


Decentralised Wastewater Management in Kafr El Sheikh Governorate, Egypt

El-Moufty El-Kobra Pilot Concept & Lessons Learnt

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Deutsche Gesellschaft für
Technische Zusammenarbeit (GTZ) GmbH
Postfach 5180
65726 Eschborn
T +49 61 96 79-0
F +49 61 96 79-11 15
E info@gtz.de

Internet:
www.gtz.de

Name of project:
Decentralised Wastewater Management Project Kafr El Sheikh

Responsible:
Dr. Stefan Sennewald (GTZ, Cairo, Egypt)

Authors:
Karl Wehrle (Skat, St. Gallen, Switzerland)
Alexander Burns (Rodeco Consulting GmbH, Bad Homburg, Germany)
Dr. Mahmoud Abdel Azim (Aldar Consultants, Cairo, Egypt)

Layout:
Tina Eisele, Timur El Hadidi (GTZ, Cairo, Egypt)

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Preamble

Since the mid 1980s water supply in the Governorate of Kafr El Sheikh has been gradually improved with the support of German Development Cooperation through the Federal Ministry for Economic Cooperation and Development (BMZ). In order to counter the combined increase of wastewater quantity and health risks, central wastewater systems have been implemented in cities and towns in the last decade. However, only about 30 % of the total population will be connected to these systems because most of the people are living in small communities. Although these communities are facing significant problems related to poor sanitation, adequate solutions to serve the needs of villages have not been available.

Facing this challenge, a new approach to provide adequate sanitation services to small communities in the delta region has been developed and is implemented since mid 2002 with German development assistance through GTZ, who contracted RODECO Consulting GmbH as implementing consultant. The key implementing agency on the Egyptian side is the Kafr El Sheikh Water and Sewerage Company (KWSC).

The success story of the sewage system in the first village of El-Moufty El-Kobra contains high potential for replication. The provision of a well functioning sewer system and treatment plant, which went into operation in February 2005, has in a short time upgraded the village to a showcase model in the Governorate. The participation of the population coupled with hygiene promotion programmes leading to improved hygienic behaviour, the low investment costs, the high quality of the design and execution and simple operation management at very low, affordable costs as well as the trouble-free performance of the system make it an excellent example for rural development. A second village in the same Governorate is already implementing a similar sewage system while additional systems are being prepared in at least seven more villages until end of 2007.

Although this is a pilot scale project covering only a small number of villages in the governorate of Kafr El-Sheikh the potential for replication is quite significant. For various reasons, such as the high groundwater table, small communities in the delta region are facing the most urgent problems with regard to inadequate sanitation services. There are more than 200 villages with populations up to 5000 in the Kafr El Sheikh Governorate alone and many hundreds more in the delta region.

Provided that sufficient resources become available, it is estimated that adequate sanitation services could be provided to about 50 villages over a five year period. This would benefit about 250,000 people at an estimated total cost of LE 125 mio. (equivalent to € 17.5 mio.).
The purpose of this paper is to briefly present the experience gained in the ongoing Decentralised Waste Water Management Project in the Governorate of Kafr El Sheikh. It intends to give an overview of the project. Further reference and detailed documentation on guiding principles, project process development, comparison of alternative technical options, management, financing and O&M models etc. is currently compiled in a modular document package entitled "Basic Framework Concepts for Decentralised Sanitation Systems in Kafr El Sheikh Governorate". This package will also include periodically updated case studies for each of the villages supported.

Abbreviations and Acronyms

BMZ	Ministry for Economic Cooperation of the Federal Republic of Germany
BOT	Build-Operate-Transfer arrangement between public and private sector
CDA	Community Development Association
GTZ	German Technical Cooperation Agency
HCES	Household-Centred Environmental Sanitation Approach
HCWW	Holding Company for Water and Waste Water
HRD	Human Resources Development
KWSC	Kafr El Sheikh Water and Sewerage Company
LVU	Local Village Unit
MKV	Moufty Kobra Village
NGO	Non Governmental Organisation
O&M	Operation and Maintenance
PT	Project Team of external consultant (RODECO)
R&R	Roles and Responsibilities
RODECO	Implementing Consultant
SANDEC	Department of Water and Sanitation in Developing Countries at the Swiss Federal Institute for Environmental Science and Technology
SBS	Small Bore Sewer System
SC	Steering Committee
SKAT	Sub Consultant to Rodeco
SWM	Solid Waste Management
ToR	Terms of Reference

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1 Introduction

To Basic Framework Concept for Decentralised Sanitation Systems in Kafr El Sheikh Governorate

1.1 Aim and Scope of "Pilots Concept and Lessons Learnt"

Overall aim

The overall aim of the framework concept is to support the achievement of the project aim, which has been formulated as follows: *"Hygienic, harmless, appropriate, low-cost wastewater disposal possibilities are accepted and applied by the population and the responsible institutions."*

The **Framework Concept describes how** this project aim can be achieved efficiently and effectively. It also **explains why** a certain approach or methodology is applied and why a certain stakeholder is made responsible etc.

Specific objectives

The specific objectives of the framework concept are as follows:

- to clarify and communicate the project concept (including approaches, learning loops etc.) to all key project stakeholders (e.g. to facilitate negotiations),
- to document the experiences, lessons learnt and best practices,
- to facilitate the replication of the pilot project in Kafr El Sheikh Governorate,
- to provide the project management with adequate tools,
- to facilitate its application in other projects in Egypt where appropriate,
- to share experiences and knowledge at global level where appropriate.

Scope

From the specific objectives it is clear that the framework will be addressing a range of target groups (Community Development Associations, The Kafr El Sheikh Water and Sewage Company (KWSC), project planners and managers, donors, etc.). That is why the framework is composed of different chapters, which are tailored to the needs of the various stakeholder groups.

1.2 Lay Out and Target Groups Addressed

The lay out follows the requirements, which result from the aims and scope of the framework concept. Accordingly "Pilot Concept and Lessons Learnt" is built up in various chapters, which are addressed to the different target groups as shown below:

Chapter	Title	Target Group
2	"The Ten Key Step Process" in developing, planning, implementing and starting up a decentralised sanitation system.	project managers, project partners: government, communities
3	"The Key Stakeholders" including their roles and responsibilities as well as their interactions.	all key stakeholders
4	"Management and Financing Model(s) for Operation & Maintenance"	project managers, project partners: government, communities
5	"Appropriate Technologies"	project engineers
6	"The Guiding Principles" mostly drawn from current global learning	project managers, government officers
7	"Case Studies" including some essential figures, facts and lessons learnt	decision makers and planners of wastewater systems

2 The Ten Key Step Process

In developing, planning, implementing and starting up a decentralised sanitation system

2.1 Aim and Scope

The aim of chapter 2 is to inform about the key steps, which need to be taken in developing, planning, implementing and launching a sustainable decentralised sanitation system in Kafr El Sheikh Governorate. Though this guide is based on the actual experience it does not necessarily reflect what has actually been done, but rather informs about what the project team feel should be done. (The current situation will be described in chapter 7 "Case studies"). The steps presented reflect the particular situation experienced during the initial stages of establishing the project, with the first three steps in particular being of relevance mainly during this time. It is expected that these three steps will be different for subsequent villages. (Adjustments will be made according to the lessons obtained in the next project phase).

This chapter is addressed to the project managers and officers both at the level of the external implementing agency and the project partners at government and community level.

It starts after the external implementing agency has been contracted and set up their office in the project area and the local project partner at government level is organised to play their part in the project implementation. It stops with the local project structure being fully in place and enabled to carry on with the project.

Though the guide presents the ten key steps in sequence this does not mean that each step would need to be implemented one after the other in a mechanistic way. In practice they will usually overlap, some steps may need to be repeated more than once in an iteration to find acceptable solutions.

2.2 Step 1: Project Identification and Formulation

(Including Partner Identification and Securing Project Funding)

This step is not comprehensively elaborated within this chapter, since the chapter is intended to cover the required activities after the project has been identified and the partners have been selected and contracted. However, since it is important that all key stakeholders have an understanding of the critical issues of step 1, some of the key elements of this step are discussed in the following.

Aim

To assess the need and demand and to formulate the project (along the logical framework) including the identification of capable project partners and negotiations of roles and responsibilities as well as securing the financial means required.

Results

- A request written by key stakeholders is received by the external support agency.
- The need is assessed taking the existing context into consideration.
- Project partners are identified and a mode of collaboration negotiated.
- The project idea is developed in a consultative manner with the key stakeholders and the project framework is established accordingly.
- The funding of the project implementation is negotiated and the local financing of the required operation and maintenance secured.

- A capable external implementing agency is selected and contracted in consultation with the local project partner.
- The local project structure is in place and the institution and human resources building needs are identified.

Key ingredients

- The project identification should be based on an expressed need (demand) by the key stakeholders and ultimate beneficiaries.
- Transparency and agreement about the roles and responsibilities of key stakeholders (including the external support agency) and mode of collaboration during project implementation as well as regarding future operation and maintenance should be clearly established from the very beginning.
- The guiding principles elaborated in chapter 6 of this framework concept are valid from this first step.

2.3 Step 2: Project Structure Establishment

(including mode of collaboration with project partners at government and private sector level)

Aim

To achieve an appropriate and enabled project structure at government and private sector level through participative development of the structure and close collaboration with the direct project partners.

Results

- The existing institutional set up, including sector stakeholders, is assessed for their capacities (report available).
- An appropriate decentralised project structure for the various project phases (including O&M) is pre-designed (considering the existing context), negotiated and accepted including clarification of roles and responsibilities as well as staff and capacity building needs ("business plan" available at government partner level).
- The required project structure at partner level is in place (required staff assigned, office organised).
- A Human Resource Development (HRD) plan is established, agreed upon and implemented. (HRD-plan has to remain open for feedback to allow continuous development).
- A legal framework facilitating the selected project structure is established.
- A Steering Committee (SC) is established at governorate level.
- A capable Egyptian consultant is identified selected and contracted as overall project consultant in consultation with the project partner.

Key activities

- Conduct introductory meetings between project team and partners at governmental level.
- Hold structured workshop(s) with all key stakeholders with the following aim: i.) to explain project philosophy, ii.) to clarify roles and responsibilities, iii.) to agree on the required project structure including steering committee, iv.) to agree on the composition of the decentralised sanitation unit at project partner level. For activity ii.) and iii.) the development of a stakeholder map may be very useful (c.f. chapter 3).
- Establish in a participative manner mode of collaboration and working plan (for the start up phase).
- Approval of working plan by SC.
- Identify and select trustworthy local project consultant in collaboration with partners.
- Develop in a participative manner HRD plan and implement it along with the project realisation (e.g. on the job training, selected courses, etc. in particular for long-term stakeholders but also for local consultant to enable them to identify and design a range of technically appropriate systems, based on the demand of the situation.).

Key ingredients

- Transparency about external support agency's (GTZ) expectations (negotiable and non-negotiable conditions) including information about the reasons for them (lessons learnt e.g. regarding the need for intensive user involvement and subsequently the need for a HCES approach).
- Willing and committed staff at all levels.
- Continuity of staff at all levels.
- Opportunities for training and career advancement.
- Capacity building partly in-built into collaboration (on-the-job) and partly formal training.
- Encouragement of collaboration and building up of trust with project partners through measures such as office location in partners premises, maintaining an open door attitude, involvement in decision making, holding regular formal and informal information meetings etc.

2.4 Step 3: Village Selection

Aim

To select a desired number of villages according to the village selection procedure and the criteria agreed upon by the government and the external supporting agency.

Results

- An approach and methodology for a proper village selection procedure is in a participative manner and transparently developed and agreed upon.
- Selection criteria and village ranking are agreed upon, clearly formulated and known by all stakeholders concerned.
- A list of pre-selected villages is established by the SC.

- The pre-selected villages are prioritised according to a detailed assessment, which has been based on agreed criteria.
- Final selection is decided and agreed upon by the SC.
- MoUs are negotiated and agreed upon.

Key activities

- Agreement on approach and methodology for proper village selection procedure.
- Development and formulation of pre-selection and final selection criteria in consultation and agreement with SC by the project team.
- Pre-selection of a desired number of villages by the SC and provision of a list to the project team.
- Project presentation and agreement of time table for visiting the pre-selected villages by the project team in a meeting with a representation of the pre-selected villages.
- Participatory assessment of the pre-selected villages by the project team based on the agreed criteria.
- Analysis of collected data, assigning priorities and recommendation for the final selection by the project.
- Final selection is presented to the SC for approval.
- Agreement on the next steps.

Key ingredients

- Transparency about the selection criteria and process at any stage to all stakeholders.
- Interactions with and involvement of all stakeholders aiming at confidence and ownership building at all stages of the process, with particular attention on the communities.
- Preventing wrong expectations among all key stakeholders.

2.5 General Remark to First Three Steps

The first three steps as outlined above have been relevant for the initial phase. It is expected that these steps do not have to be repeated to the full extent in the project scaling up phase. E.g. the village selection process may be simplified and based (possibly) on direct demand from the villages. These adjustments will need to be planned for in advance to the next project phase.

2.6 Step 4: Village Preparation

Aim

i.) To enable villagers to express their needs, ii.) to enable them to take informed decisions, iii.) to involve them in the technology selection, thus creating acceptance and "ownership" of the selected solution, iv.) to empower and enable them through capacity and institution building etc. to manage their own affairs regarding safe waste water management.

Results

- Baseline data are established regarding the hygienic situation in the village including health condition. (This data will be considered in the project monitoring as outlined in step 8).
- Villagers are fully informed about and intensively involved in the development of the project lay out (regarding the organisational project structure and the physical lay out).
- Roles and responsibilities in the various project phases (in particular regarding O&M) of the different stakeholders at village level are clarified, understood and accepted (legalised bye-laws are available). (The development of a stakeholder map may be useful for this result, see chapter 3).
- Villagers have developed confidence towards the project team.
- A Community Development Association (CDA) is established by the village committee and functional.
- Villagers' awareness and knowledge regarding the links between hygiene, sanitation and health is enhanced and a mechanism is established at village level for continued promotion.
- Villagers' awareness and knowledge regarding the sanitation possibilities open to them and the advantages and disadvantages of these systems is enhanced, as is their awareness of the resources contained in wastewater and the possible mechanisms to recover and use them.
- The villagers' expectations match with the technical, economical, institutional and environmental feasible solution. (This is should be also facilitated through the selection process of the technologies, which should consider the villagers needs, c.f. step 6).
- The expected contributions by the villagers and by the project are negotiated and agreed upon. The agreement is clearly documented and confirmed in a contract or memorandum of understanding.
- The village contributions required to start the project implementation (e.g. land for the treatment plant) are available.
- Villagers in the various positions (CDA) are empowered and capable to perform the tasks.
- Appropriate training modules to support the capacity building at village level are developed.
- Appropriate manuals and guidelines are available to support the villagers in the various positions (e.g. CDA) to perform their tasks.

Key Activities

- Establish baseline data regarding the hygienic situation in the village and in particular about the health condition of villagers.
- Involve villagers in all planning activities in particular regarding issues concerning the village level.
- Introduce the project (including aims, organisation, working principles, roles and responsibilities) to the villagers at an early stage and inform them about any subsequent substantial changes and developments.
- Establish a village committee (or sub-committee if CDA already exists).
- Prepare working programme regarding main steps in collaboration with village committee.
- Encourage the establishment of the CDA if one does not already exist.
- Provide initial training on project management (including administration, dealing with communities etc.) to CDA.
- Develop a "business plan" for O&M in consultation / negotiation with the users.
- Select and nominate health promoters in consultation with the village committee.

- Train health promoters through classroom, practical and on-the-job trainings.
- Hold awareness campaign e.g. at the levels of schools, mosques, households etc. with the involvement of the village committee.

Key Ingredients

- Permanent intensive involvement of the villagers in all processes to develop solutions, which are "owned" by them and to build the required capacities.
- Delegation of various tasks at village level (to the greatest possible extent) to the village committee or CDA for their empowerment (e.g. regarding health promotion).
- Establish project office in the village or in the region (both for easy accessibility and better understanding of needs).

2.7 Step 5: Overall Project Work Plan Development

Aim

To agree with all key stakeholders involved on the project implementation plan regarding the project's assumptions, objectives, roles and responsibilities, expected outputs, key activities, means required and the implementation schedule.

Results

- Project implementation plan established with participation of all stakeholders.
- Operation plans established for and together with all key stakeholders.
- Monitoring / Evaluation and reporting system in place and operational.

Key Activities

- Compile overall work plan (milestones) regarding project partners, villages and complementary activities in a consultative mode.
- Present overall project work plan to SC for feedback and approval.
- Finalise overall project work plan.
- Translate in a participatory manner the overall project work plan into operation plans at the various stakeholder levels.
- Develop and introduce an essential monitoring, evaluation and reporting system (including feedback loops) for all relevant aspects of the system.

Key ingredients

- Delegation of the implementation of the various activities to the greatest possible extent to the stakeholders, who will, in the future, be responsible for O&M (with the aim to enable them to take up the future responsibilities).
- Special attention should be given to HRD.
- Inputs by the project team should always aim at capacity building at the same time.

2.8 Step 6: Technology Development and Selection

Technology in this context is understood in its full sense, which means that not only the applied technical solution is considered but also it's institutional, social, financial and ecological implications and requirements.

Aim

To develop a set of technologies that are appropriate regarding their technical performance, which consider the existing institutional, socio-economic and ecological context and which are accepted and "owned" by all key stakeholders.

Results

- Village "maps" are established which inform about the topographic and demographic, the socio-economic and health situation, existing practices regarding water supply, waste water and solid waste management, agricultural practices (including sources of irrigation water and fertiliser) and the acceptability of the re-use of resources.
- A set of technology options is developed showing not only the technical solution but also the institutional, financial, social and environmental implications in particular regarding O&M and informing about their advantages and disadvantages in consideration of the existing context.
- Technology selection criteria are established by the key stakeholders, negotiated as far as required and made transparent.
- The key stakeholders have been consulted for their preferences needs and minimum accepted levels of service. The most appropriate technical option is selected in a transparent manner and presented to the key stakeholders for approval.
- The required institutional and management set up is designed/selected considering existing institutions and capacities as well as the HCES principles.
- The economic viability of the selected technology is verified.
- Negative environmental impacts are kept at the minimum and a "closing the loop" is achieved to the greatest possible extent considering the existing context.
- The project partners' capacity for technology identification and selection is enhanced.

Key Activities

- Conduct participatory village survey by an interdisciplinary team.
- Identify together with the CDA the possibilities of re-use of resources.
- Identify and develop a set of appropriate technology options (which consider not only the technical performance but also institutional, financial, social and environmental implications, and the project guiding principles) in consultation with experienced professionals in Egypt and abroad.
- Developing appropriate means and methods to inform the various stakeholders in particular the village committee or CDA about the possibly unfamiliar technology options.
- Developing selection criteria in a consultative manner.
- Negotiating and agreeing on an appropriate solution(s) with all key stakeholders.
- Verification of suitability of agreed management model and initiation of its establishment including the required institution and capacity building.

- Verification of the ability and willingness to pay with the CDA, agreeing on village contributions for the construction as well as full cost recovering for operation and maintenance.
- Build up capacities to identify and develop appropriate technologies through networking (realising synergies).

Key Ingredients

- Close collaboration with the key stakeholders at any stage of the process with the aims of firstly achieving appropriate solutions, which are "owned" by the stakeholders concerned and secondly enabling all stakeholders to handle the affairs on their own and to build up the required capacities.
- Since the community's capacity may be limited to understand the implications of the various technology options to its full extent, appropriate means and methods have to be applied to make them aware of (also about the importance of re-use of resources).
- Special emphasis needs to be paid already at this stage to the implications and up-coming duties regarding O&M (taking into consideration that the external support will come to an end after project implementation).
- O&M friendly solutions - even when requiring higher initial investment cost - should be given preference.
- The selected options should contain provisions for future up-grading, and raising the awareness of the upgrading possibilities should be integrated into awareness programmes.
- The selected options should be technical matured and any research involved should be covered by the project and when necessary agreed with the CDA.

2.9 Step 7: System Design and Construction

Aim

To get an appropriate decentralised sanitation system designed by a qualified consultant and constructed in high quality by a reliable contractor, both of whom consider the community as their client and in whom the community builds up confidence.

Results

- Final construction design including design report and detailed plans as well as tender documents established.
- Shortlist of contractors established (in consultation with CDA).
- Tendering process is agreed upon with the stakeholders concerned and conducted, contractor selected and contracted.
- The system is completed and thereafter commissioned.
- Performance of the system is monitored according to agreed liability time and all identified shortcomings are rectified.

Key Activities

- Establish construction design and tender documentation considering the following steps: detailed topographic / demographic survey → preliminary design → consultations → finalisation of design → detailed drawings → tender documentation.
- Compile a shortlist of contractors and agree on tendering process.
- Tender the works.
- Evaluate bids (project team) and award the contracts in consultation with CDA.
- Construction implementation by selected contractor, supervised by project consultant (and project team) with the involvement of the CDA.
- Commissioning of system by project team together with CDA (including taking over of system).
- Training of future O&M stakeholders including CDA (management), operators, users, technical supervisors, government institutions (system performance) etc.
- Capacity building at all levels (e.g. training on-the-job during supervision, facilitation of specific training according to needs, training of trainers for project replication, etc.).

Key Ingredients

- High attention to O&M friendly design and high construction quality (to minimise O&M needs).
- Full transparency about the process and clear contractual arrangements for all steps.
- Acceptance of CDA as the principal client of the contractor and consultant (to be facilitated by giving the CDA a voice in the selection and signature in contracting and payments etc.).
- Technology selection based on user and O&M friendliness.
- Stringent quality control of equipment and workmanship.
- Continued capacity building for O&M.

2.10 Step 8: Operation and Maintenance (O&M): Preparation and Start Up

Preparation for O&M begins as early as the launching of the sanitation project and is continued and intensified from step 2 to step 8. In the following, the corresponding activities and expected results are compiled, which need to be achieved mainly along with step 7 but also beyond it.

Aim

To establish an O&M management and implementation system which secures sustainable operation of the sanitation system, including its proper usage and performance regarding the environment (The O&M system should include the operation of the entire wastewater disposal system including the drainage system within the village).

Results

- The institutional and management set up regarding O&M are confirmed, including roles and responsibilities of the stakeholders involved.
- The financing of the required O&M activities is clarified and secured.
- O&M management personnel are selected and enabled to perform their duties (e.g. administration, handling of financial matters etc.).
- O&M technical personnel (both at village and/or private sector level) are selected and enabled to perform their duties.
- O&M manuals including duty sheets are available to all key stakeholders.
- A monitoring and reporting system is developed, functional and applied.
- The system is accepted and properly used by the villagers.

Key Activities

- Clarification of roles and responsibilities in O&M with all stakeholders concerned.
- Setting of tariff, introduction of collection system, putting in place an adequate accounting, banking and auditing system, all done by the CDA and facilitated (including training) by the PT.
- Selection of an O&M responsible at village level (financial management, technical supervision etc.) by the CDA at the start of and training during construction (step 6).
- Selection of O&M contractor by CDA before the start of construction and training during construction (step 7).
- Assignment of an O&M contractor by CDA.
- Development and introduction (including training) of a monitoring and reporting system by project consultant.
- Finalisation and introduction of O&M manuals by the project consultant, taking the monitoring and reporting system into consideration.
- Formal training based on the manuals.
- Continuation of awareness campaigns, including proper usage of system.

Key Ingredients

- Understanding and appreciation of the benefits of adequate operation and maintenance (in particular preventive maintenance) by all key stakeholders → Begin with awareness creation as early as at the start of the project planning.
- Exposure visits for key stakeholders to similar systems may support the awareness and knowledge creation regarding the importance of proper O&M.
- Involvement of future O&M personnel already in the project construction to the extent possible to make them understand the system and to train them for their future O&M duties.
- Making sure that the position of O&M personnel is highly respected.
- Securing adequate compensation for all stakeholders involved in O&M activities (appropriate incentives at CDA level, regular payment of O&M personnel).
- Maintaining a high level of consumer satisfaction through continued reliable services.

2.11 Step 9: Project Consolidation

Aim

To secure the benefits of the investment through continued reliable services as well as to facilitate the replication of the project.

Results

- Acceptance and proper use of the system is confirmed.
- Consolidation of institutional set up, proper management and O&M performance (e.g. refresher training of O&M personnel, etc.).
- Modifications regarding "software and hardware" are made as a result of the lessons learnt through performance monitoring (operation mode of treatment plant).
- Advice on possible upgrading of the system and complementary activities (e.g. solid waste management).
- Requests for similar assistance are received from neighbouring villages.
- The local private sector expresses increased interest in participating in the project (e.g. promotes new projects and supports CDAs in project start up as a marketing activity of its services).
- Mechanisms for direct fund raising for new projects by CDAs are in place and potential funding agencies, credit institutions, etc. show interest.

Key Activities

- Regular observation of system functioning and use by O&M operator and users and reporting to CDA (according to manuals).
- Regular checking and follow up by CDA according to standard (including reporting to PT, partner and/or project consultant).
- Quarterly (initially monthly) monitoring of the entire system by PT plus partner and/or project consultant.
- Analysis of monitoring results → feedback and arrangement of modifications.
- Refresher trainings on-the-job during monitoring visits but also formal according to needs.
- Facilitation of horizontal exchange (knowledge sharing) between neighbour CDAs.
- Transfer of information to neighbour villages by CDA facilitated by project (pro-active marketing or in response to expressed interest).
- Develop package informing interested CDAs on how to contact and approach potential donors and consultants to prepare project proposals.
- Promote, raise awareness and provide advice to CDA on how to upgrade the system for resources re-use and how to carry out complimentary activities.
- Explore possibilities to provide assistance for complimentary activities (especially for solid waste management).

Key Ingredients

- Continued commitment by external support agency to monitor the performance and to provide limited but timely and well tailored support at remaining critical spots.
- The benefits of the system are recognised by the users and their willingness to pay is high.
- Roles and responsibilities are clear and known to all stakeholders involved (transparency), which leads to accountability.

- The CDAs identify with the project, maintain a feeling of ownership, understand and respect the importance of O&M.
- The government shows interest and willingness to take over the role of the external support agency, possibly through HCWW.
- The private sector recognises decentralised sanitation systems as a profitable business opportunity. Possibly, more than one company becomes involved, which may lead to healthy competition among service providers.

2.12 Step 10: Exit of leading External Support Agency (GTZ)

The exit of GTZ is not yet scheduled for the ongoing projects in the particular communities. Additional experiences have to be made to understand the time required to bring the particular project on a sustainable base. Therefore a vision is only provided at this stage, which provides only a general idea about the desired achievements of the project at the point of exit. This vision is subject to regular reviews based on the project's achievement and the support agency's policy. (Though this step is not yet relevant for all ongoing projects it is important to be prepared for taking this step when the time will be ripe for it).

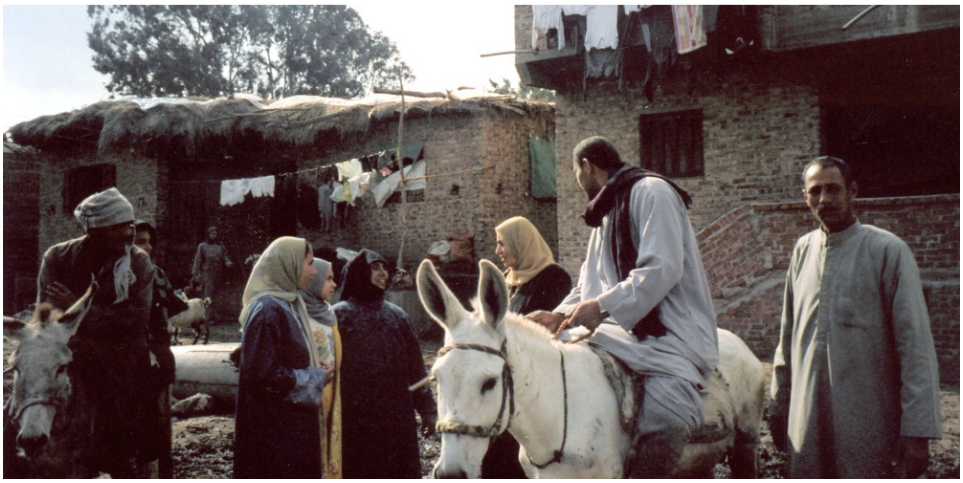
Vision regarding expected achievements

The following achievements seem to be crucial to secure sustainability in a particular village after the exit of GTZ:

- A decentralised management system (with an essential partnership between the users (CDA), the private sector and relevant government departments) maintains and operates in a sustainable manner the completed systems, which are accepted and properly used by the communities.
- The replication of the decentralised sanitation projects is facilitated by the following:
  1. A legal framework that supports the operation of the systems.
  2. Availability of an information package regarding the technology and the project development process.
  3. Awareness and appreciation of the benefits by all key stakeholders involved in the system (in particular by the operator and the users).
  4. Capacity of CDAs to formulate requests and initiate a project development process.
  5. Interest and capacity by the private sector to take up decentralised sanitation systems as a profitable business opportunity.
  6. Access to funding of initial cost (e.g. by donors, credit institutions, government, etc.).
  7. Regulating body in place, which provides performance control, advices CDAs, and facilitates (re-)training etc.

3 The Key Stakeholders

Including their roles and responsibilities as well as their interaction



3.1 Aim and Scope

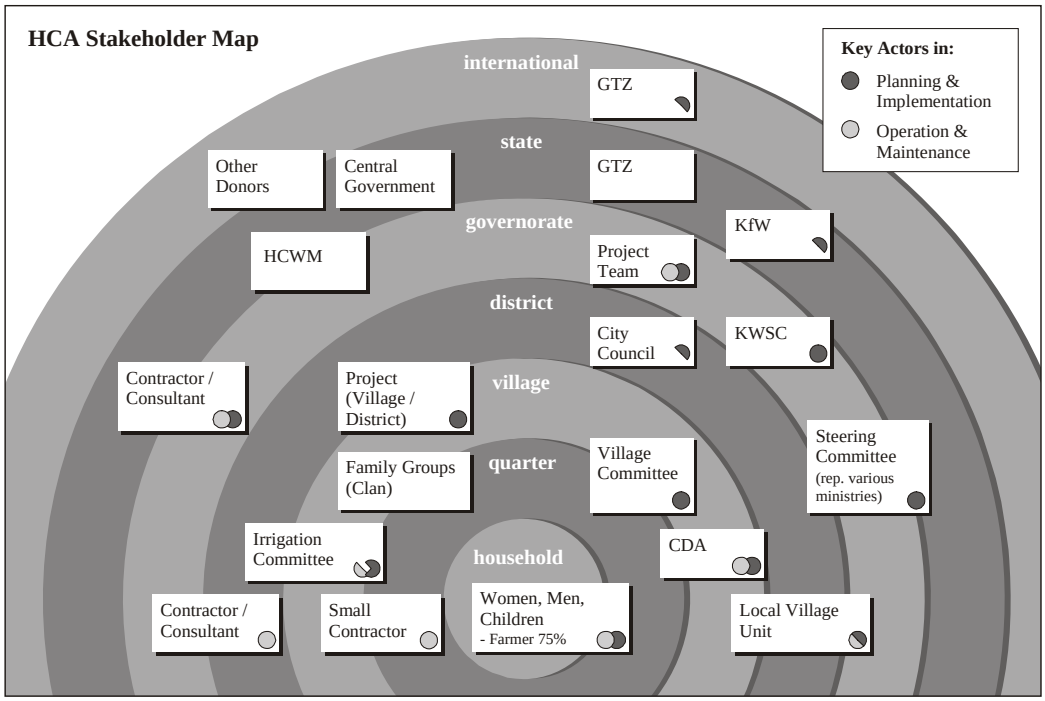
The overall aim of chapter 3 is to provide a tool to establish in a participatory manner answers and transparency regarding the following questions: Who is involved at which level, what are the interfaces and roles and responsibilities?

For practical reasons, the chapter has been split into three parts with different aims:

1. to provide an overview of the stakeholders involved in the different spheres of influence,
2. to provide a quick analysis of the key stakeholders,
3. to show the key stakeholders' roles and responsibilities in the different project phases taking into consideration the selected management and/or financing model (c.f. chapter 4).

This means that a modification of the management and/or financing model will have implications on the roles and responsibilities of the stakeholders concerned.

3.2 Stakeholder Map



The stakeholder map is a powerful instrument to identify the stakeholders involved and to discuss, clarify and agree on their roles and responsibilities. That is why the stakeholder map should be developed in a participatory manner together with the key stakeholders. When developing the stakeholder map it is very appropriate to apply the principles of the household centred approach (HCES). The box above shows the measures which proved to be practical when translating the HCES in a participatory manner into project reality:

Practical steps for the participatory development of a stakeholder map

- Visualise the stakeholder map by considering the different stakeholder levels, starting with the household level in the centre.
- Identify the various existing relevant stakeholders at the different levels.
- Discuss and agree on the different roles and responsibilities of the stakeholders as well as the interfaces between the different levels. Start with the inner circle (household level). Only move to the next level if the problem cannot be efficiently and effectively solved by the inner levels.
- Differentiate between roles and responsibilities during project planning / implementation and the operation and maintenance phase. It is crucial that the key stakeholders in the O&M phase are already involved during the project planning / implementation to the extent possible.

The stakeholder map and the results of its participatory development process (possibly in several steps) provide the basis for the formulation of the stakeholder analysis and the development of the stakeholder matrix regarding roles and responsibilities in the different project phases.

3.3 Key Stakeholder Analysis

Households: Women, men, children (demographic and socio-economic situation)

Women comprise about 50% of the community. They generally participate with the men in all important decisions affecting the family and the community e.g. such matters as education, health, daily work, private business, elections etc.
Women at the village level are engaged in various kinds of work such as farming, education, health, social, general agriculture etc.
Most of the children are educated to a fairly high level and there is no differentiation between boys and girls.

Community Development Association (CDA)

A CDA is a non-governmental organisation, which is entitled to carry out numerous tasks within the community, such as village cleaning, educational programmes, and micro-financing schemes. The CDA has the right to administer village activities including the collection of money and employment of staff. However, it has no legal power to e.g. chase debtors. For this task, it needs the help of the Local Village Unit, which forms the government administration of a group of villages. The legal basis for the CDAs is defined in detail by the decree no. 178 of the 23rd October 2002 issued by the Minister of Insurance and Social Affairs. According to this decree, CDAs have the authority to work on different activities for community development and improvement (e.g. kindergarten, environmental protection projects, women improvement, social and culture activities).
All CDAs of a certain area are represented in the Regional Union of CDAs, which is the contact body in case of problems and carries out training programmes.

In general, CDAs have the following capacity building needs:

- Education for the decree no. 178 for CDA, responsibilities, different activities, etc.
- Leadership, financial and management training.
- Team work.

Irrigation Committee

Irrigation committees were formed during the implementation of the irrigation systems in the villages. There is more than one committee in each village according to the land area and distribution.
The principal task of this committee is to manage (operate and maintain) the irrigation system as follows:

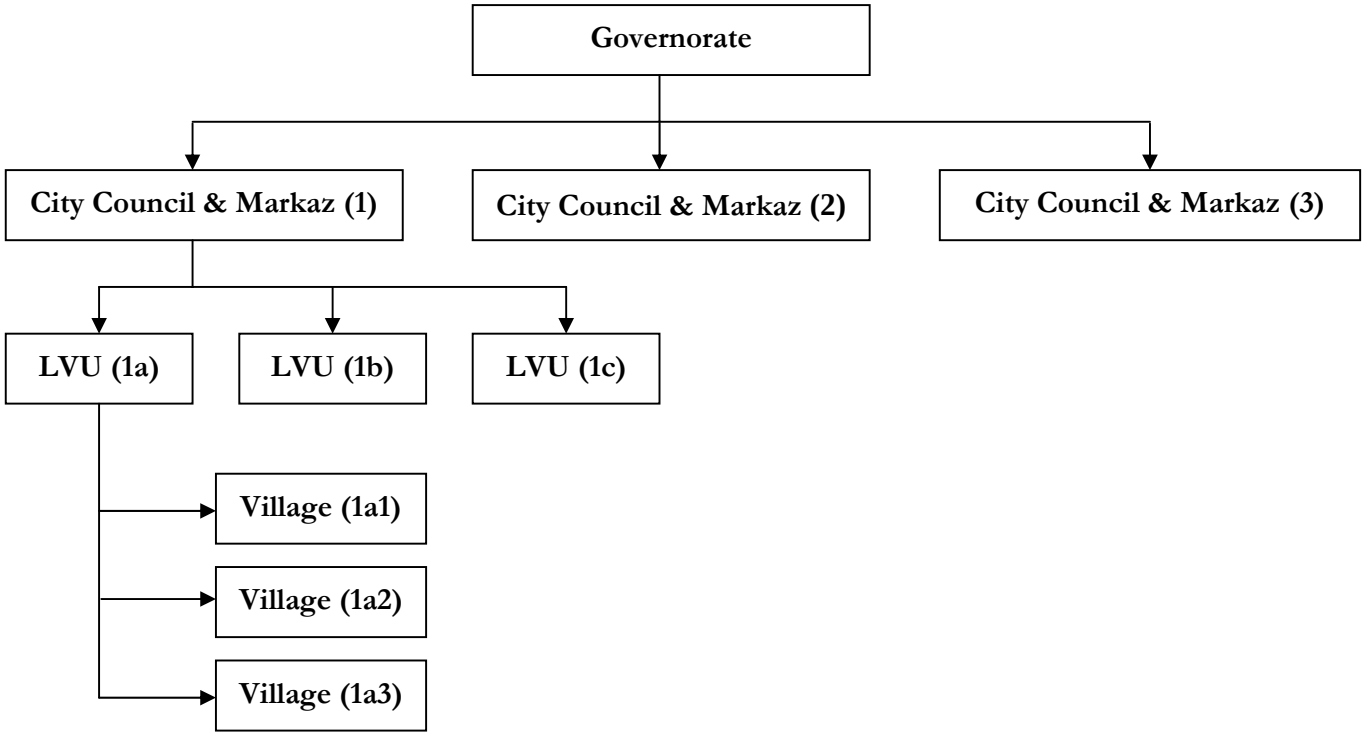
- Arrange and prepare the irrigation schedule.
- Collect money from the benefiting farmers for operation and maintenance.

- Follow up the operation and maintenance of the pump, other relevant equipment and construction work.

Local Village Unit (LVU)

The table below shows the organisational structure at governorate level:

- The LVU (local village unit) represents the governorate office for a cluster of certain villages.
- The LVU is responsible for offering all services to the communities in its area through coordination with the relevant departments in the governorate (water, sewerage, electricity, roads, etc).
- The LVU is the responsible administrative body for the CDA. It carries out financial audits of the CDA's accounting. Annual and monthly budgets have to be monitored by the LVU. In addition, the LVU assists in all legal matters, such as chasing of debtors, etc.



Holding Company for Water and Wastewater (HCWW)

HCWW holds the responsibility at the national level for water and wastewater. HCWW supervises 14 affiliated companies, one of which is KWSC. Special attention is paid to the operation and maintenance of the water and wastewater systems.

Kafr El Sheikh Water and Sewerage Company (KWSC)

KWSC's role in the water and sewerage sector in Kafr El Sheikh is to review projects proposed by governmental or non-governmental programmes within the governorate, follow up on them and coordinate them in all planning, implementation and operation phases.

Governorate

The governorate provides the required legal framework. It is also responsible for securing the required services on the governorate level or at least to assist the community to develop and improve their infrastructure and environment in coordination with different departments or organisations in the governorate. Additionally, the governorate offers a yearly budget to each village to improve the service and environment in the villages.

Private Sector Participation

One major role that KWSC has to play is to ensure that the technical, administrative, management and operation systems developed for the pilot villages are replicated in other selected villages. This can only be successfully achieved by engaging in full cooperation with the local private sector. There is potential for private sector involvement at the following levels:

- Local consultants will be required to advise on such matters as village selection, topographic and demographic surveys, and selection of appropriate technologies, engineering design and supervision of construction. Furthermore, some local consultants may acquire specific competences in designing and implementing decentralised sanitation systems together with communities and municipalities. They may see this as a business opportunity and therefore promote decentralised sanitation in the region.
- Local construction companies will be engaged to carry out the construction of the systems including the supply and delivery of materials and equipment. These companies will be encouraged to use, wherever possible, artisans and labourers from the villages.
- For operation and maintenance of the systems, it is proposed to select small firms or private individuals from the area of the village.
- Since most of the techniques applied in the project are new to Egypt, training of the contractor's staff and even more for the O&M firms must be foreseen. Such training may also be provided by the private sector.

Consultants are more likely to be found at the national level while construction and O&M companies and skills can be found or developed at the district or governorate level.

3.4 Key Stakeholder Matrix: Roles and Responsibilities (R&R) in Different Project Phases Including HRD/Training Needs

(Considering the selected management model)

Stakeholder	Planning and Construction Phase		Operation and Maintenance Phase	
	Roles and Responsibilities	**HRD / Training Needs**	**Roles and Responsibilities**	**HRD / Training Needs**
Households: Women, men, children	• Express needs → head of household → CDA • Attend promotion actions • Nominate repr. from family (clan) to village committee	• Awareness of sanitation, hygiene and health; technical options and implications (management, financial, O&M);	• Correct usage • Tariff payment • Reporting faults • re-electing CDA	• Continued enhancement of awareness of sanitation, hygiene and health, resource efficiency and upgrading possibilities • Proper usage and reporting
Irrigation Committee	• Express interest and decide on measures for re-use of resources	• Awareness of possibility / benefits of resource re-use	• Proper handling of resources • monitoring & reporting of quality	• Methods for proper usage of resources recovered
Village Committee / CDA	• Formulate request for assistance • Form CDA if not existent • Participate in technology selection • Negotiate R&R of village • Inform and consult the community • Coordinate with the irrigation committee • Accept & assume the admin. and financial responsibilities • Participate in contracting, supervision, commissioning • Take charge of the system	• Awareness regarding sanitation, hygiene and health plus promotion capacity • Knowledge about selected project • Leadership capacities • Project management, administration, financial and technical matters.	• System management including handling finances (e.g. tariff collection), administration, supervision, coordination with irrigation com. & KWSC etc., contracting and supervising operator and consultant, dealing with users (e.g. securing proper usage) • Monitoring and reporting • Initiate complementary activities	• Continued training on leadership and system management • Participation in concluding lessons learnt → decisions on amendments. • Advocating of technology dissemination to neighbouring villages • Knowledge about complementary activities (e.g. SWM)
Local Village Unit / City Council	• Participation in village selection • Consultation and support on request	• Familiarisation with project concept	• Support to CDA in all activities (on request)	• Awareness of importance of proper O&M
Steering Committee (SC)	• Approval of major policy decisions • Approval of village selection • Approval of benchmarks decision	• Familiarisation with project concept	• Receiving information on performance but no active role in O&M	

HCWW	• supervision from the state level of the 14 water and waste water companies at governorate level	• Institution has been set up afresh • Familiarisation with project concept	• Monitoring and supervision → concluding lessons learnt → amendments if required • Technical support on request to companies	• Familiarisation with project concept
Stakeholder	**Planning and Construction Phase**		**Operation and Maintenance Phase**	
	Roles and Responsibilities	**HRD / Training Needs**	**Roles and Responsibilities**	**HRD / Training Needs**
KWSC	• Establish decentralised sanitation unit including suitable staff • Planning and management (monitoring, supervision, etc.) of all activities	• Familiarisation with project concept • Enhancement of capacity in carrying out R&R	• Monitoring and supervision → concluding lessons learnt → amendments if required • Technical support on request to service providers	• Continued training on monitoring, supervision, technology aspects etc.
Project Team (PT)	• Facilitation and enabling (capacity building) of entire project process • Support to and through partner to all stake • Progress reporting (to donor agency)	• Facilitation and capacity building methods • Project steering and management	• Facilitate / support project partner in its R&R to achieve sustainable O&M system, document lessons learnt • Provide required capacity building • Advise for complementary activities	• Participate in concluding lessons learnt
Consultant	• carry out project design incl. technology options, detailed planning, supervision etc. according to ToR	• Access to current global sector learning	• Prepare O&M schedule & manuals • Provide techn. assist. & trainings • Participate in monitoring of system	• Participate in current global sector learning of sanitation, hygiene and health
Governorate	• provide required legal framework • provide political support	• enhancement of awareness of potential of decentralised sanitation systems	• secure proper O&M • encourage replication • provide access to funding for replication	

4 Management and Financing Model(s) for Operation & Maintenance

of decentralised sanitation systems

4.1 Aim and Scope

The aim of chapter 4 is twofold:

- Firstly to provide an overview of the different management models and financing systems which have been assessed for their appropriateness in the context of Kafr El Sheikh.
- Secondly to provide the reasons for the selection of the actually applied management model and financing system.

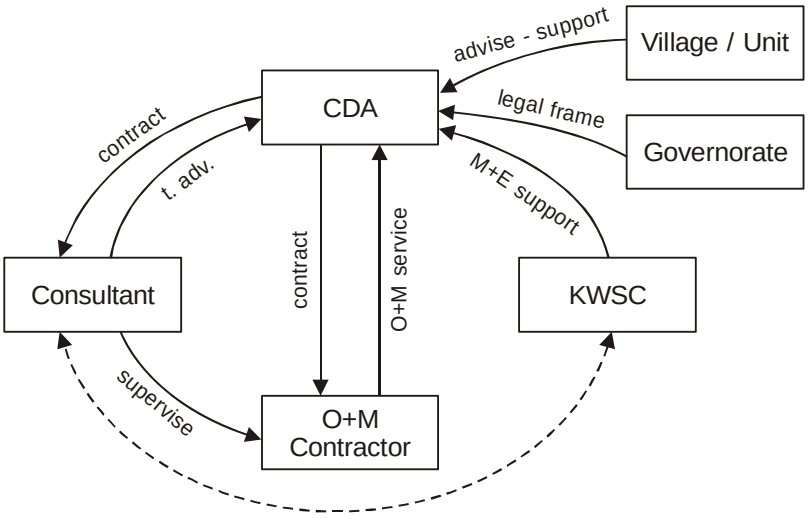
The contextual issues taken into consideration concern the users' (CDAs) interest and capacities, the government's capacities including the existing legal framework and the performance in its enforcement, the capacities and potential of the private sector as well as the existing socio-economic situation.

During the project consolidation (c.f. step 8 of chapter 2) and with the help of the in-built monitoring system this reasoning will be reviewed and the model adjusted as far as required.

4.2 Management Models for Operation & Maintenance

Five different management models have been assessed taking into consideration the experience from other places and in particular the existing context in Kafr El Sheikh Governorate. In the following, these models are illustrated, briefly described and assessed for their strengths and weaknesses. Finally, the chapter is concludes with the selection of the presently most appropriate model.

4.2.1 Model 1:



FUNCTION	STAKEHOLDER IN CHARGE
Principal service provider / project manager	Community Development Association (CDA)
Operation & Maintenance	O&M Operator (Contractor from private sector)
Work supervision & technical advise	Consultant (private sector)
Overall supervision and monitoring	KWSC
Provision of legal framework	Governor's office
Support in management and legal enforcement	Village Unit

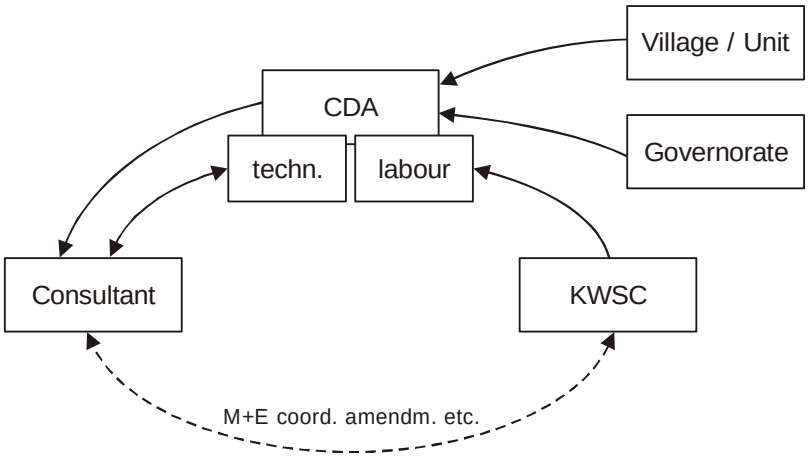
Advantages

- Considers existing capacities by communities to handle their own affairs (e.g. irrigation arrangements, mosques, etc.)
- The CDA representing the users is in direct control of the system's O&M.
- The response time in case of any calamity will be minimised.
- Willingness to pay is expected to be high (E.g. the community as a whole will know how to establish tariffs for poorer people).
- Proper usage of the system is best secured because of direct ownership and control.
- The private sector (acting in a competitive environment) is best suited to implement O&M and to provide the support services.

Disadvantages

- The decentralisation of the management to each community will require additional capacity building (e.g. managerial and technical skills) and additional supervision.
- KWSC being in charge of the overall supervision may find this mandate financially not very attractive in relation to the scale of its other core businesses.
- There might be institutional and political resistance to a strong decentralised arrangement.

4.2.2 Model 2:



FUNCTION	STAKEHOLDER IN CHARGE
Principal service provider / project manager	CDA
Operation & Maintenance	CDA with its technical staff and labourers
Work supervision & technical advise	Consultant (private sector)
Overall supervision and monitoring	KWSC
Provision of legal framework	Governor's office
Support in management and legal enforcement	Village Unit

Advantages

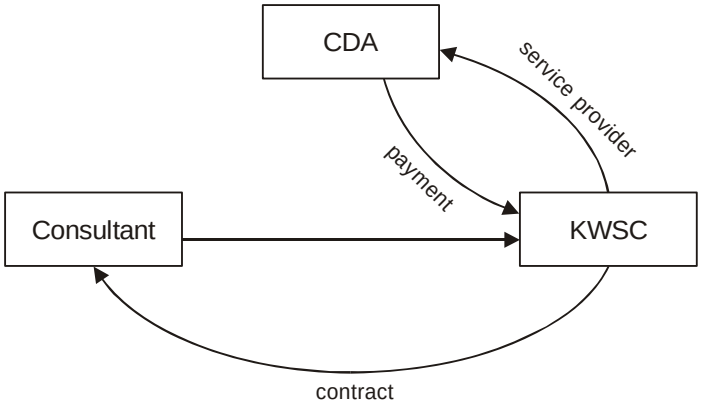
- Considers existing capacities by communities to handle their own affairs (e.g. irrigation arrangements, mosques, etc.)
- The CDA representing the users is in direct control of the system O&M.
- The response time in case of any calamity will be minimised.
- Willingness to pay is expected to be high (e.g. the community as a whole will know how to establish tariffs for financially deprived people).
- Proper usage of the system is best secured because of direct ownership and control
- The fact that the CDA will employ the required staff to implement the O&M activities will lead to very direct control of performance as well as to additional employment in the village.

Disadvantages

- The decentralisation of the management to each community will require additional capacity building (e.g. managerial and technical skills) and additional supervision.
- KWSC being in charge of the overall supervision may find this mandate financially not very attractive in relation to the scale of its other core businesses.

- The CDA will have additional tasks with the direct employment of staff (recruitment, supervision, labour affairs etc.). This additional burden may be too much for the CDA especially during the early years of operation.
- There might be institutional and political resistance to a strong decentralised arrangement.

4.2.3 Model 3:



FUNCTION	STAKEHOLDER IN CHARGE
Principal service provider / project manager	KWSC
Operation & Maintenance	KWSC plus possibly private contractor
Work supervision & technical advise	KWSC plus possibly private consultant
Overall supervision and monitoring	KWSC
Provision of legal framework	Governor's office
Support in management and legal enforcement	

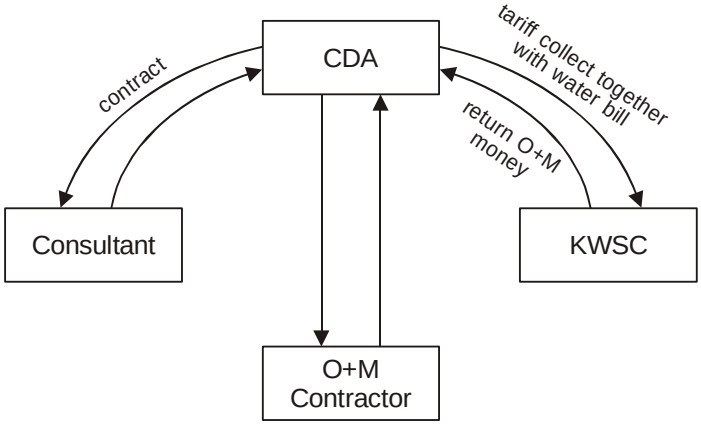
Advantages

- A centralised system with KWSC in control of all affairs may ease management and supervision.
- KWSC is already operating the water system in the village and has an established infrastructure.
- KWSC as a long-term service provider can be expected to have the capacity and experience to run the "business".

Disadvantages

- At present, the administrative structure of KWSC shows slow responses to maintenance requests. KWSC maintains no direct line of communication to the villages.
- KWSC may find the mandate to become in charge of the overall supervision may find this mandate financially not very attractive in relation to the scale of its other core businesses.
- The users' willingness to pay the tariffs may drastically reduce (c.f. recovery rate of water tariffs seems to be below 40 %?)
- Securing proper usage may be more difficult since the users will not consider the system to be their own and service provision may not be reliable.
- An opportunity is missed to provide the community with a chance to take their affairs into their own hands.

4.2.4 Model 4:



FUNCTION	STAKEHOLDER IN CHARGE
Principal service provider / project manager	CDA (but tariff collection is handled by KWSC together with the water rate)
Operation & Maintenance	Private contractor (contracted by CDA)
Work supervision & technical advise	Private consultant (optionally KWSC)
Overall supervision and monitoring	KWSC
Provision of legal framework	Governor's office
Support in management and legal enforcement	Village Unit

Advantages

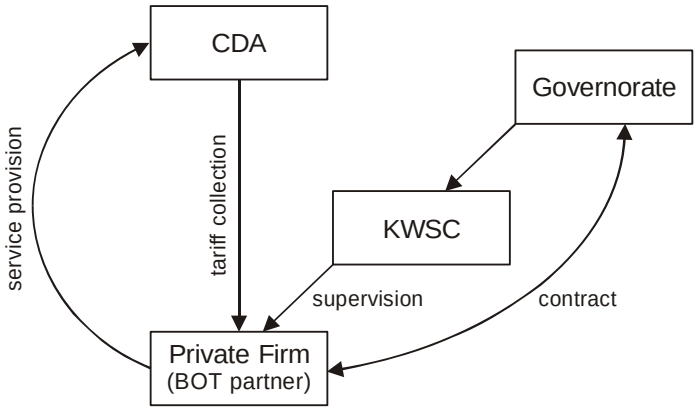
- Considers of existing capacities by communities to handle their own affairs (e.g. irrigation arrangements, mosques, etc.).
- The CDA representing the users is in direct control of the system's O&M.
- The response time in case of any calamity will be minimised.
- Proper usage of the system is best secured because of direct ownership and control.
- The private sector (in a competing environment) is best suited to implement O&M and to provide the support services.
- The administration of tariff collection seems to be simplified since tariffs for water and wastewater will be collected by the same agency at the same time.

Disadvantages

- The decentralisation of the management to each community will require additional capacity building (e.g. managerial and technical skills) and additional supervision.
- KWSC being in charge of the overall supervision may find this mandate financially not very attractive in relation to the scale of its other core businesses.
- The users' willingness to pay the tariffs may drastically reduce if it is collected by KWSC (c.f. recovery rate of water tariffs seems to be below 40 %?).

- The return of the sewage component share of the collected tariffs to the CDA may be delayed. This may hamper operations since the private sector's payments may be delayed as well and the CDA will be confronted with additional burdens and lose part of their interest and commitment.
- There might be institutional and political resistance to a strong decentralised arrangement.

4.2.5 Model 5: Build-Operate-Transfer (BOT) Arrangement



(In a typical BOT arrangement, a private firm might undertake to construct a wastewater treatment plant, operate it for a number of years, and at the end of the contract relinquish all rights to them to the public utility. The government would pay the BOT partner for the wastewater treatment, at a price calculated over the life of the contract to cover its construction and operating costs and provide reasonable return).

FUNCTION	STAKEHOLDER IN CHARGE
Principal service provider / project manager	Private firm
Operation & Maintenance	Private firm
Work supervision & technical advise	Private firm
Overall supervision and monitoring	Government (e.g. delegated to KWSC)
Provision of legal framework	Governor's office
Support in management and legal enforcement	

Advantages

- Delegation of all responsibilities by government to a private firm with a clear contractual arrangement.
- BOT arrangements seem to work well e.g. for bulk wastewater treatment plants (but less for collection efficiency).
- Uniform arrangement covering the entire governorate. Limited community mobilization required.

Disadvantages

- A functioning BOT management system demands a clear regulatory framework and a strong institutional set up to enforce it. Both prerequisites are not available in the present set up. Additionally, there is no experience available in the governorate with successful BOT arrangements.

- Evidence is not yet available that a BOT arrangement for decentralised sanitation systems will be economically attractive. It is therefore very unlikely that the private sector may show an interest at this stage.
- Securing proper usage may be more difficult since the users will not consider the system to be their own.
- An opportunity is missed to provide the community a chance to take their affairs successfully into their own hands.

4.2.6 Conclusions and Model Selection

In comparing the five models, model 1 clearly stands the best chances to facilitate a sustainable management of the decentralised sanitation systems.

The identified disadvantages or risks of model 1 can be minimised in the following way: The large demand for sanitation improvements provides the opportunity to select and start with those villages that stand the best chance for proper management. (Villages being attended to at a later stage will benefit from the experiences of the pilot villages). Selection criteria have been developed and are applied accordingly. Additionally, the O&M operator coming from the private sector may operate in more than just one village. This means that synergies between different villages will take automatically place. In case that KWSC may hesitate to fulfil its role in monitoring and supervising the systems, model 1 contains a "fall back" strategy in that the private consultant (mandated by the CDA) may take over this responsibility.

The various disadvantages discouraging the other models have been indicated in above assessment. The principal reasons can be summarised as follows: Model 2 may be applicable after some years of operation when the CDAs have collected sufficient management experience. The in many cases unreliable performance of KWSC managed schemes and the limited interest shown to date make it very clear that model 3 contains too high risks for failure. Similarly, model 4 has to be disregarded, since the transfer of the collected tariffs to the CDA's project account cannot be expected to work reliably. Model 5 may stand a chance to work if bulk systems are introduced. However, neither the government nor the private sector seems to have the capacity to manage and implement such an arrangement. Moreover, the "business", which is contained in a BOT arrangement of decentralised sanitation systems, cannot be considered to be sufficiently attractive for the private sector.

4.3 Financing System(s)

The arguments for the selection of the management model similarly apply to the financing system. That is why the financing system in the following is only discussed regarding the above selected management model.

In the course of the project preparation, a detailed study has been conducted regarding cost estimations and possible financing systems. The detailed analysis is not repeated at this place but the main conclusions of the study are summarised in the following.

4.3.1 Investment Cost

The initial investment cost for decentralised sanitation systems are composed of the sewage collection system including interceptor tanks and/or manholes, pumping stations as far as required and the treatment plant including the various basins.

This initial investment cost is clearly beyond the capacity of the communities concerned. That is why the external support agency (GTZ) agreed to provide in addition to the technical assistance also financial assistance for the construction of the first pilot system. The terms for the financial assistance will generally be as follows:

- The community provides the land required for all required buildings and piping in particular for the treatment plant. This will amount to about 10% of the overall investment cost. The households will cover the cost for the connection of their sewage system to the interceptor tanks and/or manholes.
- The government of Egypt will not be involved in the financing of the pilot project. (However, the government is involved in the replication of the pilot projects as well as in subsidising reinvestment cost as required).
- The external support agency (GTZ) will cover all costs for the pilot project regarding technical assistance, planning, design and construction of the pilot project.
- During the life of the project, GTZ will assist in obtaining investment funding for additional villages.

4.3.2 Operation & Maintenance (O&M) Cost

Operation and maintenance cost are principally composed of cost for staff, energy, transport and the maintenance of pumps and vehicles. Projected O&M cost per household (HH) have been estimated to ca. 4 LE / month (1LE = 1 Egyptian pound = 0.12 Euro as per April 08). The biggest cost factor is staff with ca. 75% of O&M cost.

Ideally, O&M cost are covered by the users of the system, i.e. the community. The above estimated O&M cost are affordable to the community concerned.

4.3.3 Total Cost(O&M Plus Expected Future Capital Cost)

In order to achieve sustainability of a sanitation system, it is important that not only the O&M cost are covered but also the expected future capital cost. The above mentioned study accomplished the financial projection by using an Excel spreadsheet computer model specifically tailored to sanitation investment programmes. The model incorporates various variables to arrive at the dynamic prime cost estimate. Assumptions have been made as regards the variables such as value and service life of capital items, population growth, wastewater discharge, variable discount rate, etc. To test the robustness against changes, a sensitivity analysis was made.

Depending on the discount rate (0 to 8%), full cost per household range between 10 to 26 LE/month. The share of capital cost amounts to 60%. Considering the current sanitation system, where household trenches need to be emptied by tankers twice a month at a total price of up to 40 LE/month, full cost recovery by the users seems to be very possible with the new system.

4.3.4 Cash Raising Options for Cost Recovery

In a first step, the most appropriate cash raising option is selected from among the main types recommended by WHO, taking into consideration the given context.

In a second step, the selected option is described in detail and assessed for its advantages and disadvantages.

Selection of cash raising option

Overview Cash raising Options	
Cash raising options	**brief assessment and selection**
Community fund raising	appropriate for non-recurring investments, from which services users benefit equally → not suitable
Indirect taxes (e.g. sanitation tax)	Since the tax collecting authority would not be to the same as the management agency (CDA), deficiencies in budgeting and delays in transfer of money have to be expected. As a consequence reliable operation will be at risk. Further it contradicts with the decentralisation approach → not suitable
Regular user charges	Is flexible and offers a variety of solutions such as A) **fixed charges** per connection→ simple to administer, no water metering necessary B) charges based on metered water consumption → charge is cost related, cross subsidy to poorer population with less consumption → though A) and B) may be suitable, A) is **selected** as the most appropriate solution (c.f. Selected Option: Monthly Service Charge per Household on a flat rate basis)
Contribution in kind	possible to a certain extent; however, since population is diverse it will not be equally manageable → not suitable

Selected Option: Monthly Service Charge per Household on a flat rate basis

Overview of selected option	
• Flat tariffs, which cover the recurrent cost, are collected monthly from each household by the CDA. The CDA maintains a separate project account, which is regularly monitored by GTZ and the Ministry of Social Insurance and Social Affairs. • Pit empty contractors are remunerated when delivering their load to the treatment plant. (Cross-checking is done through monitoring of the empting sequences of each interception tank). • The treatment plant operator is paid by the CDA. Incentives for appropriate performance are provided by the following measures: Sale of bio solids go directly to the operator; etc.	
Advantages: • Existing water supply system is based on flat rate charge → charges on metered water not possible • The easiest option to be implemented and administered by the village itself (direct control) • Complies with existing functioning collection systems such as village cleaning and irrigation. • Emptying of all pits is done regularly irrespective of the financial situation of the pit holder. • Encourages to convey the faecal soiled to the treatment plant • Abuses can be avoided through tight monitoring and cross checking • Incentives to the treatment plant operator secure high performance	**Disadvantages:** • Households have no direct control • There are no direct incentives for households to minimise wastewater production although it is desired for technical reasons (flushing) that enough sewage is produced.

4.3.5 Tariffs

Three main options have been considered:

- Equal tariff levels for all households.
- Tariff levels depending on the number of people in the household.
- Tariff levels according to the economic situation of the household.

Since the normal household size does not vary to a large extent, a system of **equal tariff levels per household** has been selected. For the few households with critical economic situation, a social tariff would be introduced.

Tariff Levels

Tariff levels need to be based on the full cost (c.f Total Cost). Considering the base case (3% discount rate), full cost in El-Moufty amounts to 16 LE/household/month.

Selected tariff for **Domestic Consumers: 10 LE/Household/Month** with the following justification:

- Commence with lower rate as an incentive for the implementation of the financing system.
- Level corresponds with static calculation of cost (0% discount rate).
- Revenues sufficient to cover all operation and reinvestment during planning period.

- Risks to a large extent covered by local authority, who are ready to subsidize reinvestment.

Monitoring and Tariff Adjustments

The selected tariffs are based on the results of the total cost estimation, for which in turn a number of assumptions had to be taken (c.f Total Cost). This implies the need for **regular monitoring of the various variables and timely tariff adjustments to any change occurring**. Adjustments may be required as regards inflation rate, average discharge per household, salary and/or price increases, population growth, required liquidity etc.

Affordability

The costs of the **current wastewater disposal system** are composed of sanitation trench emptying twice a month at a total price of up to **40 LE/month**. Therefore the **new system** with tariffs of **10 LE/month** will be very attractive and affordable for the majority of households. Accordingly, a smooth management of the financing system can be expected.

For poorer families, a special tariff system has to be applied. This system can be financed by the additional income from institutional discharges (schools, health unit, mosques).

4.3.6 Money Flow Options

Experience shows that the money flow within a decentralised sanitation system plays a crucial role in achieving sustainability of the system. SANDEC has studied various money flow options and proposes new innovative ways to enhance sustainability. Though it is impossible to provide a blue print of a model (as an ideal money flow system is highly dependent on local circumstances), an ideal case will have to consist of the right mix of incentive measures for the various stakeholders plus subsidies by the responsible authority.

In the pilot project of Kafr El Sheikh, the performance of the selected money flow model will be carefully monitored and adjustments will be made (new options tested) as need arises.

5 Appropriate technologies

For decentralised sanitation systems

5.1 Aim and Scope

This chapter aims to provide an overview of the most appropriate technologies that can be implemented to solve the sanitation problems of the villages in the governorate of Kafr El Sheikh within the context of the project guiding principles.

A range of technically feasible options will be presented and discussed in this chapter. While these solutions may technically be capable of collecting and treating the wastewater and excreta on a village level, they may not all necessarily be appropriate in light of the prevailing conditions in the villages of the governorate.

The term appropriate with reference to the technologies implies that these options are not only technically capable of addressing the sanitary problems in the project zone, but that they are also suited to the socio-economic, legislative, financial, managerial, cultural, and environmental contexts found in the area at present, as well as to the expressed preferences and needs of the users. Therefore, for the moment, some of the technologies presented are considered as being unsuitable to the contexts, needs and preferences of the users. These options should be filed under "currently not appropriate" with the reasons for this being clearly given.

Ideally these contexts, needs and preferences will evolve with time as a result of information campaigns and experience, and users will choose to increase their re-use of the resources contained in used water and excrement. The most appropriate systems should therefore allow for this to be carried out in an economical, hygienic, uncomplicated and socially acceptable manner when required, whilst at the same time ensuring that they provide the users with what they need and want today.

It is recognised that not all of the stakeholders will be able to participate in the technical aspects of developing the different sanitation systems. Nevertheless, the final choice of the system to be used must be approved by a village committee, preferably the CDA.

5.2 Technically Feasible Options

The options presented in this section are solutions that, from a purely technical perspective, are suitable to collect and treat the wastewater and excrement. Five main areas of criteria are used to present each technology – technical, economic, environmental, social and the needs of the user (of both the sanitary facility and the resources that may be recovered):

Type of technology:
To enable neat comparison between the possible options in case of using traditional and on site treatment options, the following different technologies as well the alternative collection systems are evaluated:

- **Collection Works:** Conventional sewer system and small bore sewer system will be evaluated.
- **Traditional Treatment Options:** Stabilisation pond, oxidation ditch, activated sludge process, extended aeration, constructed wetland and upflow anaerobic sludge blanket alternatives will be studied.

5.2.1 Collection Works

Two basic alternatives for collection of wastewater are discussed; these are the traditional/conventional gravity network and the small bore sewers system. Each has advantages and limitations that should be considered for the selection of the proper system to be implemented.

Conventional Sewer System (CSS)

A conventional sewer system is designed to directly receive the household wastewater for offsite treatment and disposal as shown in Figure (1). The wastewater must flow under gravity in pipes, and it must be with minimum velocity of 0.6 m/sec (self cleansing velocity) in order to avoid settling of particles and suspended solids, which in turn reduces the probability of blockage of pipes (in the case of shallow sewers 0.3 m/sec is suggested as minimum velocity). This system comprises pipes and manholes for maintenance implemented in depths remarkably deeper than SBS system, which may be a disadvantage when compared to the SBS system especially when considering application in villages distinguished by narrow, snaky roads.

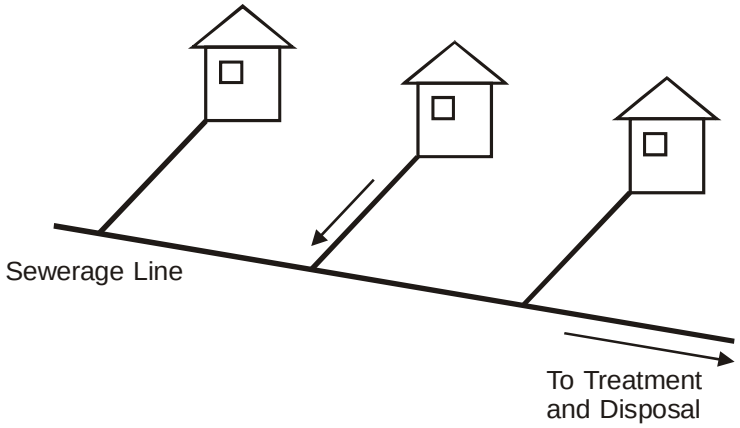


Figure (1): Conventional Sewerage Network

Small Bore Sewers (SBS)

A small-bore sewer is only designed to receive the liquid portion of household wastewater for offsite disposal as shown in Figure (2). Grit, grease and other troublesome solids which might cause obstruction in the sewer are separated from the waste flow in interceptor tanks installed upstream of every connection to the sewer, the solids which accumulate in the tank are removed periodically for disposal. A minimum of six months and maximum of 2-3 years may be the frequency of solids disposal.

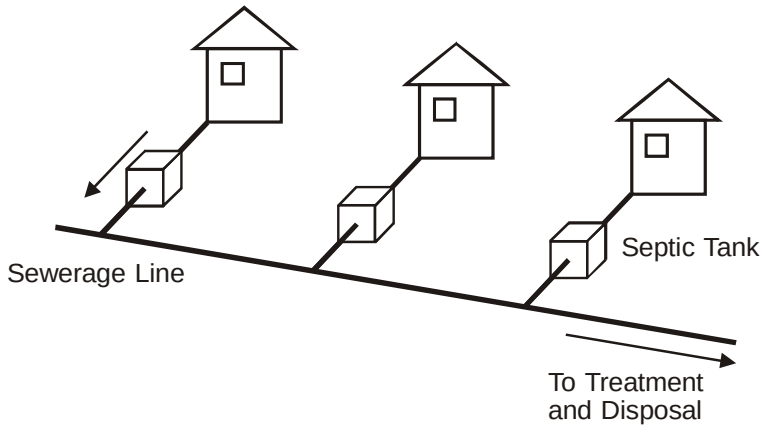


Figure (2): Small Bore Sewer System

Vacuum Sewers

Wastewater flows into a collection tank, from where it is drawn into the sewerage by sub-pressure in the network created by a vacuum pump (at the vacuum station). Wastewater moves in a series of steps through the system to arrive at the collection tank (at the vacuum station). As vacuum valves in the network are normally closed, the sub-pressure decreases only slowly as the collection tank fills. The vacuum pump therefore needs to run for only a few hours a day to create the required sub-pressure. Sewage can then be transferred from the collection station to the treatment works. Competent technical staff with good knowledge of pump maintenance and understanding of how the system works is needed. A regular monitoring programme (for pumps, valves and network) is also critical and essential. Currently available figures put the investment costs of vacuum sewers at around 75% of the costs of a comparable conventional gravity sewer. The related investment and O&M costs may be higher than for interceptor tanks with small bore sewers but still cheaper than conventional gravity systems. Also, operation and maintenance staff with a relatively high degree of technical competence is required, particularly in pump maintenance. There is no experience or legislation in Egypt for vacuum sewers. This solution therefore may prove too experimental for village management and is currently unsuitable for village level management, operation and maintenance.

Main Points of Comparison

Water Consumption

Since the SBS only deals with the liquid portion of discharged wastewater; i.e. the sewers are not required to carry solids, large quantities of water are not needed for solids transport. The SBS might thus be used in small communities where the water consumption is not high without high concerns of blockage, unlike a CSS, which may need large quantities of water, in comparison, in order to carry solids and particles to avoid settling and blockage of carrying pipes. CSS always require continuous pipe flushing especially for the pipes at the beginning of the network, which have a minimum of 6 – 8 inches diameter. The minimum flow in these pipes cannot maintain the minimum velocities of 0.6 m/s.

Excavation cost
Since percentage of solids are removed in the SBS, the sewers do not need to be designed to maintain a minimum flow velocity for self cleaning; they may be laid with curvilinear alignment with variable or inflective gradient, which reduces the excavation costs, unlike the CSS, which needs to be installed on a straight path with uniform gradient, which increases the excavation depths and accordingly the excavation cost.

Material costs
In the CSS, the water acts as a medium for suspended solids transportation; therefore its velocity must not be less than 0.6 m/s to avoid settlement of suspended solids, and the flow must go under gravity, which in turn implies large depths of laying the sewer pipes. Larger pipe diameters are needed to carry the flow and to undergo the soil loads. A CSS also requires expensive manholes for maintenance of the sewer. In the case of SBS, the suspended solids are settled in the interceptor and the flow velocity can be reduced to reach 0.3 m/s. The pipe slopes can also be reduced and in some cases the sewer pipe may be laid with a saw tooth pattern, which in turn means less depth for laying sewer pipes and less pipe diameters. The expensive manholes can be replaced with much less costly cleanouts for the sewer maintenance.

Excavation area
Due to the small size of sewers and the reduced excavation depths in the SBS compared to the CSS, SBS can be implemented in the small snaky streets of the village with less troubles or concerns than what might occur with CSS implementation.

Speed of construction
Construction of SBS is faster than CSS (due to issues discussed above) and accordingly requiring less time to provide service to the community, which implies lower cost due to reduced labour time needed.

Treatment requirements
Due to the presence of the interceptor tank in the SBS, the screens, grit removal and primary sedimentation tank or treatment in anaerobic ponds may not be needed at the treatment works because all these unit processes take place in the interceptor tank. A BOD (Biological Oxygen Demand) reduction up to 40% to 60% may be achieved. Accordingly, less treatment train may be required unlike with the CSS, which requires a complete treatment process with all its phases to meet the same set regulations.

Table: Comparison of Collection Works

From the above presentation and analysis, the following comparison can be concluded:

Comparison Criteria	CSS, Conventional System	SBS, Small Bore Sewer
Technical Criteria:		
• Ease of construction:	Less	More
• Experience in Egyptian context:	More	Less

• Operation and maintenance needs: • Equipment needed outside of home: • Expected lifetime of the works:	More Same Same	Less Same Same
Economic Criteria: • Construction costs: Recurrent costs (O&M): • Economic benefits resulting from system:	More More None	Less Less Scale Minimization of further steps
Institutional and managerial criteria: • Required institutional set up: • Required management capacities:	Required for proper operation Required for proper O&M	Minimum, Self Operated Minimum, Self Operated
Environmental Criteria: • Pollution prevention (for water courses, air and land): • Natural resources consumption (including water and land needs): • Ease of monitoring and controlling: • Prevention of pathogens from entering the environment:	Same Same Less Same	Same Same More Same
Social Criteria: • Type of institutional organisation needed (level of management required): • Possibilities for community participation: • Legality of the system under current legislation: • Acceptance by users of the system (sanitary facilities and possibly recovered resources):	High, Organisational Less Highly Accepted Highly Accepted	Less, Private or Self Operated High Less Accepted Less Accepted
Criteria addressing the needs of the user: • Equipment required in the home / to recover resources: • Accessibility: • Ease of use: Costs to the user: • Owner maintenance requirements: • Suitable for which type of dwelling? Multi / single storey, densely built / houses outside of village centre etc	More Same Same High Multi storey and less population density and outside of village centres.	Less Same Same Minimum Single Storey with high population density

5.2.2 Central Treatment Works

The collected wastewater will be pumped through a submersible pumping station in a force main to the treatment facility. This facility should have the capability to treat the influent wastes and reduce the organic loading and other pollutants to meet the regulating parameters. The treated effluent wastes will be re-used for irrigation, if applicable, or allowed to be discharged into the nearby drain. Law 44/2000 will be applied in the first option and law 48/1982 in case of the second option. The location of the villages under consideration is within the agricultural area of the KES governorate, where a full network of irrigation canals and drains exists to serve the surrounding fields. Respectively, the treated wastes, nowadays, are discharged to the agricultural drains and accordingly, it should meet the requirements of law 48/1982 for the drainage to water bodies.
The treatment facility should have primary and secondary treatment (depending also on the collection system) to meet the above criteria for the applied law. However, with the shortage of water era that may affect Egypt during the coming decade, all ideas for re-use of treated wastes for irrigation will be highly appreciated. The designer will consider this parameter in selecting the suggested treatment technique for any possible future reconsideration of treated wastes reuse. Law 44/2000 guidelines should be fulfilled for that consideration and the treatment plant should have the capability to consider such requirement.

The two alternative techniques that may be applied are the aerobic and anaerobic treatments. The selection of a certain treatment train will rely again on the collection work selected according to the above discussion. The following is a presentation of the possible applicable systems for aerobic and anaerobic techniques. The studied systems include: stabilisation ponds, oxidation ditch, conventional activated sludge, extended aeration activated sludge, constructed wetland and up flow anaerobic sludge blanket reactor (UASB).

Stabilisation Ponds

Figure (3) represents the flow diagram for the stabilisation ponds, at which the collected wastewater directly flows to the treatment train, which consists of anaerobic-facultative-maturation ponds. In case of SBS, the anaerobic ponds at the treatment entrance may be eliminated because of the primary treatment that takes place in the houses' interceptors, but it was decided to rely on a more conservative approach by not eliminating the anaerobic pond until a detailed monitoring program may suggest such option. From the facultative ponds, where the upper layer is maintained as an aerobic zone through algal photosynthesis and the lower layer is considered as anaerobic zone, it is then transferred to the maturation pond. These ponds are made to provide high quality effluent and to reduce the various disease causing organisms through extended detention time. This system is perfect for Egyptian villages due to its simplicity and minimum maintenance and electrical requirements. Moreover, it has the advantages of low production of stabilised sludge, high efficiency in the removal of pathogens, no need for skilled supervision, and suitability for shock loads.

Also, in view of the issues discussed above, this system will meet the requirements of Law 44/2000 for treated wastewater reuse perfectly. The WHO regulation for restricted and unrestricted irrigations guidelines stresses the advantages of this system to meet these requirements. The main basic criteria for wastewater re-use is the control of nematodes and micro-organisms bacterial count, which can be controlled either by high loading of chlorine or usage of prolonged detention time as achieved in this technique. The high chlorine concentration has the disadvantage of high cost along with the negative environmental effect

on irrigation and agricultural requirements. Yet irrigation with stabilisation ponds effluents provides a good balance of plant nutrients (principally N , P & K salts), which can markedly increase crop production and reduce the requirements for expensive artificial fertilizers. It also brings additional benefits since the algae they contain add to the organic (humus) content of the soil and improve soil structure and its water holding capacity. The algae also acts as "slow-release" fertilizer, releasing plant nutrients as they slowly decomposes in the soil even after irrigation has ceased. The main disadvantage of this technique is the need for greater land area comparing to all other systems. This may hinder its application in the Egypt Delta which suffers from land shortage and high cost of agricultural land if compared to Upper Egypt.

Figure (3): Flow Diagram of Stabilisation Pond

Oxidation Ditch

Figure (4) represents a flow diagram for oxidation ditch, which consists of a ring or oval shaped channel which is equipped with mechanical aeration devices. Screened and gritted wastewater entering the ditch is aerated and circulated at a specific velocity range of (0.25-0.35 m/sec), and this process could be upgraded to be **carsoul** type, at which the depth is increased and which is characterized by the possibility of controlling the amount of oxygen supply to the ditch, which produces some places near one end free from oxygen, which leads to the activation of anaerobic bacteria and nitrification of nitrates into nitrogen gas, which provides an easy way for nitrification process. This system may be considered to have some basic advantages of the stabilisation pond technique, not all in view of microbial control, along with the applicability to minimise land area required within an acceptable range. There nevertheless are some disadvantages, including a higher level of complexity for maintenance and higher power consumption.

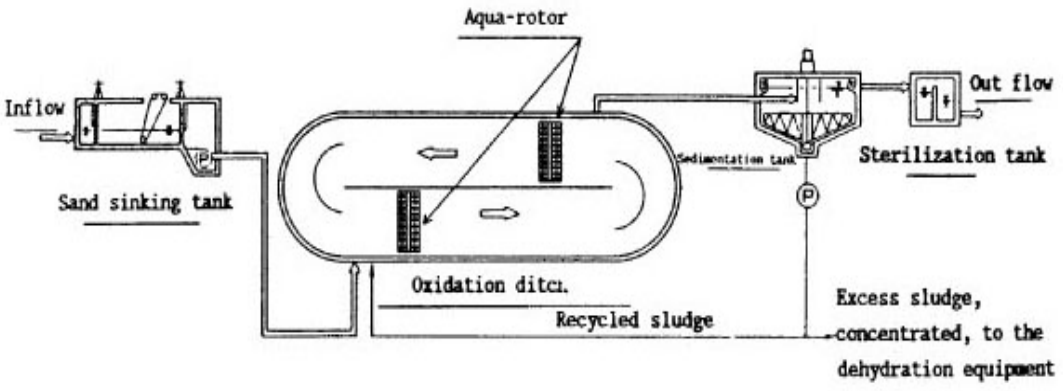


Figure (4): Flow Diagram of Oxidation Ditch

Activated Sludge Process

Figure (5) represents the flow diagram of the conventional activated sludge process, at which the preliminary treated influent is allowed to sediment in a primary clarification tank for a few hours. It is then transferred to a complete mix aeration tank, in which aerobic bacteria are supplied with oxygen by mixing air continuously with the pre-treated influent forming flocs. The latter is transferred to a final settling tank where the flocs are settled and a percentage of the sludge is returned to the reactor to keep the active biomass in the optimal concentration for aerobic digestion of the organic matter. This system in its forms of conventional or step tapered or step aeration will not be adequate because of cost, land requirements and difficulty of maintenance required.

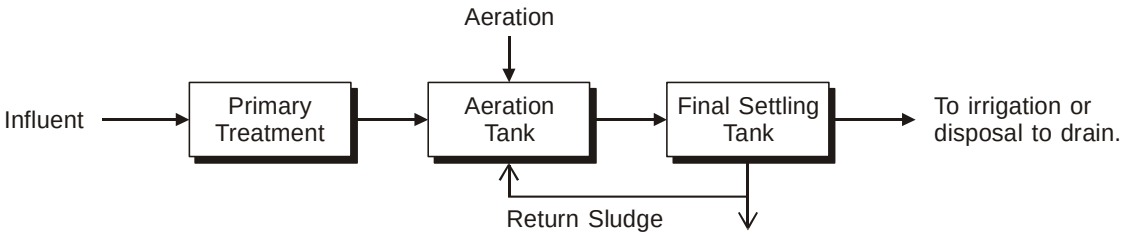


Figure (5): Flow Diagram of Activated Sludge

Extended Aeration Activated Sludge process

Figure (6) represents the flow diagram of the extended aeration activated sludge process, in which unsettled, screened and ideally degritted sewerage is aerated with activated sludge. A long period of aeration is provided to bring oxidation to the sludge, thereby ensuring that the excess is more stable and less in quantity; the process operates in the endogenous respiration phase of the growth curve, which needs a relatively low organic loading and long aeration time. This process maximizes the total oxygen requirement per unit substrate removed per unit time and thus increases energy costs. Also a high degree of nitrification of wastewater and mineralisation of the activated sludge are reached due to the prolonged aeration time.

The assessment of this option reveals less opportunity in comparison to other technologies. The extended aeration is one of the best stable technologies specifically in sludge treatment; however, it is not fully suitable in case of application in rural villages. A detailed comparison will be included.

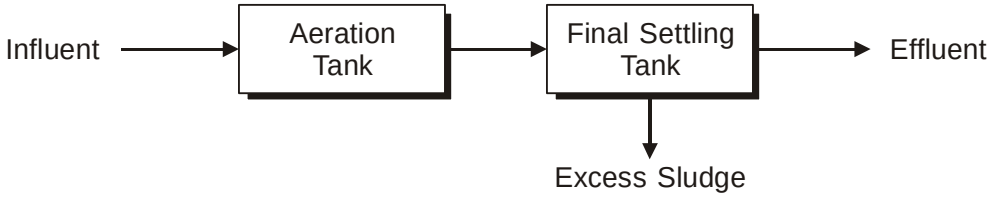


Figure (6): Flow Diagram of Extended Aeration Activated Sludge Process

Constructed Wetlands

Figure (7) represents the flow diagram of the constructed wetland. Natural wetlands, in general, are one of the richest and most productive ecosystems on earth. Constructed wetlands for wastewater treatment are man-made complexes of saturated substrate, emergent and submerged vegetation, animal life and water that simulate natural wetlands. In such systems, water undergoes a series of purification processes, including biological degradation, filtration, sedimentation and absorption. These processes significantly reduce the presence of organic compounds suspended solids and pathogens and, to a lesser extent, nitrogen compounds and phosphorus.

Constructed wetlands are either:

- Free-Water surface systems (FW), where water flows over the soil
- Subsurface Flow systems (SF), where water flows through sand or gravel layers horizontally or vertically.

Both types consist of basins or channels with a subsurface barrier to prevent seepage, and soil or another suitable medium to support the emergent vegetation. FW systems have a shallow water depth of 10-50cm. Plants in constructed wetlands serve as carriers for attached microbial growth, enhance effective fluid flow, control algae growth, and to some extent, transfer oxygen to the root zone and remove nutrients by uptake.

This technique is a promising technology as a low cost system but some disadvantages regarding the huge land requirement and difficulties in harvesting hamper the direct application of this alternative.

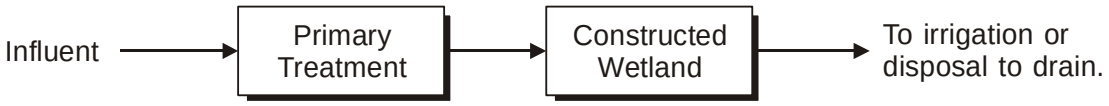


Figure (7): Flow Diagram in Constructed Wetland

Up flow Anaerobic Sludge Blanket Reactor (UASB)

The UASB reactor is a high rate suspended growth anaerobic reactor. Figure (8) represents the flow diagram of the UASB reactor. The UASB treatment unit consists of an up flow reactor with a feed inlet distribution system at the bottom of the reactor and gas-liquid-solid separator (GLSS) at the top. The wastewater is evenly distributed over the reactor bottom through feed inlet pipes and flows upwards through a bed of anaerobic sludge in the lower part of the reactor, called the digestion compartment. During passage through the sludge bed, particulate matter is entrapped and the degradable matter is completely or partially digested, dissolved. Organic matter is removed from the solution by the anaerobic bacteria and converted into biogas and a small fraction into new bacterial biomass; the biogas provides a gentle mixing in the sludge bed. In the upper part of the reactor the GLSS is installed. The biogas product is collected in a gas collector. From where it is withdrawn, the remaining water-sludge mixture enters a settling compartment, where the sludge can settle and flow back into the digestion compartment. After settling, the water is collected in effluent gutters and discharged from the reactor to the final polishing unit to meet discharge standards. The biogas has a methane content of about 75% and may be collected and used to supply the plant with its electrical needs or can be utilised in the surrounding houses. The main elements of a UASB reactor are illustrated in Figure (9).

The UASB has a good efficiency in BOD removal of about 85%. Among the advantages of this process are its simplicity and low cost with minimum land requirements; it is also free from odour and flies problems. Moreover, both grey water and black water can be flushed through the system. It needs no care during a period of shutdown. In addition, its operation can be resumed with only half or one day of preparatory work.

The UASB might not be appropriate at the onsite sanitation alternatives level due to the need to ensure that the flow rate is controlled to ensure that the hydraulic and organic loads are in balance and the level of the sludge blanket is maintained. In practice, this is difficult for small units for which there are likely to be high fluctuations in inflow which can not easily be controlled. Also it is not possible to increase the hydraulic retention time to stabilize the process without reducing the upward flow velocity to a point at which it is not possible to keep the sludge blanket in suspension.

UASB are claimed to provide high performance at low investment and operational costs and have been proposed as a suitable technology for use at a traditional level. There have been considerable interests in UASB as an appropriate form of wastewater treatment plant in developing countries and notably in Brazil.

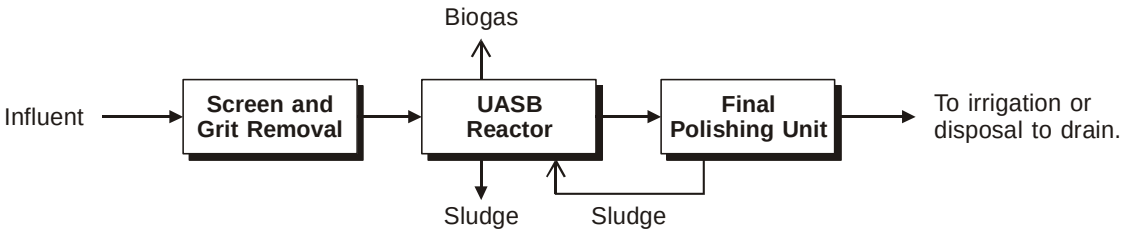
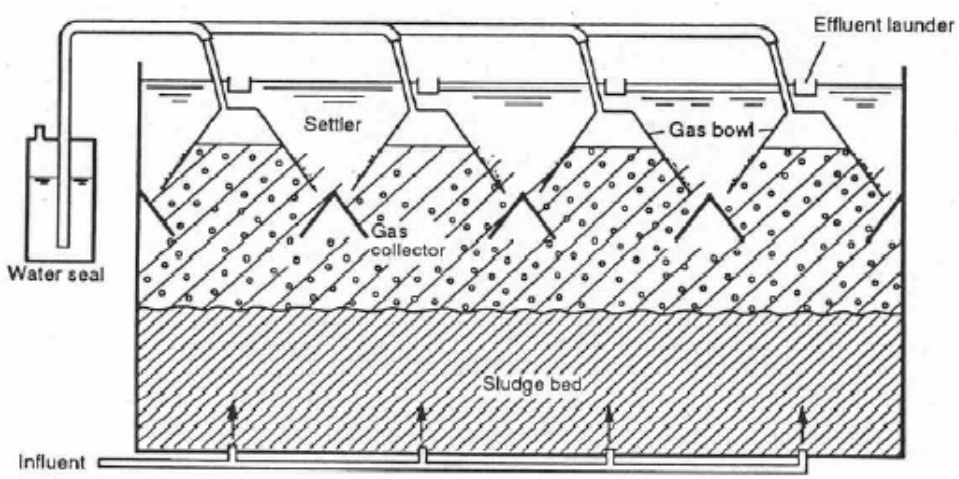


Figure (8): Flow Diagram of UASB Reactor.



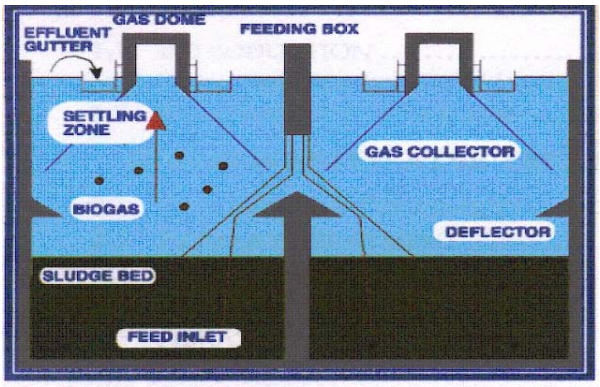


Figure (9): Main Elements of UASB Reactor.

Table: Comparison of Central Treatment Options

Type of process	Population	Land required	Efficiency of BOD removal	Advantages	Disadvantages
1) Stabilisation Ponds	Small community	Large area, but less than 5	60 – 90 %	- Simple & cheap in operation. - Low production of stabilised sludge. - Efficient in removal of pathogens. - No need of skilled supervision. - Suitable for shock loads.	- Large area. - S.S. high in effluent if not filtered. - Bad odour. - Efficiency depends upon temperature and sunshine.
2) Oxidation Ditch	Up to 20000	Small compared with ponds	85 – 95 %	- BOD removal up to 90%. - Produce more stabilised sludge. - More suitable for shock loads. - Lower capital cost.	- High operation cost due to high-energy consumption - Needs mechanical equipment.
3) Conventional Activated Sludge	Larger than 50000	Less area than 1,2 &4	90 – 95 %	- BOD removal up to 90% - Low and required. - No problem with flies. - Fewer odours.	- High equipment & O&M cost. - Needs careful supervision and complex process. - Produce large volumes of sludge. - More sensitive to shock loads.
4) Extended Aeration A.S.	Larger than 50000	Less area than 1,2	90 - 98 %	- BOD removal up to 90% - Low Production of stabilised sludge. - No problems with flies and odour.	- Needs low organic loading - High operation cost due to the need of large amount of air - High maintains cost.
5) Constructed Wetland	Valid for both small and large communities	Large area	85 – 95 %	- Simple & cheap in operation. - Efficient in removal of pathogens. - No need of skilled supervision. - Suitable for shock loads.	- Large area. - S.S. high in effluent if not filtered. - Needs harvesting - Efficiency depends upon temperature, type of vegetation and sunshine.
6) UASB	Valid for both small and large communities	Less area than 1,2 &4	80 – 90 %	- BOD removal up to 85%. - Product in of biogas. - Simple and cheap operation. - Low land required. - No problem with odour and flies.	- Needs high organic loading. - Require gas control or use system.

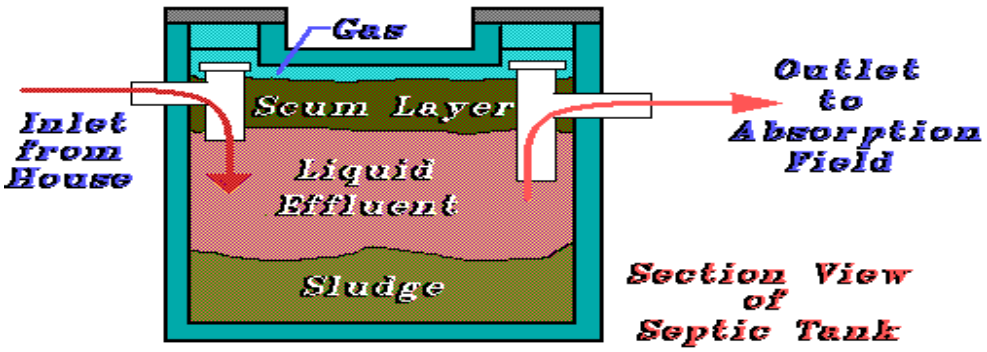
5.2.3 On Site Treatment Options

Conventional Septic Tanks

The septic tank is the most familiar low-rate anaerobic suspended growth reactor. Septic tanks consist of tanks buried on site which collect and store domestic wastewater from individual homes, clusters of houses, or institutes. Due to the fact that they require no traditional infrastructure, septic tanks are the most widely used form of household sanitation in rural and pre-urban areas. Septic tanks are essentially sedimentation basins designed to remove 90 – 98% of settle able solids and 40 – 60% of BOD5 during an average hydraulic retention time of several hours to a couple of days. Sediment and solids settle to the bottom of the tanks and the wastewater undergoes physical and biochemical treatment. The septic tanks are followed by either an effluent disposal facility or further treatment by sand filter, for example, and then re-use.

As for the seepage, it must be removed from septic tanks and transported by vehicular transportation to a point of treatment and disposal in which liquid is allowed to leach into the ground either directly or via some form of drainage system. Some other common operational problems are associated with septic tanks such as odour nuisance, backing up of sewage, surface flooding, solid discharge, local water course pollution and ground water pollution. Conventional septic tanks described above and shown in Figure (10) have been developed and modified in various sizes and layouts. This includes:

- Baffled septic tanks.
- Septic tanks combined with anaerobic filters.



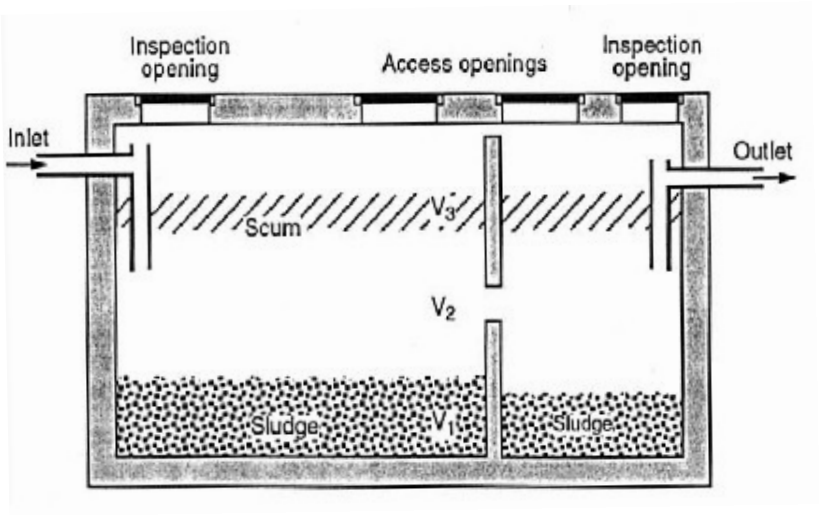


Figure (10): Sectional View of Septic Tank.

Baffled Septic Tanks

The baffled septic tank, which is similar to a conventional septic tank, consists of a series of baffled compartments in a series rather than one large chamber as shown in Figure (11). The flow enters at the bottom of each compartment and flows vertically towards the top of the compartment where the outlet is located. The effect of the compartments results in improved hydraulic retention time and an improved treatment efficiency due to the flow of wastewater through the sludge at the bottom of each compartment. The last chamber may have a filter in its upper part to prevent solid particles from escaping with the outflow. The treatment performance of a baffled septic tank is in range of 70-95 % BOD removal.

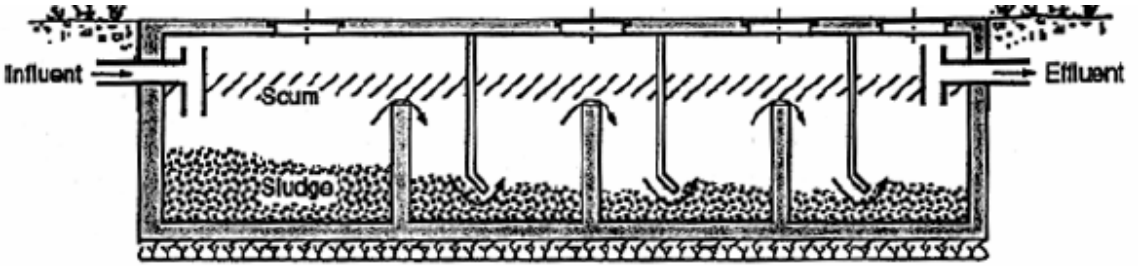


Figure (11): Longitudinal Section in Baffled Septic Tank.

Septic Tanks Combined with Anaerobic Filter

This option is used, in most cases, as a follow up to septic tanks as shown in Figure (12).
This type of septic tanks requires low land space, which leads to low construction cost. No electrical equipment is needed, resulting in low operation and maintenance cost.
Researchers found that operational problems of the household septic tanks with Anaerobic Up flow Filter (AUF) were caused by the clogging of the perforations of the distribution pipe at the bottom of the AUF. However, this problem can be overcome by frequent cleaning of the filter.

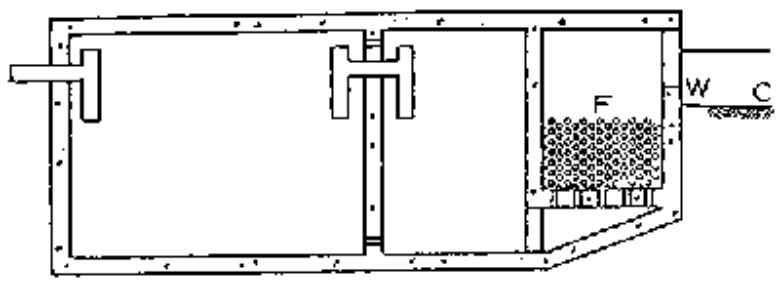


Figure (12): A Section in Septic tank Combined with Anaerobic Filter.

Imhoff Tank

The Imhoff Tank is a low rate suspended growth type of reactor in which fresh effluent is separated from the bottom sludge as shown in Figure (13). Settlement takes place within a zone bounded by funnel-shaped baffle walls with slots in the base of the funnel. The digestion chamber continuous to the top water level on either side of the baffle walls to allow the scum to rise to the surface and foul gas bubbles to float upwards. The objective is to reduce hydraulic short-circuiting and allowing settled sludge to pass into the digestion zone and thus prevent bio-solids from mixing with the raw influent sludge. Imhoff Tanks are suitable for domestic and combined wastewater flow for low density population. The main problem with the operation of an Imhoff is related to the need to remove scum and sludge which effects treatment performance. Imhoff Tanks are deep to allow separation of the settling and digestion zones, which leads to high construction costs, unless it is built partly above ground. The application of Imhoff Tanks in developing countries is limited as the benefits over conventional septic tanks are not great enough to warrant the use of the sophisticated design. Imhoff Tanks are suitable for use in on-site systems for which good operation and maintenance can be guaranteed.

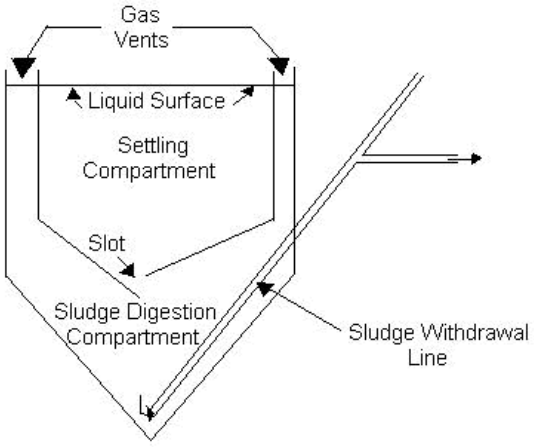


Figure (13): A Section in Imhoff Tank.

Upward Flow Anaerobic Filter (UFAF)

The anaerobic filter was developed early in the twentieth century as a modification of the septic tank. It is a low rate anaerobic attached growth rate reactor. An anaerobic filter provides for some treatment of non settle able and dissolved solids by bringing them into contract with the active bacterial mass that exists in the filter. Filter material may be gravel, rocks, cinder, or plastic media, as shown in Figure (14), especially designed to maximize the available surface area.

UFAF treating domestic wastewater can remove about the same amount of BOD5 as a septic tank and are more effective at removing suspended solids. The bacterial film on the filters over time gradually increases in thickness and eventually has to be removed. This can be done by removing the filter mass for cleaning outside the filter. However, this would screen to be a fairly unpleasant job and is thus likely to be postponed or avoided completely, thus reducing the probability that routine maintenance will be carried out effectively. The second option is to clean the film by backwashing with wastewater. This is easier to do with an upward flow filter, hence the preference for upward flow over downward flow filters.

There have been several attempts to use upward flow anaerobic filters for sewage treatment at scales ranging from that of the individual household to that of a housing development with several hundred houses.

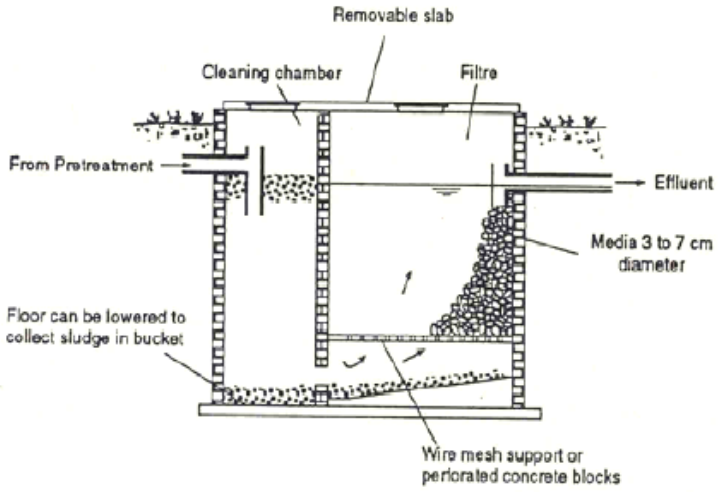


Figure (14): A Section in Upward Flow Anaerobic Filter.

Assessment of On Site Wastewater Management System

Advantages

- Reduces fresh water requirement for waste transportation.
- Decreases the risks associated with system failure.
- Increases wastewater re-uses opportunities.
- Cost effective due to shallow excavation depths, use of small diameter pipes, and simple inspection chambers. It saves about 10 – 50% of capital cost compared to conventional treatment.
- Possibility of upgrade of on site sanitation system to traditional when necessary.

- Requires small space.
- Lower operation and maintenance cost because it includes maintenance of interceptor tanks only.
- Environmentally responsible and responsive to the water scarcity.
- The digested and well stabilised sludge of the interceptor can be directly used as soil conditioner without further treatment.
- Settled sewers have the ability to function at per-capita water use levels much lower than those required for conventional sewerage.
- Wastewater is managed within a minimum practicable size (household, cluster, and neighbourhood) thus pollution is retained.

Disadvantages

- Need high technology to decrease nuisance.
- Require effective operation and maintenance that must not be underestimated by planners, operators, and pubic.
- Threaten ground water resources.
- Need low development density of population.
- Technology should be applied to reduce water consumption, such as water pricing, low volume flush toilet, etc.
- Unpleasant job of cleaning the media.

Table: Comparison of On Site Treatment Options

Type of process	Treatment Process	Wastewater	Advantages	Disadvantages
1)Conventional Septic Tank	Sedimentation, Sludge stabilisation.	Wastewater of settleable solids (especially domestic)	- Low land space required. - No electrical requirements. - Low operational and maintenance requirements. - Low cost. - Simple and durable.	- Low effluent quality. - Still heavily contaminated with pathogens, cysts and worm eggs. - Bad odour.
2) Baffled Septic Tank.	Anaerobic degradation of suspended and dissolved solids.	Pre-settled domestic and industrial wastewater of narrow COD/BOD ratio.	- High treatment. efficiency compared with conventional. - Not subject to blockages. - No electrical requirements. - Relatively cheap compared with anaerobic filter.	- Needs skilled contractors for construction. - Require larger space than conventional. - Less efficient with weak wastewater. - Longer start-up phase than anaerobic filter.
3) Septic Tanks with Anaerobic Filters.	Anaerobic degradation of suspended and dissolved solids.	Pre-settled domestic and industrial wastewater of narrow COD/BOD ratio.	- Low land space required. - No electrical requirements. - Low operational and maintenance requirements.	- Needs skilled contractors for construction. - Needs careful supervision and regular cleaning.
4) Imhoff Tank	Sedimentation, Sludge stabilisation.	Wastewater of settleable solids (especially domestic).	- Low land space required. - Durable. - No problems with odour.	- More complicated than a septic tank. - Needs regular desludging.
5) Upward Flow Anaerobic Filter.	Anaerobic degradation of suspended and dissolved solids.	Pre-settled domestic and industrial wastewater of narrow COD/BOD ratio.	- Simple and fairly durable if well constructed and wastewater has been properly pre-treated. - High treatment efficiency. - Little permanent space required because of underground.	- Costly in construction because of special filter material. - Possible blockage of filter. - Odour problems despite high treatment efficiency.

5.2.4 General Assessment of Treatment Works (Central and On Site)

From the above elaborations and comparison (chapter 5.2.2 and 5.2.3), it becomes obvious that certain technologies are more advantageous than the others. According to this pre-selection the following technologies are assessed on more general criteria in the table below: Stabilisation ponds, the UASB and the up-flow anaerobic filters.

Comparison Criteria	Stabilisation Pond	UASB	Septic Tank and filter
Technical Criteria:			
• Ease of construction:	More	Less	More
• Experience in Egyptian context:	More	Less	Less
• O&M needs	Nil	More	Less
• Equipment needed outside of home:	Nil	Less	Less
• Expected lifetime of works:	Long	Less	Long
Economic Criteria:			
• Construction costs:	Much More	More	Less
• Recurrent costs (O&M):	Less	More	Less
• Economic benefits resulting from system	More	Less	More
Institutional and managerial criteria:			
• Required institutional set up	Less	More	Less
• Required management capacities	Less	More	Less
Environmental Criteria:			
• Pollution prevention (for water courses, air and land):	More	Less	Less
• Natural resources consumption (including water and land needs):	More	Less	Much Less
• Ease of monitoring and controlling:	More	Less	More
• Prevention of pathogens from entering the environment:	More	Less	Less
Social Criteria:			
• Type of institutional organisation needed (level of management required):	Self Operated	Organisational Level	Self Operated
• Possibilities for community participation:	High	Less	High
• Legality of the system under current legislation:	Accepted	Less Accepted	Much Less Accepted
• Acceptance by users of the system (sanitary facilities and possibly recovered resources):	More Accepted	Less Accepted	Much Less Accepted
Criteria addressing the needs of the user:			
• Equipment required in the home / to recover resources:	Less	More	Less
• Accessibility:	More	Less	More
• Ease of use:	More	Less	More
Costs to the user:			
• Owner maintenance requirements:	Less	More	Less
Suitable for which type of dwelling? Multi / single storey, densely built / houses outside of village centre etc	All	Small Scale	Small Scale

5.3 Selection of Technology

Selection Process (involvement of stakeholders concerned)
The above presentation highlights the most effective criteria for the selection between the different options and alternatives. To compare between the different techniques, the most reliable method is the eliminating approach, where the technique with the highest disadvantages is excluded and only the remaining options are considered.

This approach was primarily applied when comparing all the possible alternatives of the traditional and onsite treatment options. Systems like activated sludge were excluded for many reasons including power consumption, unsuitability for rural areas and others. The wetland is a proper technology; yet the need for a large piece of land is one of the main disadvantages of this system.

Accordingly, all alternatives that were initially proposed were screened and a decision was reached to compare between the three options defined in the table of comparison above.

The selection of a specific option will require satisfying the former set of criteria including technical, economic, environmental and social aspects. The above comparison table shows a comparative evaluation of these three options.

In addition, after a first round of selection between all possible alternatives, it was essential to deeply involve the stakeholders. Series of discussions and brain storming meetings were planned and conducted to transfer the idea of each technique satisfactorily to the beneficiaries and the stakeholders. Subsequently, their thoughts, concerns, suggestions and experiences from surrounding projects were discussed and the advantages and disadvantages of each option were precisely studied and evaluated. This process enabled a more in depth and accurate selection of the proposed technology. The results of such screening and evaluation process enabled the optimum selection of the proper alternative at the end.

5.3.1 Selected Choice and Reasoning for First Pilot Village (El-Moufty El-Kobra)

Collection work

For the collection work alternatives, the SBS was selected as the most appropriate technique due to the identified advantages which could be summarised as:

- Technically feasible for proper application from the engineering design and implementation requirements,
- More suitable and reliable in rural areas, especially Egyptian villages with narrow roads,
- Less expensive in capital and running costs due to small sizes and dealing only with the liquid portion of the wastes,
- Great reduction potential on the size of the treatment facility and consequently on its cost,
- Fewer requirements for managerial operational level.

Treatment Works (Central and On Site)

For the treatment alternatives, where 6 traditional techniques and 5 on site techniques were evaluated and studied, the elimination "screening" approach (pre-selection) resulted in avoiding systems like activated sludge, wetland, extended aeration, oxidation ditch due to high cost and unsuitability for rural areas, and also eliminating some of the typical less effective onsite treatment due to their low performance.

The remaining three options included the stabilisation pond and the UASB and the septic tank followed by UAF. Those from the first perspective were found to be more technically feasible and applicable; however, the final comparison given in the table below was carried out to decide which of them are more appropriate. In addition, the following comparison addressed some of the questions raised by users and authorities, to be included with the technical concerns raised above.

Point of Comparison	Stabilisation Pond	UASB	Septic Tank with Up flow Anaerobic Filter
Maintenance & Operation	Simple and cheap	Simple and cheap, but require certain precautions	Simple operation and maintenance
Gas control	Slightly in anaerobic pond	Needs gas control	slightly
Area Required	Large but available	Low land space	Low land space, problem with land on site of the village area
Odour Problem	Bad odour sometimes	Bad odour sometimes	No odour
Electrical Requirement	No need	Needs electrical requirements	No need
Supervision	No need for skilled supervision	Some skilled are needed	No need for skilled supervision
Cleaning	Needs cleaning every 5 years	Sludge will be daily cleaned	Should be cleaned regularly

It was concluded that the stabilisation pond would be the most appropriate technique due to the following:

- Simple and reliable.
- Easy to operate.
- Lower cost, especially the running cost.
- Minimum O&M.
- Effective especially in dealing with pathogens and hazards.
- Treated wastes could be re-used safely.
- Less experience needed for operational and maintenance.
- Minimum managerial level is needed.
- People were more convinced of its simplicity and reliability and that it would not cause any future malfunctioning.

The UASB and the septic tank followed by UAF were eliminated due to the following:

- UASB would require further polishing technique and consequently more land for the treatment facility.
- Operating cost of UASB will be higher because of need for continuous daily sludge treatment if compared to ponds.
- UASB operations require more skilled and well trained managerial level, especially to deal with the possible system failure due to low loading conditions.
- UASB will require more equipment and facilities and consequently more cost.
- UASB is not very suitable with SBS because it requires high organic loading to work more efficient.
- Septic tank followed by UAF is mainly rejected for social reasons; people and authorities are convinced that it is just another shape of already existing bottomless septic tanks. Accordingly, it is believed that it will not improve anything.
- Land utilisation inside the village roads will be maximised and it is believed that for Egyptian villages in Delta this would be possible. They may be possible in desert villages with sufficient road widths or availability of land within the houses complex.

Monitoring and Possible Future Options

The monitoring and performance indicators (as part of the Environmental Management Plan) identify monitoring objectives and specify the type of monitoring required. They also include environmental performance indicators that provide linkage between impacts and mitigation measures.

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6 The Guiding Principles

In developing, planning, implementing and starting up a decentralised sanitation system

6.1 Guiding Principles

(Key requirements for sustainable solutions)

Aim of these guiding principles is to provide the stakeholders involved with the background, why and how the selected approaches or methodologies have to be applied.

The guiding principles as outlined in this first part are of a more general nature. They are based on the following two principal sources:

- Existing guidelines and commitments indicated in the official project documents.
- Current global knowledge and thinking in the sanitation sector regarding requirements for sustainable solutions such as "Agenda 21", the "Bellagio Statement", the "Household-centred Approach in Environmental Sanitation" etc.

It is commonly accepted that sustainable solutions can only be achieved with a holistic understanding considering the sanitation programmes in the context of their specific socio-cultural and natural environment. Therefore a balanced strategy should be followed, which considers the six related and interacting fields as shown in the box.

The six interacting strategic fields for sustainable solutions:

- **Social** field including active participation of users.
- **Institutional** field covering division of tasks.
- **Economic** field covering financing and resources management.
- **Technological** field dealing with appropriate technologies.
- Field of **rules & regulations** covering rights and responsibilities.
- **Ecological** field considering the resources / water cycle.

In the following paragraphs, the guiding principles are classified according to these six fields.

The guiding principles have implications for all project phases to different degrees. That is why they have been considered in the design of all chapters within this document.

Additionally and very important, the key guiding principles and their implications must be agreed upon by all key stakeholders. They should be used to explain how and why the various activities should be implemented in a specific way. It is recommended that tailored workshops are conducted with the principal stakeholders so that these principles are (i) understood, (ii) adjusted if necessary, (iii) accepted and (iv) taken into consideration during implementation. This process may be carried on during the various interactions during the entire pilot phase.

6.2 Social Field

The motivation and participation of all stakeholders involved are decisive in achieving the required ownership, which facilitates sustainable utilisation of the implemented facilities.

- Human dignity, quality of life and environmental security at household level should be at the centre of the applied approach.
- Solutions should be responsive to needs and demands, and tailored to the prevailing social concerns of the users.
- Understanding and agreement on the project objectives by all stakeholders involved must be negotiated.

- Decisions should be reached through consultation with all stakeholders affected by the decision, and based on informed choices.
- Opportunities should be created for improving equality and preventing social tensions.
- Solutions should have no negative effects on women and on prevailing gender relations. They should be at least as beneficial to women as to men (because women are chiefly responsible for children and health issues).

6.3 Institutional Field

In line with good governance principles, efficient and reliable services can only be achieved if the tasks are optimally and transparently shared between all partners involved.

- The principle of subsidiarity should be followed, e.g. management at the lowest possible institutional level from the outset of the project.
- Therefore the organisational structure should aim at decentralisation and remain lean and accountable.
- Existing functioning institutional structures should be utilised as far as possible.
- An optimal division of tasks should be negotiated between the users, the public sector, the private sector and NGOs (according to existing and potential capacities).

6.4 Economic Field

Wastewater should be considered as a resource, and its management should be holistic and form part of integrated water resources, nutrient flows and waste management processes.

- Investment and running costs should be optimally balanced through negotiation with the stakeholders.
- Priority may be given to optimising cost efficiency for the operating costs and also to the development of full cost recovery taking into account the ability and willingness to pay. It should be remembered that operating costs also include payment for supervision by a regional utility.
- The economic opportunities of waste recovery and re-use should be harnessed.
- Incentives for the provision of and benefit from, services and facilities should be consistent with the overall goal, objectives and outputs.

6.5 Technological Field

Technologies should be tailored to the prevailing social, institutional, economical and environmental conditions as well as be conform to the existing rules and regulations.

- Existing technologies should be assessed and new and improved solutions devised, based as much as possible on local experience.
- A set of technical options (including their advantages and disadvantages) should be developed, based on existing and/or possibly new and innovative technologies (to provide opportunities for selection).

- If new or unfamiliar technologies are applied, the risk involved must be well taken care of by the implementing agencies. (Users should not be left to suffer from the consequences of unsuccessful experiments.)
- The many ongoing technology developments and optimisations on the international stage should be made accessible and examined for potential application.
- Household- and community-level solutions are more likely to prove sustainable than more centralised options.

6.6 Field of Rules & Regulations and Knowledge and Skills

An enabling legal framework is essential in allowing the key requirements (which are compiled in this chapter) to have the desired effect. In addition, existing gaps in know-how, skills and capacities should be closed with essential training, institution- and capacity-building.

- The task distribution must take into account the level of professional and legal competence that each task requires.
- Rights of consumers and providers should be balanced with their responsibilities to their wider human community and environment.
- Existing skills and knowledge should be utilised to the greatest extent possible.
- Continued and tailored capacity and institution building should be provided according to the stakeholders' needs, to consolidate the required social and institutional changes.
- An appropriate knowledge management system should be established for continued support and enhancement of the required capacities.
- Existing and traditional rules should be made use of to the extent possible.

6.7 Ecological Field

The domain in which environmental sanitation problems are resolved should be kept to the minimum practicable size (household, community, town, district, catchment, city) and wastes diluted as little as possible.

- Wastewater should be managed as close as possible to its source.
- Transmission of wastewater should be minimised to promote efficiency and reduce the spread of pollution.
- Water should be used as little as possible to transport waste.
- Wastewater should be recycled and added to the water budget, while nutrients, organic material and energy should be recovered and put to productive use whenever feasible.

7 "Case Studies"

Regarding decentralised sanitation system including best practices and lessons learnt

El-Moufty El-Kobra

7.1 Executive Summary

The hygienic conditions in El-Moufty, a village of 2750 inhabitants in Kafr El Sheikh Governorate in Egypt, had been of a very low standard. The traditionally used wastewater pits were connected with a high health risk to the population and were contaminating the groundwater and the drainage channels (central problem), used for the agricultural irrigation. The provision of a well functioning sewer system and the treatment plant has upgraded the village to a model in the governorate. The participation of the population coupled with education leading to improved hygienic behaviour, the low investment costs, the high quality of the design and execution and simple operation management at very low, affordable costs as well as the trouble-free performance of the system make it an excellent example for the rural development.

The visible effects of hygienic improvements in the village have the potential to be further enhanced, if at least the motor able roads would be paved. This would also substantially increase the lifespan of the infrastructure and minimise maintenance costs.

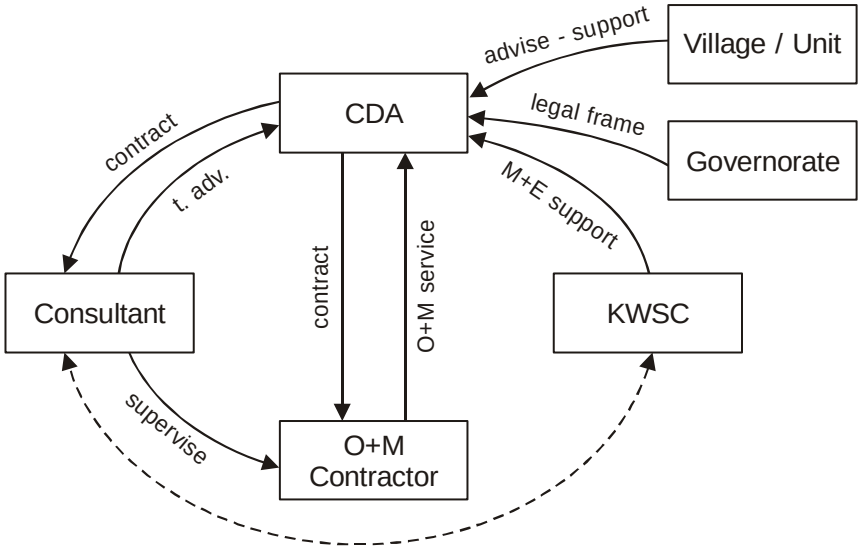
The success story of the El-Moufty sewage system contains high potential for replication. A second village in the same governorate is already implementing a similar sewage system while additional systems are under study.

General Fact Box
Present population (2002): 2750
Population growth approx. 1,5%
Design population (2020): 4500
Per capita water consumption: present 35 lit/capita, day, design 90 lit/capita, day
Type of settlement: close farming community
Farmer community: 90%
3 schools (primary, preparatory)
3 mosques
1 health clinic
1 youth club

Key Events	
Project start	April 2002
Foundation of Steering Committee	May 2002
Selection of village	Sept 2002
First planning workshop	Sept 2002
Detailed survey	Oct-Nov 2002
Final design report	March 2003
Tendering process	June 03-Jan 04
Formation of CDA	Nov 2003
Construction	March 04-Sept 04
Electrical connection	Sept 04-Feb 05
Commissioning	Feb 2005
Start O&M contract	May 2005

7.2 Management System

7.2.1 Applied Management System, Key Stakeholders and Functions



FUNCTION	STAKEHOLDER IN CHARGE
Principal service provider / project manager	Community Development Association (CDA)
Operation & Maintenance	O&M Operator (Contractor from private sector)
Work supervision & technical advise	Consultant (private sector)
Overall supervision and monitoring	KWSC
Provision of legal framework	Governor's office
Support in management and legal enforcement	Village Unit

7.2.2 Assessment

Experience shows that without an efficient management system the best technical solution will not work. The key factors that contribute to the successful management of the El-Moufty decentralised sanitation system are the simplicity, clear roles and responsibilities and transparency of the management system. The CDA acts on behalf of the community. There is a direct link (clear contractual arrangement) from the CDA to the O&M contractor. The LVU responds quickly and reliably to CDA's needs. (The LVU has a good understanding of the village and is directly accountable to the governor, who - as an elected person - is interested in well served and satisfied citizens). Finally, a control and backup system is in place: The CDA is advised and supervised by the Ministry of Social Insurance and Social Affairs (e.g. copies of meeting minutes are forwarded). Unfortunately KWSC is not (yet) performing its role.

Therefore the project still acts in its place by providing coaching, monitoring and advisory support (including continued capacity building).

KWSC's decentralised sanitation unit may be activated by a formal arrangement of payment for their expected services in the areas of technical backstopping and advisory (e.g. contract between CDA and KWSC). The project would in this case work increasingly as a facilitator through the local bodies such as LVU, village health workers and in particular KWSC.

Factors that may hinder the continuation of the efficient management system are the communities falling back into an attitude of being supplied from a central system and the vulnerability of the system in depending on personalities. That is why and in order to get the system further consolidated, coaching by the project is expected to be required for the next 2 to 4 years though in a manner reduced over time.

7.3 Technical Solution

7.3.1 Selected System

The selected small bore sewer system (SBS) consists of a collection system from the houses to inceptor tanks, where the solid parts are separated and retained. The liquid part is brought via a small-diameter sewer system to a common collection point from where it is pumped through a force main to the treatment plant. The treatment plant consists of a parallel-stream stabilisation pond system. The sludge collected from the interceptor tanks and stabilisation ponds is treated in the sludge drying beds. The treated wastewater is drained into the existing drainage system (better quality at the outlet of treatment plant than in existing drainage / irrigation system). The treated sludge will be used for agriculture purposes (low economic potential because of small quantities).

Technical Fact Box

Sewage collection system: SBS with interceptors
Length of sewers: approx. 9 km of 100 to 250 mm diameter
Approx. 500 interceptors of 1,25 m^3 capacity
450 clean out chambers
1 pumping station with two alternatively operating submersible 3 hp pumps (stand-by generator)
700 m force main from pumping station to treatment plant
Treatment plant (6000 m2): stabilisation pond, 2 parallel streams: anaerobic 3 days, facultative 8 days, maturation 5 days = total retention 16 days;
4 sludge drying beds
Average effluent quality: Chemical Oxygen Demand= 35 to 50; Biologixal Oxygen Demand = 18 to 40; suspended solids = 35 to 80 (Egyptian Standard); (effluent at homes BOD approx. 600)

7.3.2 Assessment

The effective and trouble free operation shows that the selected system is very appropriate to the existing context in Kafr El Sheikh. Investment cost is lower than for a conventional sewage

system. Of particular advantage are the system's low operational cost (affordable and within the range of willingness to pay) and its management requirements that are simple and allow for private sector involvement. In the case of El-Moufty, the SBS has been upgraded to lower risks in smooth operation by selecting slightly larger diameter pipes.

The SBS bears the additional advantage that part of the anaerobic treatment takes place in the interceptor tanks already. Nevertheless, sludge has to be carefully transported with suction tanks to the treatment plant. The "price" for the simple treatment system with stabilisation ponds is the relatively large area required. This is not un-problematic in the given context. However, extensions that may be required after the design period of the present system (20 years) is over can be accommodated within today's treatment plant area by applying advanced treatment methods (for which management capacities are expected to be available at that time in future). The present system with stabilisation ponds could possibly also allow for fish farming, which may be realised in the near future.

The most sensitive part of the system consists of the timely emptying of the inceptor tanks. Precaution measures have been taken by including the cost for the emptying within the monthly collected fee and by paying the O&M contractor the service separately for each tank emptying. Additionally, a reporting and monitoring system has been introduced that allows assessing the need for emptying of each inceptor tank at any time.

7.4 Financing, Flow of Finances and Auditing System

Investment cost:

The initial investment cost is clearly beyond the capacity of the community of El-Moufty. Therefore the external support agency (GTZ) agreed to provide in addition to the technical assistance also financial assistance for the planning, design and construction of this pilot system. The community provided the land required for all buildings and piping in particular for the treatment plant. This contribution amounts to about 10% of the overall investment cost. The households covered the cost for the connections to the inceptor tanks. The government of Egypt has not been involved in the financing of this pilot scheme (however, it is likely that government will become involved in the replication of decentralised sewage systems).

The success story of the El-Moufty decentralised sanitation system provides the opportunity to attract external funding for other development activities in El-Moufty as well as for the replication of sanitation improvements in other communities.

Cost and Financing of Operation and Maintenance (O&M)

O&M cost are principally composed of cost for staff, energy, transport and maintenance and repairs of equipment such as pumps, generator etc. plus the expected future capital cost. Depending on the discount rate (0 to 8%), full cost per household range between 10 to 26 LE/month. The share of capital cost is 60%. The previous system with household trenches and emptying with tankers twice a month resulted to cost of up to 40 LE/month. This means that the new disposal system is cheaper (ca. 50%) and hence very affordable to the community. At the same time its performance is hygienically much safer.

A monthly service charge per household on a **flat equal rate of 10 LE/month** was considered to be the most appropriate cash raising option in the given situation. Since it is simple and transparent, willingness to pay is high and the CDA has no difficulty to administer it, despite

the absence of a legal framework that would empower the CDA for fee collection. The CDA's administration of finances is further eased by the arrangement with the O&M contractor, which implies fixed cost for a given period. However, the CDA being a voluntary organisation, has not (yet) been able to manage capital at hand in a profitable way (e.g. utilizing interest rates). On the other hand issues regarding social equality are handled by the community itself.

One important advantage of the selected cash raising option with flat rates is that pit emptying is done regularly irrespective of the financial situation of the pit holder. This aspect is most crucial for the functioning of the sewage system.

Flow of Finances and Auditing System:

Experience shows that money flow within a decentralised sanitation system that is transparent and facilitates accountability plays a crucial role in achieving sustainability of the system.

Accordingly, the finances for investment cost have been handled by the CDA directly with close supervision by the project and the Ministry of Social Insurance and Social Affairs. This means that the CDA administered the purchase of required material and contracting the implementers while the supervising authorities approved all payments. In this way transparency and direct accountability have been maintained at any time and finances were utilised most efficiently. At the same time, the CDA was enabled to manage the financing of a project.

The CDA also administers the finances of O&M, including fee collection as well as contracting and payment of the O&M contractor. The system works quite well. An important factor that fosters smooth running is the clear and transparent control of all financial matters (regular auditing of balance sheets) by the Ministry of Social Insurance and Social Affairs. In this way, the pressure on the CDA is reduced and the community has access to all information (e.g. issuing of official receipts) and hence full trust into the correct handling of financial matters.

7.5 Operation and Maintenance (O&M)

The level of efficiency and effectiveness of O&M determines the sustainability and effectiveness of the decentralised wastewater project. For this reason, O&M issues have been considered from the outset of the project by selecting an appropriate approach, a management system with interested and accountable stakeholders (considering subsidiary principles) and a technology that is affordable, simple and O&M friendly.

Experience in El-Moufty shows that key for the successful O&M practices is the capable and committed **O&M contractor**. Being a citizen of the village, he is not only directly interested in and knowledgeable about what is ongoing but also very accountable. The contractual arrangement instead of employment simplifies management (e.g. no investment and maintenance of tools, simple administration, etc.). The tailored on-the-job training together with a practical O&M manual enables the contractor to do his job right.

Though the **CDA,** being a voluntary organisation, is not (yet) fully committed towards O&M, they have a stake in it since they have been involved in the selection and employment of the O&M contractor and are responsible for his payments. Since it is also the CDA's duty to collect the wastewater fees from the households it can be expected that they will become more active if problems in operation should occur and the willingness to pay would be negatively affected. Further, a sense of ownership towards the sewage system is observed that has been created through community participation in the planning and implementation process.

Since **KWSC** is not (yet) meeting its monitoring and advisory role (c.f. chapter 8.2.2) the project still acts in its place as a facilitator and coach. During regular follow up visits, dialogue is being maintained with the CDA and the O&M contractor. At the same time their capacities are being further strengthened.

The selected simple and **basic technical system (SBS)** proves to function and perform very well. Reliable functioning is further guaranteed by a back-up system consisting of two pumps that are alternately operated and a generator that will substitute power cuts.

Furthermore, the design of the treatment plant, which considers a parallel system, provides flexibility in operation in case of required maintenance or repair work.

Opportunities to strengthen the O&M system in the future may come from the following developments and activities: With the upcoming additional decentralised wastewater systems in the governorate, dependency on one single O&M contractor will be reduced. This development will also facilitate horizontal exchange and learning among CDAs and operators. The CDA's commitment is expected to become higher with the re-election of the presently nominated formation (younger villagers and additional ladies are expected to become involved). KWSC is expected to take up its responsibility in due course not only because securing service provision in water supply and wastewater disposal is its obligation but also because of the recently established HCWW as a coordination and supervisory institution at national level.

7.6 Effects and Impact

Though it may be too early after only 18 months of operation to assess effects and in particular impacts at levels that are influenced by several sectors, some observations are shared in this place.

Foremost, improvements of the hygienic situation at community level are visible: No wastewater is seen on village streets anymore; contact with the highly polluted canal water is reduced (e.g. no dish washing anymore); the village environment as a whole is cleaner. The latter is certainly linked to the numerous awareness campaigns in particular at the level of the younger generation, e.g. in schools.

These most visible effects certainly contribute to health improvements, but also to time saving for the housewives. Above improvements of the village have also been recognized at the level of the governorate and attracted further supports for improvement (e.g. planting of trees, nomination for "ideal village" competition).

The applied (bottom-up) approach in developing a decentralised system leads to increased empowerment at village level (e.g. formation of CDA), enhancement of trust among villagers and increased involvement of ladies in community affairs. The experience of a successful decentralised project both in implementation and operation contributes to increased confidence at village level that they can handle their own affairs and at government level that the tasks for service provision can be delegated to lower levels with increased efficiency and reliability.

The empowerment and enhanced awareness have already led to first steps in follow up activities (e.g. introduction of a solid waste collection system). However, the initiative power at village level requires still further nourishment to gain the required momentum.

7.7 Driving and Restraining Forces

7.7.1 Process of Change Management

The project interventions imply a change management process at different levels. The success and the sustainability of the project depend entirely on the extent to which the required change could be initiated, realised and consolidated. In understanding and assessing the change management process the following models proved to be helpful:

- **Different Layers for Change:**

Change processes occur at **various layers**. The upper layers concern the activities and the organisation, roles and responsibilities. On the lower levels more and more personal and individual issues are touched. To introduce change in the upper layers is simpler and faster: it can be carried out in several months. When change touches the lower layers, it is more complex and can easily take a couple of years. Change managers always have to consider these different layers and to be aware that changes in the upper layers also affect the lower layers and vice versa.

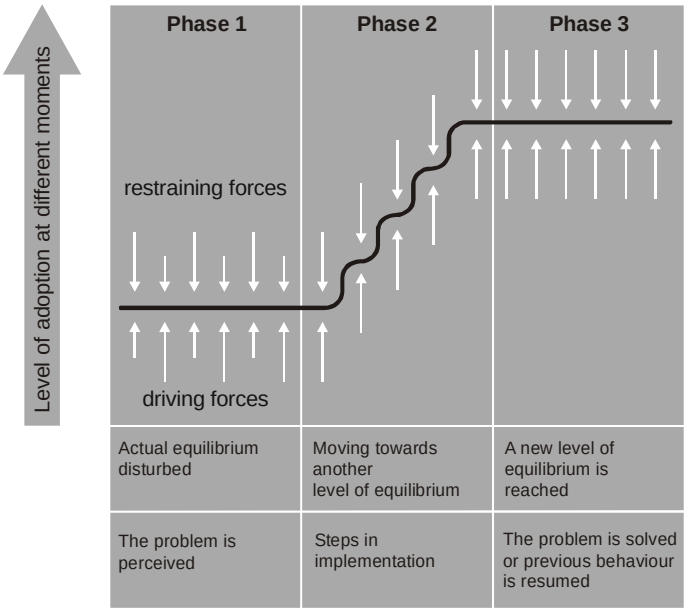
- **Change Process:**

Analyse driving and restraining forces

A force field analysis is a useful way to master change. The force field analysis was developed by Kurt Lewin in the early 1950s. Lewin suggested that any given situation could be analysed in terms of „driving forces“ and „restraining forces“.

Driving forces are the forces which cause or support some type of change from the status quo. Restraining forces are those forces that are hindering a change in the status quo. Once these forces are identified, a change manager will be able to understand why the current situation is resistant to changes or why changes occur.

Once this analysis has been carried out it will be easier to develop strategies either to maximize the driving forces or to reduce the restraining forces.



In this way the chances are increased that the desired changes will occur. Lewin detected - and experience proved it - that the most successful strategies were those that focused on ways to diminish the restraining forces. It is therefore worthwhile to keep eyes and ears open, to listen carefully and to identify doubts, worries, fears, and reservations of people.

Unfreeze, move, refreeze

Change management follows a three-step process:

Step 1: Unfreeze

- Create the insight that change is necessary and readiness of the relevant people.
- Support the process and be conscious of the reality.
- Carry out a situation analysis, define weaknesses, directions and goals.
- Develop a common vision.

Step 2: Move

- Realise the necessary changes.
- Follow a systematic project management.
- Address questions of cultural change.

Step 3: Refreeze

Once the change has taken place stabilise the situation and secure the change.

7.7.2 Driving and Restraining Forces

Driving and restraining forces have been experienced and assessed in particularly at the level of the key stakeholders the community of El-Moufty and KWSC as follows:

Community level

Restraining forces as experienced during project realisation have been very much linked to historical experience (since the 1950s) of the community with being supplied by a central system. Feelings of responsibility have been limited generally to the level of households; benefits from joint efforts had not been experienced; accordingly there had been little sense for community affairs. There was also fear of losing power, security etc. which has been manifested in mistrust among community members where the past system was broken up (e.g. if somebody participates very actively in the project, he is suspected to have a hidden agenda and is looking for personal benefits). There has also been little awareness about water related diseases and the importance of an intact environment. Although educated people could be easier convinced with proven facts they tended to stick more to the expected benefits from a central supply system.

Driving forces have been created by a capable and highly motivated and committed project team. The following activities and measures have been most effective in overcoming the restraining forces:

- The project team is considered by the community as being an accepted part of the process, yet responsibility, control and ownership is left with the community through involvement in all management issues such as decision making (e.g. selection of contractors) as well as by using and strengthening existing structures and capabilities (e.g. health promoters).
- A tailored multilevel approach regarding awareness creation etc. at different locations down to the household and individual level.
- Confidence building through regular group (e.g. addressing men and women separately) and personal contacts (more than 100 awareness interactions have been recorded!).
- Facilitation of transparency about roles and responsibilities and therefore creation of accountability.
- Demonstration of tangible benefits (e.g. more convenience and hygiene at less cost!) through exposure and exchange visits.
- School campaigns are most effective since the young generation, in particular school children, have the least reluctance to go for a new system that brings about betterment.

KWSC

Restraining forces have been very strong consisting of low interest, which is partly linked to wrong perceptions about the project concept, no direct ownership of the assets (SBS is owned by community), no direct financial benefits for KWSC as well as no personal returns (as experienced in the former KfW supported water supply programme). The existing management system lacks capacities of a modern management practice that considers a caring attitude, includes a business plan with a clear vision and goals as well as a human resources development plan with career opportunities for younger professionals. Experience is lacking with community based management of infrastructure services.

Driving forces have been difficult to create despite persistent attempts in involving the management of KWSC. However, KWSC's obligation remains to ensure continued service provision regarding water and wastewater to the people in the governorate. Of recent, HCWW has been set up at national level with the purpose to ensure and coordinate reliable service provision by the responsible agencies in the governorates such as KWSC. During first contacts, HCWW indicated a good understanding and great interest in the project concept. Through the demonstration of the advantages and sustainability of decentralised sanitation systems such as SBS, HCWW may be provided with key information to set right and enforce the role of KWSC or any other appropriate agency. A positive change of attitude by KWSC can already be detected e.g. two new young counterparts assigned to work full time on the project.

7.8 Lessons Learnt

Lessons learnt can to a large extent be drawn from the above assessment of strengths and weaknesses. In the following, the five key lessons learnt are summarised and illustrated with some eye opening stories:

Lesson 1: "Create a market – respond to clear demands – agree on terms of cooperation and follow up strictly"

In a first step, the project idea that had been developed externally was promoted at the level of the communities, who were expected to benefit from it. This clear top-down movement has been tried to be reversed to a bottom-up approach as soon as a certain level of awareness was created. Therefore, the selection criteria for the pilot projects included indicators that would confirm clearly expressed demands. However, the pilot character of the project El-Moufty never allowed for a pure bottom-up approach. This led to some set backs (e.g. continued dependency by CDA on project) that should be avoided in the replication projects. This can be achieved by the project no longer going to new villages but responding to forwarded requests in negotiating clear terms of collaboration and responsibilities and in agreeing on a MoU (including financial commitments regarding O&M). The agreed term should be strictly followed up even if some delays may be involved.

Lesson 2: "Promote ownership, responsibility and accountability"

It proved to be crucial to understand the driving and restraining forces in the change management process. It is particularly important to find the right strategies to deal with the restraining forces. The change process at community level for instance requires their full involvement in all decision making starting from the household survey up to well tailored coaching support in particular also during the consolidation period (2 to 4 years after project commissioning). It is important that at the same time experienced shortcomings are understood and learning realised.

Lesson 3: "Develop ownership by involving all stakeholders"

Consideration of the key personalities, who are involved in the change management process, is crucial at all levels. This can be in form of recognition by the communities served or appreciation by their authorities. At village level it is important to understand who benefits most from the change and who is open and eager for new learning. For this reason the ladies

may increasingly be involved (e.g. in CDA) and the younger generation be better utilised as a driving force for change.

Lesson 4: "Share financial responsibilities at early stages"

The CDA's involvement in handling the finances already for the investment cost proved to be crucial for the development of the required sense of ownership for the system as well as for guaranteeing efficient use of funds. At the same time, the trust and capacities of the community to solve its own affairs could be enhanced.

Lesson 5: "Horizontal exchanges are powerful learning opportunities"

The exchange and exposure visit to Kom El Dabaa proved to be an important step in the learning process of El-Moufty community. The facilitation of horizontal exchange is a most effective way of awareness creation, enhancement of knowledge and readiness to go for a change. The case study of El-Moufty, being even a better example than Kom El Dabaa, may be used for the promotion and capacity building of new decentralised sanitation systems in Kafr El Sheikh Governorate.

7.9 Some Illustrative Stories

Story 1: Direct accountability at village level leads to committed work

"During a public holiday period, the connection from the pump to the transport pipe to the treatment plant broke. All shops were closed, project engineers were not approachable, the collection tank started to get filled up and the system to stow backwards to the houses. At this moment, the village operator (small private contractor) took the initiative and creatively improvised a temporary connection made from an inner-tube of an old tractor tire. The improvised solution worked until the correct spare part could be obtained from a shop and the system continued to function without interruption."

Story 2: "Trust on the messenger is the basis to convince villagers about changing habits" or, "Nothing changes without trust!"

Zaida, the health promoter, states: "I could not succeed to convince the villagers unless I became one of them. During the survey I entered all the houses not only to gather the required information but to get to know the people and the way they think. In this way I made friends and one of the closest became a very committed village health promoter."

Story 3: "Young children very quickly and playfully change their habits and at the same time, they are the strongest messengers in their families."

The project launched various campaigns in the schools; teachers were equipped with documentation material and included domestic hygiene in the classes. One young child reported: "I have been asked by my mother to dispose some waste into the channel. But I refused because we have been told in school not to spoil the environment and I was ashamed if my classmates would see me doing it. My mother accepted my reasoning!"