacles for planning WSS in peri-urban areas

There was a set of serious obstacles connected to peri-urban areas pointed out by the interview group. Tufvesson mentions institutional problems between the water utility and the municipality workers whereas Kvarnström brings up the problems with unfeasible standards for these areas recommended in the guiding policies. Colling refers to the low priority of these areas by the water utility managers and McConville to the cultural and economical gap between rural and urban areas. Martinsen sees tenure problems and the lack of urban planning as crucial problems for peri-urban areas.

Perspectives of appropriate planning approaches

There were quite diverse opinions on which perspective that is most appropriate to apply in the planning process. Colling argues for the advantages of considering the WSS-systems with a large scale perspective to enable the up-scaling of the systems and sees the limitations of only using the bottom-up approach. McConville, Kvarnström and Tufvesson on the other hand are emphasising mainly on small scale participatory bottom-up approach. Kvarnström sees OWP, CLTS and Sanitation 21 as promising models to take action from, mainly due to their openness for the planners to choose between different alternatives. Additionally, Tufvesson points at HCES and PHAST as other interesting tools to encourage the participation of the future users. Martinsen argues that putting the issue on the political agenda and into the national policy documents is a necessary basis for planning at more local levels.

Characterisation of required tools

There are different requirements from the interviewees for what type of tools that is needed for the planning process. These are quite diverse in aspect of complexity, from the range of checklists to software tools. Tufvesson calls for tools to be used in the very beginning of the project and for the comprehensive planning on national and regional level where the standards are set. Colling requires standardised tools which may be different for actors on different levels. He sees the possibilities of using more complex software tools when enough competence and resources are available. McConville thinks that tools aimed for the local planners are most important as they are closest to the problem. Martinsen calls for simple tools that can be used by the mayors for making the evaluation of technologies easier.

Pros and cons for using software tools

Both McConville and Kvarnström point at the limitations of using software tools when choosing technologies as it can narrow the mind of the planners. McConville also stresses that

these tools can be requiring too much competence for being suitable at a local level. Colling on the other hand argues for the need of weighting tools in the decision-making process for making this dialogue with stakeholders with diverse preferences more professional.

Aspects for achieving sustainable systems

There are different views present for how to obtain sustainable systems. Tufvesson argues that the systems need to be looked at in a holistic way for being able to function in a certain context. Important sustainability aspects are ability for self-financing, flexibility and possibility to upgrade the system. Kvarnström points at the importance to understand the context and that participatory approaches automatically take account for many criteria. Colling sees demand and economical sustainability as the most important aspects. McConville believes that life cycle thinking is necessary and that operation and maintenance is central to consider early in the feasibility analysis. Both Colling and Martinsen point at the difficulty on focusing on the core of the WSS work, like improving infrastructure and health, as there are so many external aspects to consider.

6.2 THE MODIFIED FRAMEWORK FOR PLANNING

The interview study contributed with new perspectives and aspects to consider when working with these kinds of issues. Some of them may be suitable to use for modifying the planning framework and are discussed below.

6.2.1 Aspects and tools of special interest

The Community Led Total Sanitation

The Community Led Total Sanitation, CLTS, was recommended by both Tufvesson and Kvarnström as an interesting approach for improving the sanitation situation in peri-urban areas mainly by changing people's behaviours. The approach is dependent of the communities own willingness to improve their situation by realising the linkage between open defecation and health issues. The approach is mostly used in rural areas but has been proven to be successful in urban slums in Kolkata in India. Here the Kolkata Urban Services for the Poor has used the concept of CLTS to improve participation for limiting the open defecation which has resulted in communities constructing sanitation systems without any external financing (Kar, 2006). The model uses facilator consultants as the major tool for stimulating shame over open defecation. A transect walk in the community together with the villagers is often used as a starting point. This often turns out to be a "walk of shame" for the villagers when the places for open defecation are visited by a foreigner. The CLTS uses Participatory Rural Appraisal methods were visual tools as well as transect walks is used (Kar, 2003). The success of CLTS is dependent on possibilities for constructing low-cost sanitation systems which in their turn are dependent on land quality, land space and land owning. These aspects as well as strong community affinity, which are important for successful spreading of the idea, could be problematic in some peri-urban areas.

Use of Sustainability criteria

The criteria used in the *Evaluation in Sanitation- Review of Three Illustrative Examples* by Lennartsson et al. (Manuscript), where Kvarnström is a co-author, can be used as a tool in the comparing mode for ranking alternatives. In this report, the criteria were used in three case studies performed in Sweden, South Africa and Mexico. Table 25 is showing the criteria matrix used in the case study were the systems should be compared to a zero alternative, in this case a connection to a wastewater treatment plant and subsequent treatment. Each sanitation system should be given scores in the form of ++, +, 0, - or -- where a plus sign always indicates higher performance compared to the 0 alternative. The indicators is quite

similar to the set of indicators used to consider the sustainability of the planning models in this work, which can be found in Table 6. It should be mentioned that Table 6 does include some indicators more suitable for the feasibility analysis than the comparing mode.

Table 25: The criteria matrix used in the case studies in the report by Lennartsson et al. (Modified from Lennartsson et al, Manuscript).

Criteria	**0 alternative**	**Sanitation system 1**	**Sanitation system 2**	**Sanitation system 3**
Health				
Risk of infection: household	Qualitative			
Risk of infection: immediate environment	Qualitative			
Risk of infection: downstream	Qualitative			
Environment				
Discharge: BOD, mg/L	Quantitative			
Discharge: N,P, mg/L	Quantitative			
Potential for reuse of water	Quantitative			
Potential for reuse of nutrients	Qualitative			
Water-use	Qualitative			
Quality of recycled product	Qualitative			
Economy				
Investment costs (individual & societal)	Quantitative			
O&M costs (individual & societal)	Quantitative			
Socio-cultural				
Convenience	Qualitative			
Safety	Qualitative			
Appropriateness to local context	Qualitative			
Technical function				
System robustness	Qualitative			
Odor	Qualitative			
Complexity of construction and O&M (individual & societal)	Qualitative			

Checklist by McConville

McConville (2006) has designed a comprehensive checklist to be used for improving sustainable development of WSS-projects based on her own experiences and best practice guidelines by Peace Corps, Engineers Without Boarders, Canadian International Development Agency and a set of researchers. The assessment tool is constructed as a matrix with the sustainability aspects of socio-cultural respect, community participation, political cohesion, economics and environment on one side and the five life cycle stages: needs assessment, conceptual design and feasibility, design and action planning, implementation and operation and maintenance on the other. The tool contributes the user with a wide ranged guideline for each matrix element. Especially the checklists in the 'Needs assessment' and 'Conceptual design and feasibility' rows are of interest to use in respectively the shaping mode and the designing mode. For the shaping mode the tool can be useful for making a comprehensive

situation analysis whereas for the designing mode it can be applied for widening the feasibility study. The checklists can be found on pp.75-139 in her master thesis *Applying Life Cycle Thinking to International Water and Sanitation Projects: an assessment tool for project managers in sustainable development work.*

Need to widen the system boundaries
It is important to study the systems in a holistic way in contrast to looking at one part at a time. All the different components of the sanitation system must be suitable for a certain context. As an example, if septic tanks are found to be the best alternative for a certain location, there has to be enough capacity for the disposal of the tanks, otherwise the tanks might become highly unhygienic and not at all the priority alternative. In the Strategic Choice Approach these different components are called decision areas and are recommended first to be looked at separately for finding feasible alternatives and subsequently at possible combinations of the areas. These must be able to work together since viewing them separately can lead to unfeasible systems.

Need for policy building
There is also much emphasis on the policy building as this can restrict the possibilities of choosing alternatives from a wide starting point. Policy makers are often unaware of which alternatives are feasible outside the city centre as there often is a deep gap present between urban and rural contexts. There is therefore a call for tools to support the procedure of designing policies. These should take account of the possibilities and limitation when choosing a system in the peri-urban context.

Need of using different tools for different situations
Using the same set of tools for all projects may not be suitable due to the differences in competences and resources as well as the aim of the project. Flexibility of a tool is essential. Software tools can also be restricting if putting to much faith in them as to provide the best alternative. The range of possible alternatives gets narrower which can lead to possible options for a certain location being overlooked.

6.2.2 Two versions of the framework for planning

New features to the framework
The set of sustainability criteria to use in the decision-making process is a suitable tool for the comparing mode while the list designed by McConville is an example of a possible checklist to use instead of the example checklist in 4.5.2 for regarding the many aspects needed in the situation analysis as well as for the designing mode. The CLTS is an appropriate approach for increasing awareness of the link between open defecation and health issues. This could be of use for initiating the demand for sanitation which is the basis for any planning of WSS-systems. One possibility can be to design a step before the shaping mode which takes awareness building into account. Here can also other participatory tools for raising the issues about hygiene and behavioural changes like PHAST be used. The need for looking at all components or decision areas of a system is pointed out by the HCES and should be taken into account in the feasibility analysis.

The policy building is another necessary base for the planning process which is not explicitly illustrated in the framework. This is however included in the ‘Consensus for common visions’ in the shaping mode. For this activity it could be useful to use tools for evaluating feasible technologies in peri-urban areas when the guiding standards are set. As the awareness building policy building on different levels could be seen as a parallel but still strongly

connected process to the planning. The modified framework can be seen below in Figure 18. The above discussed additions to the framework are marked in bold.

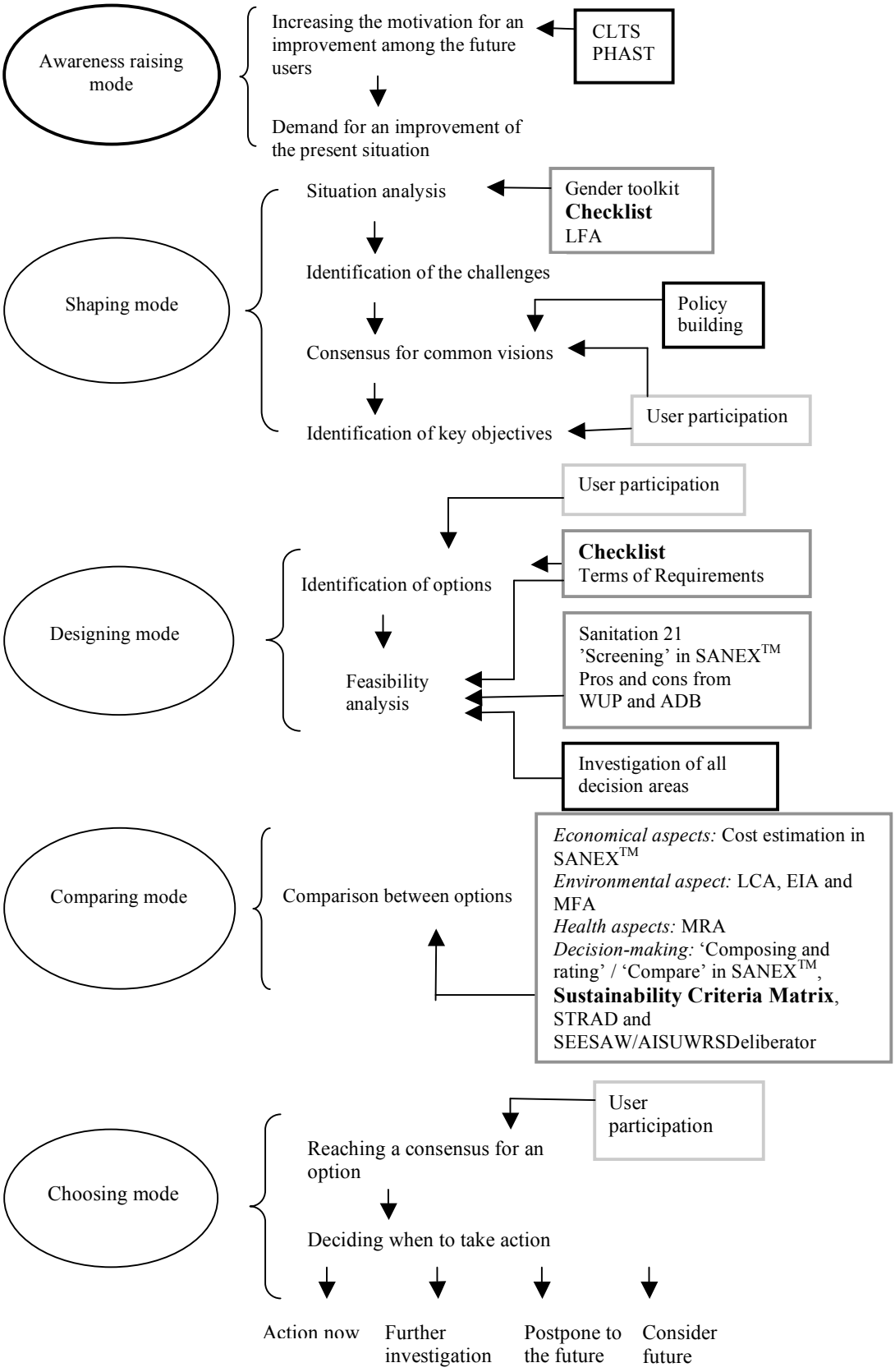


Figure 18: The modified framework for planning where changes are marked in bold.

Different frameworks for different budgets and situations
Another key aspect that was identified in the interview study was the call for different kind of support for different users with diverse amount of resources. This calls for a framework with a high degree of flexibility for being suitable for different users. The suggestion in Figure 18 might be suitable for a user group with a relative strong resource base. Thereby they can afford experts for the wide range of aspects to consider and the software tools may be interesting to use. These types of projects can for example be financed by foreign aid and be performed by non-local consultants. They could also be more common when the water utility in the cities is involved which often has a larger budget than the municipality. Additionally, there may also be great differences in previous research about an area and knowledge among the communities. This can result in a need for less effort put on certain steps like awareness raising, situation analysis and policy building.

The framework for a stricter budget
If the project has a small budget the framework may be needed to modify, mainly with regard to which tools that are feasible and suitable to use. Below a possible suggestion is described. It should be mentioned that many other combinations of tools to use of course could be suitable.

If starting with the *shaping mode*, as the *awareness raising mode* could remain unchanged, a checklist could be suitable to use as well as the Logical framework approach. The McConville checklist is for example mainly dependent on communication with the future users of the system for gaining understanding about the possibilities and limitations connected to a special context. This can thus be relatively time consuming but does not require expert knowledge. The Logical Framework Approach can be used as a tool for focusing on the characterisation of the problem and give suggestions of appropriate forms for a stakeholder workshop. The Gender toolkit and the policy building may have to be aspects of lower priority in this situation as they require a rather big amount of resources. It should also be mentioned that the checklist should be considering gender issues, so this aspect will not be ignored.

For the *designing mode* the framework can remain unchanged. The use of SANEX^{TM} can however be replaced with consultation from different technology handbooks to complement the overviews from WUP and ADB. In the *comparing mode* it may be needed to perform more changes as this is a rather complex activity. Here it could be suitable to use a Sustainability Criteria Matrix and to use information about environmental impact, costs, technical function and health impact of different technologies from previous studies from a handbook preferably aimed at the country or even the certain region. One example especially designed for the Philippine context is the "*Philippines Sanitation Sourcebook and Decision aid"* distributed by the Water and Sanitation Program in East Asia and the Pacific. This handbook includes a comprehensive overview of technologies of different characterisation and their impact on environment, health and their costs. It also divides communities for identifying their special problems and the peri-urban category is further divided into one 'Tenured low-income urban community' sub-group and one 'Peri-urban coastal community' sub-group (Water and Sanitation Program in East Asia and the Pacific, 2005). This activity is however dependent on how reliable these references are. For some areas it may be hard to find useful references and in these cases own investigations have to be done. The suitability for the context should already been taken account for in a wide way in the designing mode. The *choosing mode* could remain the same.

6.3 PLANNING SUPPORT IN COMPARISON

There exists a range of planning models for sustainable water supply and sanitation, yet of different characterisations and suitability to the peri-urban context. They vary in aspects of focus on participation of the future users, complexity and in variance of being concrete planning models vs. guiding suggestions. For the aspect of complexity, one key issue is what kinds of tools are being used and how resource demanding these is. On one side of the range are models which use checklists and other guiding approaches and on the other side those who recommend more complex software tools or highly resource demanding investigations.

Comparison between the approaches in aspect of complexity and focus on participation

In Figure 20 the models, including the framework in this report, are being compared with each other in aspect of how much focus that is put on participation and the degree of complexity. Models marked with a ring were selected for further evaluation in section 4 and are thereby either included explicitly in the framework as tools or are contributing to the choice of steps in the planning modes. The suggested framework is marked with a grey ring.

The figure has the intention to give an overview of the diversity of the models with regard to complexity and focus on participation, rather than an exact position of each model. Adjacent models should thereby be seen as possessing approximately the same degree of involvement of the users and resource demand. These aspects were pointed out by the interviewees as essential characteristics of the tools but at the same time they had diverse preferences of what to recommend. This implies that there may be requirements for different type of tools from planners with different perspectives and in different contexts. For example, for planners working mainly from a participatory approach the Open Wastewater Planning (4), Household Centred Environmental Sanitation (5) and Sanitation 21 (8) are the most appropriate.

In the lower right corner is a collection of models that are mainly aimed for developed countries where a high degree of complexity may not be a limitation and where participation of future users in the planning process seems to be of low priority. These characteristics make the models difficult to apply in this context. This is an interesting observation as many of the different examples of planning support in the developing world put participation as an important key aspect. The cause for this may be the difference in use of centralised versus decentralised systems for the different context. The centralised systems are mainly dependent on the maintenance by experts whereas the decentralised systems mainly depend on the user's participation.

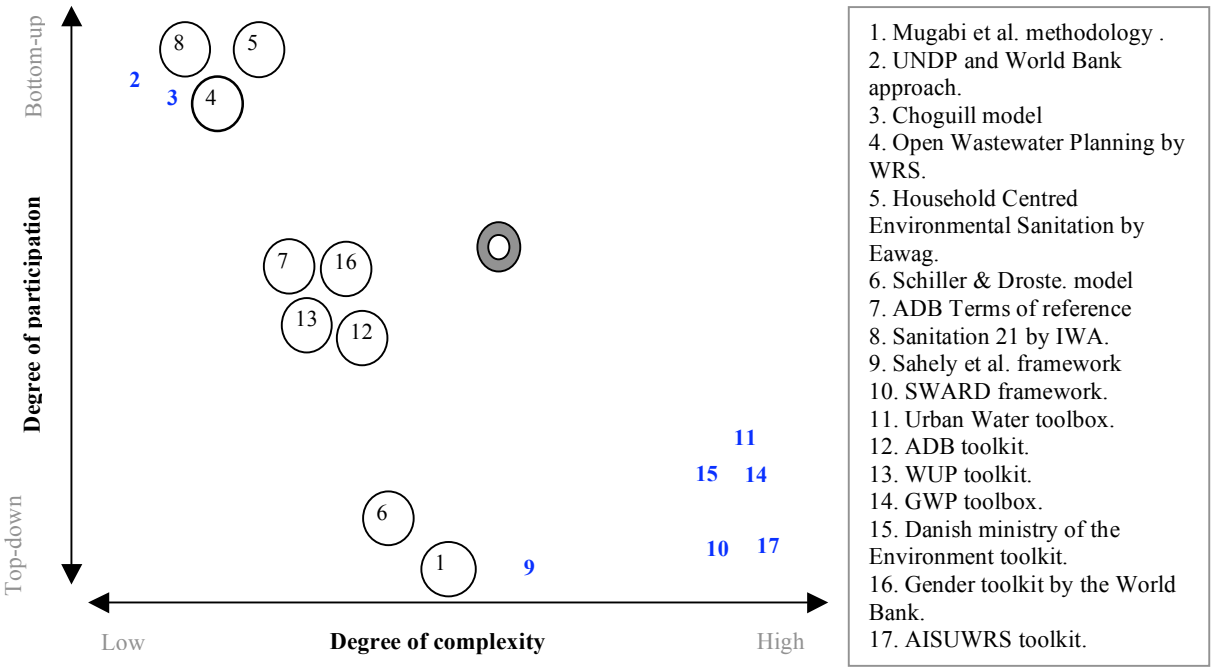


Figure 20: A comparison between the planning models with regard to degree of focus on participation and complexity. The models marked with a ring are either included in the framework as tools or are contributing to the steps in its planning modes. The suggested framework in this report is marked with a grey ring.

The framework in the report compared to the other approaches

The suggested framework in this report is put in the complexity range between the models for developed and developing countries due to the use of software tools. However, is it not put at the same degree of complexity as models not explicitly aimed for developing countries. It is though possible to move the grey ring further to the left hand side by using the framework modified for a stricter budget. With regard to focus on participation the ring is put somewhere in the middle as it consists of steps both with and without participation. The framework is emphasising participation as an essential aspect for successful planning, yet is it flexible for planning at different levels.

When considering the characterisation of the models a great variety was found. The models with greatest possibilities of being used by planners of WSS-projects were chosen for further evaluation of the consideration of the set of sustainability criteria. The outcome of this selection and evaluation showed that the toolkit *'Water and sanitation for all'* by the WUP and the Open Wastewater Planning by WRS were the two most suitable for the aim in focus. These can thereby be seen to be most similar to the framework in the report. Neither of the models includes any software tools, yet the OWP uses LFA and PHAST as participatory tools. WUP provides the users with a set of checklists to take action from where the one including pros and cons for different technologies is used in the framework. If comparing these two approaches, the OWP is emphasising participation at a higher degree whereas the toolkit is more explicitly aimed for the peri-urban context and the issues of concern connected. The suggested framework is yet using key aspects and tools from other models as well for getting a holistic approach.

6.4 RESULTS FROM THE INTERVIEWS VS LITERATURE

When comparing the findings in the literature with the results of the interview study many similarities were found between emphasised aspects. For example all of the highlighted

obstacles for planning WSS-systems in peri-urban areas could be found in section 3.3 where sustainability aspects connected to issues for this specific context were studied and in section 3.2.1 where peri-urban areas were defined. One repeatedly recognized issue was the institutional problems in these areas due to lack of collaboration between water utilities and municipalities. This problematic and highly influencing aspect for the outcome of a WSS-system is contradictory an example of an aspect not mentioned in the same quantity in the literature as in the interviews. For the requirements of different perspectives of the planning i.e. top-down or bottom-up, and tools for this purposes Figure 20 can be used as an illustration of the present differences between models which also were found between the interviewees.

Consideration of sustainability criteria

The aspects mentioned in the interviews for obtaining sustainable systems are all considered in the list of sustainability aspects. These were used in section 4.3 to find models which considered various aspects important for the peri-urban context. Yet, these were later argued upon by some of the interviewees as limiting the focus on the core issues of WSS-systems like health and expanding urban infrastructure. Weighting between which aspects to consider is a difficult dilemma when the project budget is restricted. In this report sustainability is made a key feature for the planning of systems and is consisting of five criteria; environmental aspects, health aspects, economical aspects, socio-cultural aspects and technical aspects. It must be understood that there may come situations were not all of these issues can be considered, yet the intention should be to do so. The planners should preferably have all sustainability criteria in mind and take into account each of them as much as possible for getting systems that will be used and maintained in a certain context.

Restricting policies and policy building

When looking at the issue of policies setting standards and requirements for tools for policy building, a step back to section 3.1 has to be taken. Here, it could be seen that the policy from SIDA is the one with most explicitly focus on peri-urban areas. The other policy documents do not mention peri-urban areas but refers to the urban poor and have much focus on necessary actions for reaching the Millennium Development Goals. These international targets were criticised by some of the interviewees for setting standards with little flexibility for a specific context. It is also important that peri-urban areas are mentioned in the policy documents for not being ignored by the government which is often the case. The strategic planning approach for urban sanitation services from the Water and Sanitation Program which has founders and appliers of urban sanitation programmes as the target group can thus be seen as a possible and appropriate tool for policy building. The approach recommends the users to look at possible technologies, including low-cost and innovative alternatives, in a wide way for choosing the one with best agreement to a specific context.

6.5 POSSIBLE APPLICATIONS AND FUTURE DEVELOPMENTS

The framework in this report can be seen as a suggestion for how to use supportive tools and models found in the literature. Additionally, it takes into account aspects pointed out in the interview study as well as a set of sustainability indicators.

Applications of the framework

The framework can be a suggested starting point for how to look at the WSS-planning process in peri-urban areas. It gives a suggestion for which steps to perform in the planning process and which tools that could be used in each step for covering a range of sustainability aspects important for the peri-urban context. The framework is not intended to provide the users with one absolute and best solution. By contrast, it should be flexible for different users and

contexts as there exists no absolute definition of peri-urban areas as these differ greatly between each other and with time. The framework intends to point at the need for looking at possible technologies in a wide way for finding a context specific solution in these complex areas. The situation analysis is therefore an essential starting point for investigating the area and to identify limitations and possibilities. As mentioned above, the framework should be seen as a suggestion and could preferably be modified by the user with regard to which tools to use and special focus points. Figure 19 is an example of the framework when the budget is stricter and number of tools must be limited. The flexibility of how to use the framework is essential as the target group is planners with different backgrounds and with different amount of resources.

Future development

The framework has great potential for further development. One obvious limitation in this study is the lack of performance of a case study. The interview study should be complemented with interviews with local planners in developing countries. Even though the interviewees in this study have much international experience and have been working at different levels it should be of great interest to get a complementary view from local planners. It could be interesting to study differences in requirements of tools and emphasised problems connected to peri-urban areas. The framework must also be tested in the real context before any actual recommendations can be made. It must be investigated if all essential aspects are being considered and if there are areas in the planning process where more focus has to be put.

The interviews did not give much support for using software tools. There seems to be little demand for them due to uncertainties of the possibility for application in these areas and mistrust of the results given by them. Especially some of the tools used in the comparing mode like STRAD and the SEESAW / AISUWRS Deliberator are not explicitly designed for the developing world. It is therefore an interesting task to examine how well they would work in another context with regard the possibility to gather data needed as well as the requirements for them by local planners.

7. CONCLUDING REMARKS

In this master thesis, the challenging problem of planning sustainable water supply and sanitation systems for the peri-urban context has been studied. Below is a summary of conclusions that have been made:

Sustainability is a key issue to consider for managing the challenge of reaching the Millennium Development Goals.

Due to the extent of the water supply and sanitation problematic around the world it may be hard to reach the Millennium Development Goals in time i.e. in 2015. Additionally, it should be emphasised that the water supply and sanitation systems designed to accomplish the MDG 7:10 must be sustainable, otherwise people will not use them or maintain them with the consequence that their durability will not reach 2015. The framework in this report provides a possible entry point for how to deal with the many sustainability aspects needed for the great challenge of planning water supply and sanitation systems in peri-urban areas.

The complexity and lack of constancy of the peri-urban context requires the use of a multifaceted and flexible planning approach.

The literature study in the report demonstrates the complexity of the peri-urban context and points at the need to view the planning process with many aspects in mind. There are great variations in characteristics such as degree of poverty, rural vs. urban influence and legality between peri-urban areas as well as with time within an area due to rapid urbanisation. These features emphasise the value of having a context specific planning approach and leads to the conclusion that one best solution for planning and for choosing a technology is hard to reach. In addition, the interview study did emphasise the importance of different kinds of planning support for planners with different amount of resources and for different situations. Consequently, a planning framework must be flexible and easy to modify for different users and contexts for reaching sustainable solutions.

The framework in this report is a suggestion of which tools to choose from when considering various sustainability aspects in the recommended steps of the planning process.

The planning framework in this report is based on the *Strategic Choice Approach* but largely modified by using findings from the literature and from the interview study essential for the peri-urban context. As an example, the four modes of the *Strategic Choice Approach*; shaping, designing, comparing and choosing, were complemented by a preceding awareness raising mode. The aim of this mode was to improve the demand for water supply and sanitation which is crucial for obtaining sustainable systems. This could be done by emphasising the connection between severe health issues and absence of water supply and sanitation systems to the future users of the system. In the shaping mode the problem should be identified by studying the present situation in the area of focus whereas in the designing mode the requirements of the technologies should be settled among the stakeholders as well as identifying feasible solutions with regard to the specific context. In the next mode the alternatives are compared with each other due to their consideration of sustainability aspects which require a weighting discussion among the stakeholders as these can have diverse perspectives of the importance of different aspects. In the final choosing mode a system is chosen which has the intention to suit the context in many aspects due to the previous steps of investigation. For each mode a set of tools with diverse complexity is suggested for enabling the work.

The framework is flexible and can be modified for different planning situations.
The framework should be applicable in many different situations and the target group is planners of different backgrounds. The framework takes this into account by being flexible by letting the user choose the amount of tools to use and activities to perform. The tools are of diverse character with regard to complexity and demand of resources as there are for example both relatively complex software tools for enabling the decision-making process as well as basic checklists for helping the planners to cover necessary aspects in the situation analysis. This diversity implies that the planners would find a set of tools from the framework that suites the specific planning situation. The framework could therefore be seen as a suggestion for which tools that are possible to choose from for the different modes of the planning process and raise awareness among planners of new possibilities of planning in peri-urban areas.

A future development of this report could be a case study for deepening the understanding of the context.
One recommended future development of this report is the performance of a case study in a peri-urban area. This should give a deeper understanding of the context and probably result in recognizing aspects that are difficult to find in the literature. An interview study with local planners on different levels could be a valuable complement to the interviews in this report for getting a broader view of requirements and possibilities for the peri-urban context.

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APPENDIX

An overview of the the planning support with regard to their characteristics in originators, target groups, planning focus and aimed context.

	1. Mugabi et al. Methodology	2. UNDP and World Bank approach	3. Choguill model
Originator			
Research group	Loughborough University, UK		University of Sheffield, UK
Organisation		UNDP-World Bank Water and Sanitation programme	
Target group			
Experts			
Decision makers		Founders and appliers of urban sanitation programmes	Governments
Practioners	Water utility managements		
Planning focus of the tool			
Support for the process		Strategic approach for sanitation incl. policy making and institutional change	Support to improve the urban poor's access to infrastructure
Performance of the process	Stategic planning of the process		
Context			
For WSS?	Water utiliities	Sanitation	Infrastructure
For the devoloping world?	Yes	Yes	Yes
For the urban poor?	Yes	Yes	Yes
For peri-urban areas?	Not explicitly	Much focus on peri-urban situations	Much focus on informal settlemnets
Software tools	No	No	No

	4. Open Wastewater Planning	5. Household Centred Environmental Sanitation	6. Schiller and Droste model
Originator			
Research group	SwedEnviro Consulting Group		University of Ottawa, Canada
Organisation		Eawag	
Target group			
Experts			
Decision makers			
Practioners	Project planners	Project planners	Project planners
Planning focus of the tool			
Support for the process			
Performance of the process	Stategic planning of the process	Stategic planning of the process	The planning process
Context			
For WSS?	Sanitation	Sanitation	WSS-systems
For the devoloping world?	Yes	Yes	Yes
For the urban poor?	Yes	Yes	Not explicitly
For peri-urban areas?	Not explicitly	Yes	Not explicitly
Software tools	No	Material Flow Analysis	No

	7. ADB Terms of Reference	8. Sanitation 21	9. Saheley et al. framework
Orginator			
Research group		International Water Association	University of Toronto, Canada
Organisation	Asian Development Bank		
Target group			
Experts		Technical planners and designers	Engineers
Decision makers			
Practioners	Project planners		
Planning focus of the tool			
Support for the process		Support for the planning process	
Performance of the process	The planning process	The planning process	The planning process
Context			
For WSS?	Sanitation	Sanitation	WSS-system
For the devoloping world?	Yes	Yes	Not explicitly
For the urban poor?	Yes	Yes	Not explicitly
For peri-urban areas?	Not explicitly	Land tenure are regarded	Not explicitly
Software tools	No	No	No

	10. SWARD framework	11. Urban Water toolbox	12. ADB toolkit
Orginator			
Research group		Urban Water Programme	
Organisation	SWARD		Asian Development Bank
Target group			
Experts			
Decision makers			Governments
Practioners	Water service providers	WSS planners	Providers of sanitation services
Planning focus of the tool			
Support for the process			Policy implemention and community mobilization
Performance of the process	The planning process	The planning process	Technology options
Context			
For WSS?	WSS-system	WSS-system	Sanitation
For the devoloping world?	Not explicitly	Not explicitly	Yes (Asia)
For the urban poor?	Not explicitly	Not explicitly	Yes
For peri-urban areas?	Not explicitly	Not explicitly	Not explicitly
Software tools	MCDA-methods	MCDA-methods	SANEX
	Eco-Indicator 99	URWARE and SEWSYS	
	AQUATOR, InfoWorks WS and	MRA	
	InfoWorks CS	Costing model in Excel	

	13. WUP toolkit	14. GWP toolkit	15. Dannish Ministry of the Environment toolkit
Orginator			
Research group			
Organisation	Water Utility Partnership	Global Water Partnership	Dannish Ministry of the Environment
Target group			
Experts			Planners in the water utility sector
Decision makers	Policy and decision makers	Government	
Practioners	Providers of WSS-services		
Planning focus of the tool			
Support for the process	Strategy for implement the process by policies and legal regulations.	Institutional reforms, policies and organisational frameworks	Political acceptability and institutional framework
Performance of the process	The planning proccess		
Context			
For WSS?	WSS-systems	WSS-systems	WSS-systems
For the devoloping world?	Yes (Africa)	Yes	Not explicitly
For the urban poor?	Yes	Yes	Not explicitly
For peri-urban areas?	Unplanned settlements and integration of services is regarded	Not explicitly	Not explicitly
Software tools	No	No	No

	16. Gender toolkit	17. AISUWRS toolkit
Orginator		
Research group		University of Karlsruhe, Germany
Organisation	World Bank	
Target group		
Experts		Planners of urban WSS-systems
Decision makers		
Practioners	World Bank staff in the WSS-sector	
Planning focus of the tool		
Support for the process		
Performance of the process	Consider gender in the process	Consider sustainability in the process
Context		
For WSS?	WSS-systems	WSS-systems
For the devoloping world?	Yes	Not explicitly
For the urban poor?	Not explicitly	Not explicitly
For peri-urban areas?	Not explicitly	Not explicitly
Software tools	No	Groundwater modelling tools
		SEESAW