

THE CLARA PROJECT – CAPACITY-LINKED WATER SUPPLY AND SANITATION IMPROVEMENT FOR AFRICA'S PERI-URBAN AND RURAL AREAS

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ABSTRACT

There are a large number of small communities and towns in Africa that suffer from severe problems with water supply and sanitation. Small communities in rural areas and peri-urban areas of small towns have comparable settlement structures in which reuse of water and use of sanitation products can be utilized. However, there is only limited local capacity to adopt, implement and operate integrated water supply and sanitation. CLARA's overall objective is to strengthen the local capacity in the water supply and sanitation sector. From a technological point of view, existing low cost technologies for decentralized water supply and sanitation systems shall be assessed and adapted for African conditions with the focus on reducing risks in use and reuse of water and sanitation products, and providing demand oriented water quality. Based on these technological improvements and the experiences from the FP6 projects ROSA (<http://rosa.boku.ac.at/>) and NETSSAF (<http://www.netssaf.net/>), a simplified planning tool for integrated water supply and sanitation systems for small communities and peri-urban areas shall be developed that incorporates the key factors for success, i.e. operation and maintenance issues and reuse potential, from the beginning of the planning process, and that can be tailored to available local capacities. This simplified integrated CLARA planning tool shall then be tested and evaluated in different geographical African regions to incorporate different economic, cultural and social boundary conditions. For the communities participating in the planning process, application documents will be prepared as a final output that serve as basis to ask for funding of their implementation plans for integrated water supply and sanitation.

Keywords: CAPACITY BUILDING, RESOURCES-ORIENTED SANITATION, SYSTEMS APPROACH, WATER SUPPLY AND SANITATION PLANNING.

INTRODUCTION

The UN Millennium Development Goals (MDGs), as agreed at the UN Summit 2000, encourage that half of the people without access to safe drinking water should have access by 2015. The goal was completed at the UN World Summit 2002 in Johannesburg, South Africa, with the formulation of the demand for access to basic sanitation (UN, 2002). The formulation of the MDGs resulted in a wide range of activities to reach these goals. However, the current results of WHO's and UNICEF's joint monitoring programme (JMP) show that a number of world regions and especially Africa is one of the most problematic regions in terms of improved water supply and sanitation coverage showing severe disparities between urban and rural development (WHO/UNICEF, 2010). The JMP stated in their report e.g. that *'although 1.3 billion people have gained access to improved sanitation since 1990, the world is likely to miss the MDG sanitation target by a billion people. [...] Seven out of ten people without improved sanitation live in rural areas, but the number of people in urban areas without improved sanitation is increasing because of rapid growth in urban populations.'*

'Resources-oriented sanitation' describes the approach in which human excreta and water from households are recognized as resources made available for re-use. These systems are based on the closure of material flow cycles. To optimise the potential for reuse different wastewater flows are collected and treated separately. Nowadays 'resources-oriented sanitation' is used in the same way as 'ecological sanitation', and 'sustainable sanitation'. For resources-oriented sanitation systems to be truly sustainable they have to comply with the definition of sustainable sanitation as given by the Sustainable Sanitation Alliance (SuSanA, www.susana.org), the following aspects need to be considered:

- Health and hygiene
- Environment and natural resources
- Technology and operation
- Financial and economic issues
- Socio-cultural and institutional aspects

For sustainable implementation of sanitation systems the whole system has to be kept in mind. A sanitation system – contrary to a sanitation technology – considers all components required for the adequate management of human wastes (Zurbrügg and Tilley, 2009). In the "Compendium of Sanitation Systems and Technologies" (Tilley et al., 2008) the following five functional groups that form sanitation systems are defined: 1) User Interface, 2) Collection and Storage, 3) Conveyance, 4) Treatment and 5) Use and/or Disposal. Depending on the configuration of technologies that carry out different processes on specific products (wastes) different systems are defined. Two main criteria for subdividing the systems are "wet" and "dry", and the degree of waste separation, whereby the terms "wet" and "dry" indicate the presence of flushing water for the transport of excreta.

Experiences from the EU funded research project ROSA (<http://rosa.boku.ac.at/>) show that besides the required adaptation of technologies to local conditions especially soft factors are of importance for successful implementation of sanitation systems. These soft factors include:

- participation of all stakeholders from the beginning (as described in a number of sanitation planning approaches, e.g. the Household-Centred Environmental Sanitation approach),
- capacity building to raise awareness on sanitation issues,
- creating demand for products from sanitation systems for reuse (liquid and solid fertilizer),
- consideration of operation and maintenance from the beginning,
- combining excreta and solid waste management schemes (e.g. Ronteltap et al., 2009),

In parallel to the ROSA project in East Africa the project NETSSAF (Network for the Development of Sustainable Approaches for Large Scale Implementation of Sanitation in Africa; <http://www.netssaf.net/>) which was also funded by the EU was running in West Africa. NETSSAF (a Coordination Action) aimed for coordination of efforts and exchange of knowledge to promote the development of innovative methods and low-cost technologies that enhance the application of adapted sustainable sanitation in Africa.

Based on the experiences and lessons learnt from ROSA and NETSSAF a follow-up project has been proposed at the EU FP7 Africa Call (submission deadline January 2010). The following points have been identified and were addressed in the proposal:

- extend ROSA and NETSSAF work from sanitation to water supply and reuse aspects to close the cycle,
- develop a simplified planning tool that is applicable and will be used in practice,
- perform field research at a site where a adequate number of sanitation installations is in place (i.e. the ROSA pilot city Arba Minch in Ethiopia),
- research the gaps in the technological part of water supply and sanitation systems that have been identified from the practical experiences,
- emphasis operation and maintenance for sustainable implementation of water supply and sanitation systems,
- include reuse aspects in planning as they can be a main driver for people to intensify implementation of resources-oriented sanitation concepts, and
- include other than East and West African regions.

The new CLARA project (Capacity-Linked water supply and sanitation improvement for Africa's peri-urban and Rural Areas) started in March 2011 with duration of 3 years. CLARA will be coordinated by the BOKU University, Austria, and has 15 partners. Besides BOKU there are 3 more European partners that have been all partners in ROSA and/or NETSSAF: EcoSan Club Austria (was partner in ROSA and NETSSAF), ttz Bremerhaven, Germany (the coordinator of NETSSAF), and BIOAZUL, Spain (partner in NETSSAF). The African partners (Figure 1) cover 4 geographical regions: Eastern Africa (Ethiopia and Kenya), Southern Africa (South Africa), Western Africa (Burkina Faso) and Northern Africa (Morocco and Tunisia). From the African partners Egerton University (Kenya), Arba Minch University and Arba Minch Water Supply and Sewerage Enterprise (both from Ethiopia) have been partners in ROSA whereas WSA (Water and Sanitation for Africa, formerly CREPA, Burkina Faso) was partner in NETSSAF.

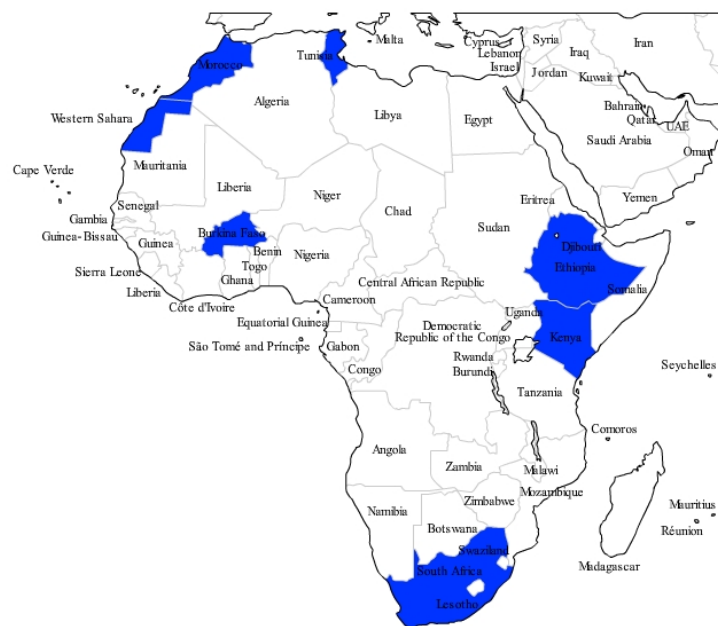


Figure 1: African CLARA countries

To include the relevant partners for the field research in Arba Minch besides the ROSA partners AMU (Arba Minch University) and AWSSE (Arba Minch Water Supply and Sewerage Enterprise) also the following partners have been included in the project:

- Arba Minch Town Municipality (AMTM)
- 'Engan New Mayet' Compost Production Youth Association (EMN)
- 'Wubet le Arba Minch' Solid Waste Collectors Association (SWCA)
- Arba Minch Health Center (AMHC)

All Ethiopian partners have been already cooperating together in the ROSA local consortium in Arba Minch which was formed at the start of the ROSA project. The Ethiopian partners will be mainly responsible to carry out the field research in Arba Minch. AMTM is an important partner for incorporation of the whole work into town policy and the link to the SPA programme, similar the Arba Minch Health Center is important for linking CLARA's work to the overall Ethiopian water supply and sanitation agenda. The incorporation of two SMEs, EMN and SWCA, which are already working and sanitation related activities to produce sanitation products (co-composting and transport of urine and faeces, respectively), is essential to get the micro enterprise view of the sanitation business. To include the business point of view in the process is essential for sustainable implementation of the sanitation systems.

The African partners WSA, Egerton University, ONEP (Office National de l'Eau Potable, Morocco) and WRC (Water Research Commission, South Africa) are responsible for the case studies in Burkina Faso, Kenya, Morocco and South Africa, respectively. CBS (Centre of Biotechnology of Sfax, Tunisia) is an African research partner.

The work in CLARA is carried out in 3 main parts that will be described in the following chapters: i) field research, ii) methodological research (the development of the simplified CLARA planning tool), and iii) case studies.

FIELD RESEARCH

As mentioned above field research is carried out in Arba Minch, Ethiopia, where

- the number of installations of Urine-Diverting Dry Toilets (UDDTs) is high (from ROSA and other projects such as the Dutch funded SPA programme),
- Arba Minch University has been proven to carry out high quality research, and
- the local cooperation between the different stakeholders in Arba Minch has been proven to be exceptional well in ROSA.

CLARA field research is carried out in 3 main fields:

1. Solutions for multi-story buildings and health impacts

Multi-story buildings (MSBs) have been introduced in Arba Minch and other Ethiopian cities as condominium houses during the last years (Meinzinger et al., 2009). The MSBs are usually constructed at the edge of the city boundaries. They have a standardized design which includes flush toilets. In Arba Minch this will cause severe problems as the water supply scheme in place can hardly cope with the water demand under normal conditions. Measures to reduce water consumption at the MSBs and resource-oriented solutions will be researched. Introduction of re-use and resource oriented water supply and sanitation options in multi-story buildings requires technology adaptation. Technologies that are promising in this respect are e.g. rainwater harvesting and biogas utilization together with wet sanitation systems.

Additionally, a baseline analysis carried out in CLARA revealed that residents of the MSBs suffer from significantly higher health risks from water borne diseases than the average population of Arba Minch. The development and implementation of solutions for MSB and the installation of a pilot facility shall have highest priority to reduce health risks for an increasing part of the population.

Besides the health problems at the MSBs, it is aimed to research the reduction of risks of water reuse and use of sanitation products based on the multi-barrier approach as described in the "Guidelines for a safe use of wastewater, excreta and greywater" (WHO, 2006).

2. Sludge treatment, co-composting and urine conditioning methods

Within the ROSA project several types of toilets that allow reuse have been constructed in Arba Minch: Urine diverting dry toilets (UDDTs), fossa alternas, and arborloos. Local materials have been used for construction of the toilets. The toilets have been constructed in private houses, institutions and schools, in total about 600 persons are served by the toilets (most of them in the schools).

In the case that urine and faeces from the UDDTs can not be utilized on the household level excreta management will be made by existing micro and small enterprises. Transport of urine and faeces shall be done by solid waste collectors. For the time being one hand driven cart and one light-weight donkey cart were purchased for transporting the urine and faeces. The households/institutions will have pay for the solid waste collector's service. Urine will be stored in two places then transported to enterprises involved in urban agriculture, the state farm and other farms which are inside and nearby the town. The end-users will have to pay for the urine. Faeces will be transported to the Egnan New Mayet Compost Association for co-composting. Experiments for optimising the co-composting process are planned within CLARA.

Urine separation is a well-known option to generate locally available natural nitrogen fertilizers (Winker et al., 2009). The practiced methods of storage for self hygienization leads to a significant nitrogen loss that can be avoided by applying urine conditioning technologies (Ronteltap et al., 2010) that need to be adapted to local conditions (Etter et al., 2011). Additionally, the reduced volume after conditioning makes transport and handling for farmers easier. Urine conditioning technologies (such as production of struvite from urine) need adaptation to African conditions and will be researched in Arba Minch. Collaboration between CLARA and the BMGF-funded VUNA project (www.eawag.ch/vuna) has been set-up.

For treating faecal sludge from septic tanks a constructed wetland (CW) for treatment sludge has been already constructed at the end of the ROSA project, however, due to several reasons has not started operation yet. Within CLARA the sludge drying reed bed should start of operation and the operation should be monitored and optimized.

3. Operation and maintenance and financing mechanisms

Operation and maintenance (O&M) is of high importance for sustainable implementation of sanitation systems. Based on the existing installations current operation and maintenance practises shall be analysed and optimized. Additionally, the incorporation of private businesses as sanitation service providers and the barriers towards this shall be analysed by the means of e.g. business plans.

In this topic the following points shall be researched in Arba Minch:

1. to analyse and optimise the profitability and sustainability of the services carried out by the solid waste collectors and the composting association in Arba Minch
2. to analyse the financing of the O&M of the sludge drying bed

THE SIMPLIFIED CLARA PLANNING TOOL

A simplified CLARA planning tool for integrated water supply and sanitation systems shall be developed based on these experiences and shall then be tested in different geographical regions in Africa.

Principles

Within CLARA it is not aimed to define a new overall planning approach. The CLARA planning tool aims to support local planners to find the best solution for water supply and sanitation in the planning objective (i.e. the technical part of the overall planning process). The CLARA simplified planning tool therefore comprises only a part of an overall planning process.

According to the NETSSAF Participatory Planning Approach (<http://www.netssaf.net/>) the overall planning process comprises the following steps:

- STEP 1 Project start-up and launch of the planning process
- STEP 2 Creation of demand for improved sanitation
- STEP 3 Description of settlement conditions, with assessment of existing sanitation situation and user priorities
- STEP 4 Identification of feasible sanitation concepts and service systems
- STEP 5 Consolidation and finalisation of implementation plans for sustainable sanitation
- STEP 6 Implementation

- STEP 7 Participatory monitoring and evaluation

The CLARA planning tool covers steps 3 and 4 of the NETTSAF Participatory Planning Approach. Other steps such as demand creation through education, awareness creation and social marketing are important parts of the overall planning process and need to be carried out.

Systems and technologies:

Technologies are defined as the specific infrastructure, methods, or services that are designed to contain, transform, or transport products between different functional groups. On the other hand, water supply and sanitation systems encompass the collection, treatment, distribution, storage and final use of water, as well as the collection, transport, treatment and management of human excreta, solid waste, industrial wastewater and storm water. The functional groups as defined in the Sustainable Sanitation and Water Management (SSWM; <http://www.sswm.info>) toolbox shall be used in the CLARA planning tool, these are:

- Water sources
- Water purification
- Water distribution
- Water use
- Collection and transport
- Treatment
- Recharge / reuse

Criteria for evaluation

The evaluation of the pre-selected systems is performed through a cost-benefit analysis. Environmental and health benefits will not be considered explicitly in the evaluation since it is assumed that these aspects are already considered in the framework conditions, i.e. it is assumed that all systems fulfilling the legal requirements benefit environment and health.

The Net Present Value (NPV) is calculated according to different cost criteria. The NPV has been selected as the performance indicator of the cost criteria for the following reasons:

- It permits to quantify different criteria in the same units (monetary units)
- It permits to assess and compare the investment needed for project implementation as well as the costs for O&M of the systems.
- It is an objective and relatively easy to measure indicator

The following methodology is applied for developing the cost functions for the planning tool:

a) Description of technical components:

General descriptions of the technical components can be found in the Compendium of Sanitation systems and Technologies and the SSWM toolbox.

For each technology calculations and technical drawings will be prepared based on the design assumptions. These calculations and drawings are the base of the development of BoQs.

b) Develop lists of materials and labour required to construct, maintain, and repair technical components (Bill of quantities, BoQs)

For each technology a bills of quantities of materials and labour for different sizes are prepared. The costs of the items included shall be entered by the relevant authority of every CLARA partner country. Therefore the costs of the items vary from region to region. These country-specific costs are an input for the calculation of the cost functions for the technologies.

The BoQs are ideally identical for each country; exceptions may be necessary if special legal requirements concerning the design of the technology result in a change in the standardized designs of the technologies.

c) Develop cost functions for materials, parts and labour

The combination of the data coming from the BoQs (quantities of materials, parts, labour) and the site specific costs for these materials, parts and labour leads to the cost of a certain technology of a certain size. Having these costs for different sizes of the technologies a cost function can be regressed.

The cost function can then be used to calculate the costs of a technology of a size entered by the user of the CLARA planning tool.

The user of the simplified CLARA planning tool

The user of the tool- the planner- is an expert either hired by the client or part of the client's staff with adequate knowledge and experience regarding water supply and sanitation and equipped with required legal permits. The planner is responsible for developing appropriate solutions, collecting the necessary information regarding local context and available technologies, taking into account the framework conditions, and apply the CLARA planning tool according to the data obtained.

There are certain requirements which the planner necessarily has to fulfil:

1. Knowledge of legal standards applicable in the project area
2. Capability to select possible systems based on the legal requirements and the data of the project area collected
3. Capability to do the (preliminary) design of the selected systems
4. Capability to use the CLARA planning tool

The CLARA planning tool can assist the planner by giving him the link to the SSWM toolbox, which can give him a complete overview on the technologies available. The SSWM toolbox also contains the available resource oriented technologies; therefore the planner shall be motivated to take also resource oriented solutions into consideration.

Generally the planner has to be able to combine available technologies to complete and feasible systems. The tool assists with this task since mass balance checks are implemented which shall show if all the mass input (water, nutrients ...) is taken into account. Therefore only complete systems which consider all inputs and outputs of the system are allowed.

Implementation

In September 2012 a draft version of the simplified CLARA planning tool will be made available to the project partners for testing. The draft version is implemented in MSEXcel® whereas the final version should be coupled to the SSWM toolbox. Figure 2 shows the structure for the draft version of the simplified CLARA planning tool in MSEXcel®. Different sheets will be accessible for the users of the tool restricted access will be provided for the sheets containing information on cost functions for different technologies and unit prices, respectively.

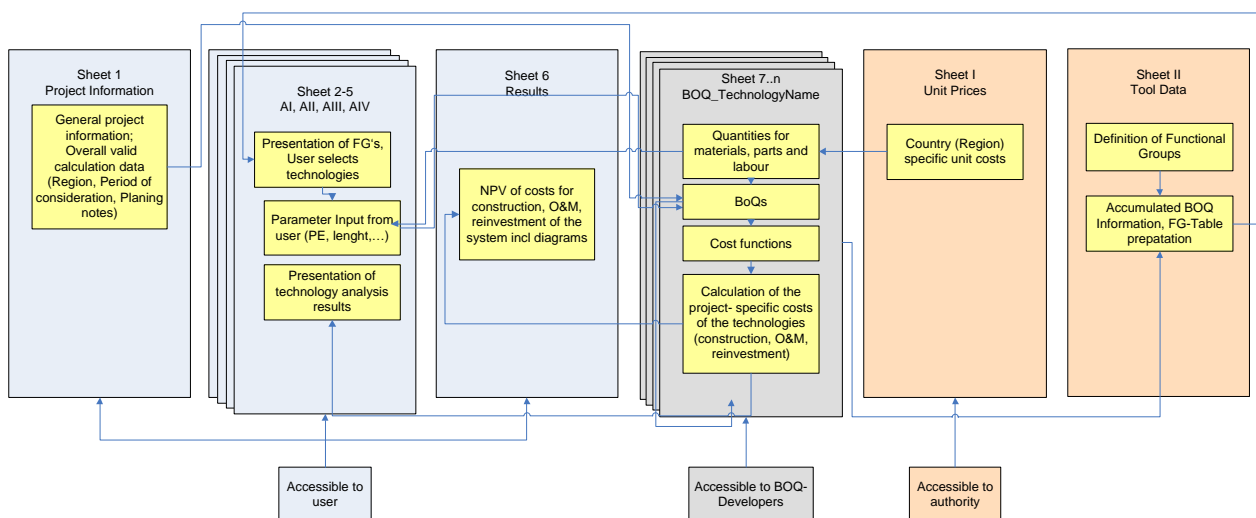


Figure 2: Structure of the simplified CLARA planning tool

The final version of the simplified CLARA planning tool will be available at the end of the project (early 2014) and will be available free of charge.

CASE STUDIES

The simplified CLARA planning tool will be tested and evaluated in Arba Minch and in the CLARA pilot cities in Burkina Faso, Ethiopia, Kenya, Morocco and South Africa. At all case study sites a planning process for an integrated water supply and sanitation system for the pilot city will be carried out. Within the process the simplified CLARA planning tool will be used for evaluating different solutions proposed.

After planning the integrated water supply and sanitation system, application documents will be prepared that shall allow the pilot cities to request donor money. The application documents shall be made in the format as required by the donors, e.g. the African Water Facility or similar.

SUMMARY

The overall objective of the CLARA project is to strengthen the local capacity in the water supply and sanitation sector which is needed to adopt, implement and operate integrated resource-oriented water supply and sanitation solutions. The work of the CLARA project was planned based on the experiences from the FP6 projects ROSA (<http://rosa.boku.ac.at/>) and NETSSAF (<http://www.netssaf.net/>).

CLARA has two main objectives: we aim to develop a simplified planning tool for water supply and sanitation planning under African conditions, and encourage technological and non-technological improvements of low-cost water supply and sanitation systems.

The CLARA simplified planning tool is not a new participatory planning approach but shall assist local planners and consultants to compare different solutions of water supply and sanitation systems based on real costs. After developing a draft version of the planning tool, it is tested in the case study sites the five African CLARA countries, Ethiopia, Kenya, Morocco, Burkina Faso and South Africa.

Field research on technological and non-technological improvements is carried out in Arba Minch, Ethiopia. Three main topics are investigated: 1) operation and maintenance, and financing mechanisms – strengthening the incorporation of businesses in the sanitation service chain; 2) faecal sludge treatment and urine conditioning methods; and 3) solutions for multi-storey condominium houses

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