Small-Scale Sanitation in Egypt: Challenges and Ways Forward

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Picture on the cover page: Village Scene in Abu Dora, Beheira Governorate (©Philippe Reymond)

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ESRISS Project

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Executive summary

This report is a result of the *Egyptian-Swiss Research on Innovations in Sustainable Sanitation* (ESRISS - www.sandec.ch/esriss), a parallel research component of the World-Bank funded *Integrated Sanitation and Sewerage Infrastructure Project* (ISSIP); this component is administered by the *Swiss Federal Institute of Aquatic Science and Technology* (Eawag) in partnership with the *Egyptian Holding Company for Water and Wastewater* (HCWW) and financed by the *Swiss State Secretariat for Economic Affair*s (Seco). This report is primarily addressed to all stakeholders of the sanitation sector, decision-makers, governmental agencies, consultants and academics, who deal with rural sanitation and small-scale sanitation in general. However, some of the identified challenges may concern other sectors as well, and development experts may find in this analysis a useful insight into some characteristics of the Egyptian context.

Objectives

Extensive sector analysis based on meetings with most sector stakeholders in Cairo (Ministries, utilities, research institutions and consultants) has led to the conclusion that there is a great need for the development of cost-effective, context-appropriate and replicable small-scale sanitation systems for settlements not covered by present or future large-scale centralised schemes. By “small-scale” we refer to “settlements or groups of settlements of up to 5,000 inhabitants”. This need is reflected in the ISSIP project, where solutions are currently needed for villages with a population up to 1,500 inhabitants.

The development of a wide-scale replicable model for the Nile Delta is the ultimate goal of the ESRISS Project. In order to achieve that, the first step is to analyse the past experience of small-scale sanitation in Egypt and understand the reasons behind the success and failures. This report is the result of this analysis and provides a comprehensive review of all factors influencing small-scale sanitation systems, with recommendations for future projects.

Methodology

Different methods were used to build our assessment: (i) Interviews with key-stakeholders of the sector to identify the existing initiatives, gather the sparse data, available knowledge and experience; (ii) a thorough literature review; (iii) Selection of the most prominent initiatives, field visits, assessment with evaluation questionnaire and analysis of samples at the National Research Centre (NRC).

The main matrix of analysis is the *enabling environment framework*. It structures the factors that impact projects’ success and failures into six components: government support, legal framework, institutional arrangements, skills and capacities, financial arrangements and socio-cultural acceptance. Thus, all the components of sanitation systems are assessed comprehensively. Technical factors are analysed separately.

In the first part of the report (Chapter 3), the identified challenges are discussed, component by component. The main challenges observed are described, and suggestions for improvement are formulated. These challenges are synthesised in a table at the end of the chapter. Then, the second part (Chapter 4) provides practical recommendations for small-scale sanitation project design. This directly relates to the tasks that consultants have to carry out in sector projects such as ISSIP.

Background

The Nile Delta is a very challenging area, with very dense housing, growing pressure on the agricultural land, high water demands and high population growth. Villages of the Nile Delta are now served with water supply, but few of them already benefit from proper wastewater collection and treatment. There is a clear demand to properly dispose of wastewater in small communities, with some of them building “informal” or “groundwater lowering” sewer systems. Otherwise, people rely on on-site sanitation. In both cases, wastewater and sludge are dumped in the nearest water body (drain or, often and illegally, canal) or directly on agricultural fields. At the same time, the situation is worsening due to rising water tables caused by perennial irrigation and increased provision of drinking water, often leading to the malfunctioning of existing on-site treatment facilities. So far, there is no viable small-scale system (including viable financial and management schemes) available for replication in Egypt. Most small-scale initiatives in Egypt did not stand the test of time or remained at a pilot stage.

Results and recommendations

This assessment reveals that isolation of existing initiatives and lack of commitment by the government agencies are significant factors preventing wide-scale replication. Indeed, none of the approaches tested so far has been institutionalised. Furthermore, fully community-based approaches do not appear to work in the Egyptian context. It is clear that HCWW and its Affiliates must play a pivotal role in the development and management of small-scale sanitation; collaboration and coordination with the other stakeholders of the sector (Ministries, communities, NGOs, researchers) should be fostered. So far, the sector is in a vicious circle as isolated initiatives remain prototypes and, as such, are not cost-effective, do not receive the attention required, are considered too expensive and/or prone to failure, and therefore are not replicated.

A clear governmental strategy is required to develop a standardised model for wide-scale replication. Standardisation of small-scale sanitation systems is needed to allow economies of scale, reduction of costs and an increase in quality. These systems should be modular and flexible. The use of prefabricated units, which could easily be manufactured in Egypt, for part of or for the entire treatment scheme, would be an added advantage. Standardisation also means that the systems could be managed by specialised units in the Affiliated Companies, or by a professional private company subcontracted by HCWW.

Laws, regulations and Codes of Practice need to be adapted to this specific context, and innovative mechanisms should be put in place to allow full-cost recovery. An incremental approach should replace the current “all or nothing” philosophy, which has not served Egypt well. The legal and institutional framework should enable consultants to move beyond “business as usual”. Small-scale sanitation needs pragmatic answers.

The assessment also reveals a lack of baseline data characterising sanitation in rural villages, leading to under- or over-dimensioned infrastructure. Animal manure and effluent of dairy factories need to be considered as parts of the sanitation system. Small-scale sanitation needs an integrated approach with tailor-made designs, coupled with a comprehensive preliminary assessment in each settlement. “Soft components” (e.g. preliminary interview of stakeholders and management schemes) must become an integral part of each design.

Donors have a major role to play to foster integrate approaches. Specificities of small-scale sanitation should be reflected in the terms of reference, as well as in the tendering and bidding procedures. The non-technical components should be considered as a must and more flexibility is necessary to foster innovation and cost-efficient designs.

Finally, rural sanitation needs lessons learnt. Several projects have been implemented by different organisations and Ministries in the past, but lessons learnt are few and far between. Solutions need to be built incrementally. Failures should be documented and analysed, in order to avoid them in future. It is strongly recommended that HCWW create an online library and repository on its website, to collect reports and experiences done in Egypt. It would help any motivated agency, NGO or interested individuals to take up rural sanitation challenges.

Acronyms

ABR	Anaerobic Baffled Reactor
BOD	Biological Oxygen Demand
BORDA	Bremen Overseas Research and Development Association
BOT	Build-Operate-Transfer
BWADC	Beheira Water & Drainage Company
CARE	International Development NGO
CBO	Community-Based Organisation
CDA	Community Development Association
CEDARE	Centre for Environment and Development for the Arab Region and Europe
COD	Chemical Oxygen Demand
DBAF	Dual Biological Aerated Filter
DEWATS	Decentralised Water Treatment System (Borda, Bremen)
EAWAG	Swiss Federal Institute of Aquatic Science & Technology
EEAA	Egyptian Environmental Affairs Agency
EGP = LE	Egyptian Pound = "Livre Egyptienne" (1 EGP = 0.15 CHF - *rate on 22.01.2012*)
ESDF	Egyptian-Swiss Development Fund
ESRISS	Egyptian-Swiss Research on Innovations in Sustainable Sanitation
GIZ	German International Cooperation (former GTZ)
HCWW	Holding Company for Water and Wastewater
ISSIP	Integrated Sanitation and Sewerage Project
KES	Kafr El Sheikh
KWSC	Kafr el Sheikh Water and wastewater Subsidiary Company
LAU	Local Administrative Unit
LE = EGP	Egyptian Pound
LVU	Local Village Units
MFA	Material Flow Analysis
MOHP	Ministry of Health and Population
MWRI	Ministry of Water Resources & Irrigation
MWSU	Ministry of Water and Sanitation Utilities
NOPWASD	National Organisation for Potable Water and Sanitary Drainage

NRC	National Research Centre (Markaz El Behoos, in Dokki)
O&M	Operation & Maintenance
PE	Population-Equivalent
PIU	Project Implementation Unit (ISSIP)
PM/TA	Project Monitoring / Technical Assistance
PPP	Public-Private Partnership
QMRA	Quantitative Microbial Risk Assessment
RBC	Rotating Biological Contactor
RODECO	German Consulting Company (which worked for GIZ in Kafr El Sheikh)
RSU	Rural Sanitation Unit
SANDEC	Department for Sanitation in Developing Countries (Eawag)
SDC	Swiss Development Cooperation
SECO	Swiss State Secretariat for Economic Affairs
SPO	Swiss Programme Office
SWM	Solid Waste Management
SWOT	Strengths, Weaknesses, Opportunities, Threats
ToRs	Terms of Reference
UASB	Upflow Anaerobic Sludge Blanket
USBR	Upflow Septic Tank/Baffled Reactor
WB	World Bank
WSP	Waste Stabilisation Ponds
WUA	Water Users' Association
WW	Wastewater
WWTP	Wastewater Treatment Plant

ESRISS Project

Small-Scale Sanitation in Egypt:

Challenges and Ways Forward

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*This report is a result of the **Egyptian-Swiss Research on Innovations in Sustainable Sanitation** (ESRISS - www.sandec.ch/esriss), a parallel research component of the **World-Bank** funded Integrated Sanitation and Sewerage Infrastructure Project (**ISSIP**); this component is run by the Swiss Federal Research Institute on Water and Wastewater (**Eawag**) in partnership with the Egyptian Holding Company for Water and Wastewater (**HCWW**) and financed by the Swiss State Secretariat for Economic Affairs (**Seco**).*

It is the first published of a series of reports. The outcomes of this report have been summarised in a Research for Policy Brief, entitled "Small-Scale Sanitation in Egypt: 10 Points to Move Forward".

This report will be followed by another one on current practices, sewage and septage characterisation and material flow analysis for small communities in the Nile delta.

1 Introduction

The Nile Delta is a very challenging area, with very dense housing, very high pressure on the agricultural land, high water demands and fast-growing population. If villages of the Nile Delta are now served by water supply, few of them already benefit from proper wastewater collection and treatment. The Egyptian Holding Company for Water and Wastewater (HCWW) has divided the different governorates in clusters, which will be served step-by-step via governmental investment funds / local funds or several large-scale donor-funded projects (e.g. World Bank, KfW, EIB).

The Integrated Sanitation & Sewerage Infrastructure Project (ISSIP), funded by World Bank through a loan to the Egyptian Government (GoE) is one of them. It aims at developing the rural sanitation sector in towns and villages in three Northern Governorates in the Delta region: Gharbeya, Kafr-el-Sheikh and Beheira. The project is providing improved wastewater collection and treatment systems in targeted clusters to help reduce the pollution in the surrounding water canals and drains. The three project Governorates have a total population of approximately 8 million, of which 73% live in rural areas. The two Command Areas selected for the ISSIP project – Mahmoudeya and Mit Yazid – encompass about 1.35 million people; ISSIP priority areas are estimated to include about 1 million of these.

The objective of ISSIP is to contribute to the sustainable improvement in sanitation and environmental conditions for the beneficiary communities and the water quality in the selected drainage basins within the served areas. ISSIP consists mainly in providing sanitation systems within the selected drainage sub-basins. This includes the planning, designing and construction of sanitation systems of various scales: (i) centralised wastewater treatment plants and sewer networks; (ii) decentralised sanitation systems including house connections, simplified collection networks and local treatment plants to cover villages of about 500 to 1500 inhabitants.

Until now, ISSIP projects mainly addressed the centralised systems. However, between the areas served by large-scale centralised systems, there are a large number of smaller settlements for which connection to the large schemes is financially not possible and for which alternatives have to be found. GIZ has been experimenting since 2004 a community-based model, serving isolated villages up to 5,000 inhabitants (Wehrle, Burns et al. 2007). Seven treatment plants have been implemented. Unfortunately, this model showed its limits and its wide-scale replication had to be abandoned. As a consequence, ISSIP is now searching for new ways. Cost-effective and context-appropriate small-scale systems have still to be developed, which have the potential to be replicated on a wide-scale through ISSIP and other major projects.

In order to fill this gap, Seco has mandated Eawag to investigate the sector challenges and develop solutions. Rural sanitation has been recognised as a priority at the national level and several trials have been done so far, but without the necessary integrated planning approach. Besides, it is recognised that decentralised systems will increase the opportunities for reuse, in a context where demand on freshwater is growing (Abdel Wahaab and Mohy El-Din 2011). There is a great need to analyse the existing initiatives, compare them and draw the necessary lessons learnt; it is also capital to study existing sanitation practices in the Nile Delta.

Up to now, very little has been done for sanitation in small and mid-sized settlements in the Delta. People rely on on-site sanitation or informal sewer systems, with the wastewater and sludge being dumped in the nearest water body or directly on agricultural fields. At the same time, the situation is worsening due to rising water tables caused by perennial irrigation and increased provision of drinking water, often leading to the malfunctioning of existing on-site treatment facilities. As a consequence, water in the drains and groundwater are heavily contaminated ((Abdel-Shafy and Aly 2007; EcoConServ 2007; HCWW 2008)). As mentioned by Prof. Ahmed Gaber, Nile Delta villages are getting more and more “vulnerable”.

It is expected that at least 15-20 years will be needed to cover the backlog in rural sanitation coverage. Many people are now blaming decentralisation and so-called “decentralised” systems. However thousands of villages and ezbas are not connectable to large sewer networks in the short and middle-term. What is the alternative? If no alternative is provided, people will continue “business as usual”: discharging raw wastewater and sludge in drains and canals, injecting wastewater into the ground, or resorting to mitigation measures such as raising the level of their houses, as has already been seen in Kafr El Sheikh Governorate.

So far, there are no viable small-scale systems (including viable financial and management schemes) available for replication in Egypt. Most small-scale initiatives in Egypt did not stand the test of time or remained at a pilot stage. It is high-time to draw lessons learnt, in order to move forward.

ESRISS Project takes up the challenge with a rigorous, neutral, and independent research approach, for the sake of the Egyptian rural population. Something has to be done, even temporary, to avoid a real environmental disaster.

1.1 Focus of the ESRISS project

Extensive sector analysis based on meetings with most sanitation stakeholders in Cairo (ministries, utilities, research institutions and consultants) has led to the following conclusions:

There is a great need for the development of **cost-effective, context-appropriate and replicable small-scale sanitation systems** for settlements not covered by present or future large-scale centralised schemes. By "small-scale" is meant "**settlements or groups of settlements of up to 5,000 inhabitants"**. This need is reflected in ISSIP project, where solutions are currently needed for villages with a population up to 1,500 inhabitants.

The development of a **wide-scale replicable model** is the ultimate goal of ESRISS. As such, the **interface between small-scale systems and the Utility** (HCWW and Affiliates) and the **integration of the model in its strategies** is a key factor in ESRISS' approach.

In parallel, ESRISS intends to **strengthen understanding** of the particularities of sanitation in Nile Delta villages and to **develop a data baseline** for planners and designers. In particular, tools and methodologies are developed to quickly quantify and characterise the wastewater to be treated, on a site-specific basis.

Beyond ISSIP, those outcomes have the potential to benefit other large-scale sanitation projects and to **support the National Rural Sanitation Strategy**, currently under revision.

Egyptian partners expressed their needs and demands for this focus, especially our main research partner HCWW. Clearly, rural sanitation is now receiving increased attention from the Egyptian Government and the donor community; there is a real need for strategies and evidence-based solutions. The cluster approach has been widely studied by different consultants during the ISSIP appraisal phase and is now deeply rooted in HCWW's strategy (HCWW 2008). For main towns in the Nile delta, there is no doubt that the cluster approach is the most cost-effective, as it benefits from the economy of scale and the concentration of skills. This approach could be argued for Upper Egypt, but it falls out of our geographical scope.

It is important to note that in the Egyptian context, everything outside of the major cities is referred to as *rural sanitation*. This encompasses the centralised sanitation service clusters, financed by ISSIP in the governorates and presented in the National Rural Sanitation Strategy. As a matter of fact, the Nile Delta is one of the most densely populated areas in the world, with villages that can count more than 50,000 inhabitants and that are more urban than rural in character, even the smaller ones. Looking from the airplane, the Delta resembles a huge peri-urban area.

A lot of experience has been accumulated in the small-scale sanitation sector in Egypt (Chemonics 1992; Gaber 2004; Chemonics 2006). However, there is no small-scale model available for replication, lessons learnt are lacking and there is no real baseline data for rural wastewater quantities and characteristics.

Based on that, ESRISS's applied research focuses on three themes:

1. Assess existing initiatives of small-scale sanitation in Egypt and try to understand why no system has so far been replicated on a wider scale. The present report is the main output of this component.
2. Create a baseline on sanitation in rural areas of the Nile Delta and assess quantities and characteristics of flows related to sanitation.
3. Develop, implement and validate small-scale sanitation system scenarios, in partnership with HCWW and the ISSIP Project team.

   There is not one single silver bullet system that can solve all the problems of rural sanitation in Egypt, but the ESRISS project can contribute with guidelines on how to choose and implement the most appropriate system in a given condition.

1.2 "Decentralised" vs. "centralised" vs. "cost-effective"

"Centralised", "decentralised", "low-cost", "on-site": different terms which often appear in presentations and in papers, but tend to generate endless debates on their definition and application. In the following section we would like to bring greater clarity to key terminology used in rural sanitation.

A flexible and pragmatic approach has to be adopted. What has been described in the past as "decentralised" was actually merely "small-scale centralised". For this reason, we adopt here the term "**small-scale system**", which reflects better the targeted size. Then, within that range, we differentiate between "**sewered**" and "**unsewered**" systems, with the latter relying on "**on-site sanitation**" systems.

If "decentralised" is often used to qualify technical systems, it can also be applied for management systems. As such, GIZ community-based model in El Moufty has a decentralised management, as it is run by the community. "Decentralisation" in that sense could also mean the process of power transfer between the Holding Company in Cairo and the Affiliated Companies. In our case, we will prefer to talk about "**delegation of roles and responsibilities**".

In the end, if the term "decentralised" is so confusing, it is because it refers to a "centre", whose perception varies from one person to another. For that reason, we generally prefer to avoid this term.

The main parameter to choose how to serve a village should not be simple population numbers, but "**cost-effectiveness**". It is the specific location of a village and its configuration which will determine if it will be connected or not, and to which sewer network. As mentioned in *ISSIP1-Phase2 Project Identification Report*, a small village which lies within a large sewer network should be connected.

Finally, "cost-effectiveness" should not be confused with "low-cost", which in turn should not be confused with "cheap". The challenge is to optimise investments so that the whole region can be served with quality sanitation service at a minimum cost. The main indicator for that should be the cost per capita for the full life-cycle of the infrastructure, and not the mere capital cost as was often the case in the past.

1.3 Creating an enabling environment

Small-scale sanitation is much more than the selection of a combination of alternative technologies. Key for the success of any sanitation system is the “enabling environment” (Lüthi, Markard et al. 2011; Lüthi, Morel et al. 2011). An ”enabling environment” can be seen as the set of inter-related conditions that impact on the potential to bring about sustained and effective change (adapted from World Bank Social Development Note, 2003). This includes political, legal, institutional, financial and economic, educational, technical and social conditions which encourage and support certain activities. An enabling environment is important for the success of any development investment; without it, the resources committed to bringing about change will be ineffective.

It is divided into six components, as shown in Figure 1.

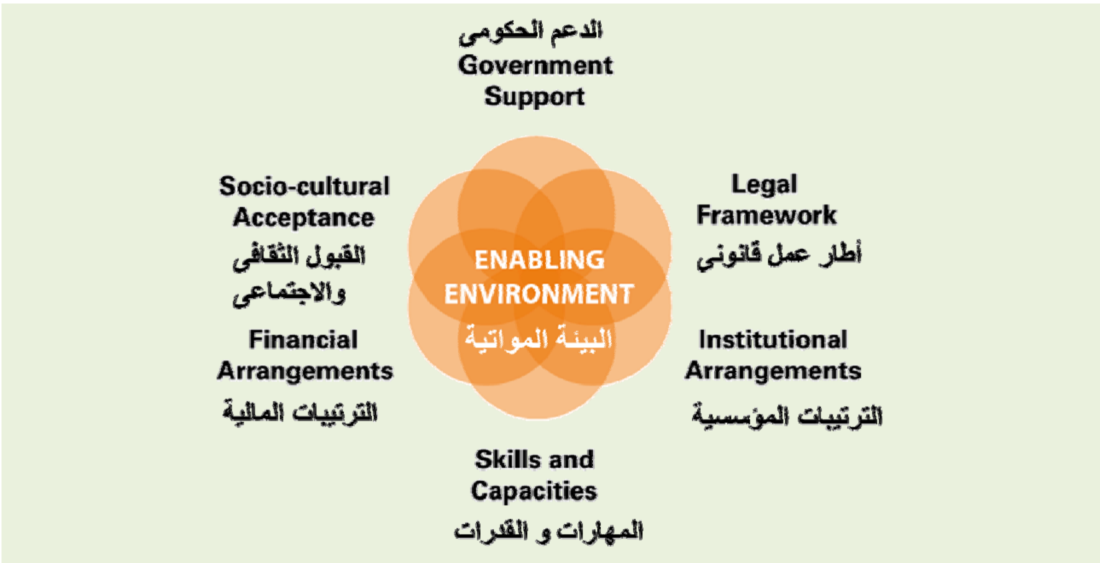

Figure 1: Components of an enabling environment (adapted from Lüthi et al, 2011)

If not existing, steps should be taken to further develop the enabling environment before going any further into implementation. For example, lack of explicit political support is often the initial cause for project failure. Unless there is a governmental commitment towards increasing community participation and decentralisation of service provision, translated into national sector policies and strategies, community-based projects will be isolated and vulnerable. A proven political commitment to decentralise decision making, service provision and promote community participation, which is supported by the highest levels of government and the top management of the sector agencies, is an important precondition for an enabling political environment.

Many existing regulations and standards are based on those developed in industrialised countries (in the wastewater domain e.g. range of accepted technologies, sewer diameters, effluent standards, wastewater reuse regulations, etc.), under conditions totally different from those in developing countries, and so they are not appropriate. If there are laws which prevent the installation of a certain technology, or standards which have become norms over time, it may be very difficult or impossible to introduce a new system. Besides, for the legal framework to contribute to the enabling environment, it must be transparent, realistic and enforced.

Small-scale sanitation requires, among others, the following preconditions:

- The right of users to be involved in the decision-making process;
- The possibility of local structures (community-based organisations (CBOs), user associations, etc.) to manage services including operation and maintenance, and the control of funds collected from users;
- Laws that allow the private sector to be involved in service provision;
- Realistic technical norms and standards that allow the use of affordable technologies.

Without this framework being in place, any donor agency, NGO or institution should think twice before launching a rural sanitation project.

Figure 2 shows how the enabling environment fits in the design process. Small-scale sanitation is about the proposal of innovative technical and management schemes, with a clear definition of roles and responsibilities. Any model proposed should be compatible with the local enabling environment. If not, either the proposal should be adapted, or the modification of one or several components of the enabling environment should become part of the project. Most projects so far failed because they were only technical projects. Implementing small-scale sanitation scheme is not only implementing infrastructure, but implementing a management scheme, O&M scheme, Monitoring & Evaluation scheme and a thorough capacity-building programme.

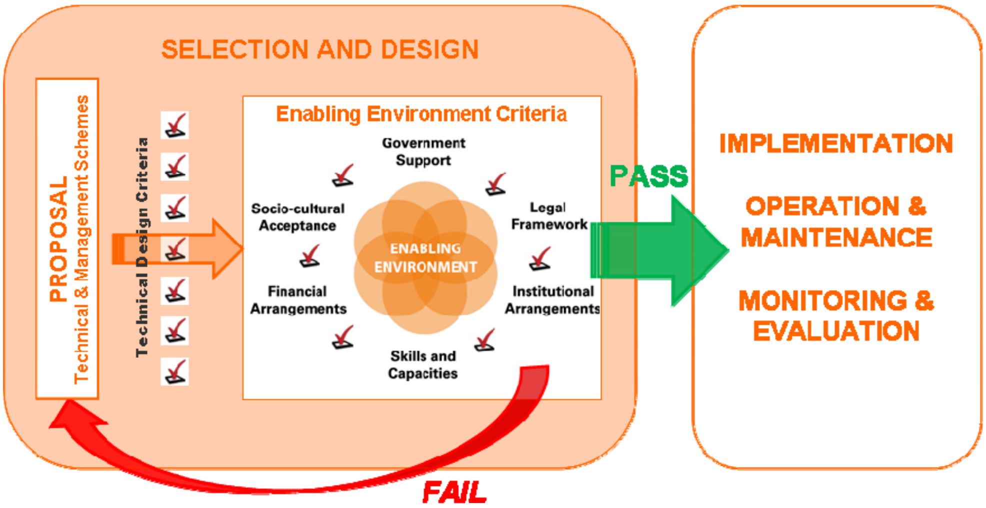

Figure 2: Procedure for selection and design of small-scale sanitation systems

2 Methodology

There is very little formally written assessment of success and failure factors of small-scale sanitation in Egypt. If existing, those are rarely published. At the same time, there is a lack of institutional memory and centralised archiving of studies and reports on the topic, the information being often confined within their respective institution, or even office or personal computer (if not completely lost).

For those reasons, different approaches were required to build our assessment:

1. **Interviews with key-stakeholders** of the sector to identify the existing initiatives, gather the sparse data and available knowledge and experience (see Appendix 3 – section 7.3 – for the list of people met).
2. **Literature review**
3. **Selection of the most prominent initiatives**, field visits and assessment with evaluation questionnaire and sample analysis in the National Research Centre (NRC); this allows completing the available data with first-hand information.

In what follows, the relevant literature is briefly presented, then the selection criteria of existing initiatives and, finally, the assessment methodology and evaluation criteria. The detailed assessment of the selected cases is found in the report "*Assessment of small-scale sanitation initiatives in Egypt*". This report is an **extrapolation** of all the results obtained through those assessments, numerous interviews and literature reviews carried out within ESRISS Phase I.

2.1 Literature review

As many factors influencing small-scale sanitation are not only proper to small-scale systems, the literature review went far beyond the respective reports, which are very few and far between. The list of studies below is not exhaustive. Relevant references are to be found in the respective chapters of this report.

Three types of reports can be differentiated, with some reports falling in between:

a. Assessment of existing initiatives
b. Conceptual frameworks on how it should be
c. Global assessments of the Egyptian wastewater sector.

The present report can be seen as an update and complement to the assessment work done by Chemonics Egypt between 1991 and 2006 (Chemonics 1992; Gaber 2004; Chemonics 2006). It is worth going back to those reports, as they provide a very useful insight in success and failure factors of technical designs, whereas the present report goes more into the analysis of small-scale sanitation systems as a whole.

Information on sanitation practices in Nile Delta villages and quantities and characteristics of wastewater generated from them can be found in several Egyptian publications, mainly reports but also theses and scientific papers.

The *Basic Village Services (BVS)* and *Local Development II – Provincial Project* (LDII-P) projects, funded by USAID, which resulted in the implementation of 24 WWTPs in rural areas, has generated a wide array of publications. Reports from these projects, contain data on quantities and characteristics of rural sewage and septage, information on sanitation practices as well as methods developed during LDII-P for needs assessment and project planning:

- *"Manual: Rural WW Project Planning"* (Chemonics 1991)
- *"GUIDELINES: Methodology and Terms of Reference to Conduct rural WS/WW Needs Assessments and Strategic Planning"* (Chemonics 1992)

More recent reports by Chemonics Egypt on rural sanitation include:

- *"Water Supply and Sanitation in rural Egypt – Assessment"* (Gaber and Bakr 1997)
- *"Stock-Taking of Egypt Rural Water Supply, Sanitation and Hygiene"* (Gaber 2004)
- "*Guidelines on Rural Sanitation - Draft Final Report*" (Chemonics 2006)

Relevant information is to be found on general studies about wastewater reuse in Egypt:

- "*Wastewater Reuse in Egypt: Opportunities and Challenges.*" (Abdel Wahaab and Mohy El-Din 2011)
- "*Feasibility of Wastewater – Integrated Water Resource Management II – Report n°14.*", published by USAID (IRG 2010)
- "*MEDA-Countries (Egypt, Lebanon, Morocco, Syria and Tunisia): Identification and Removal of Bottlenecks for extended Use of Wastewater for Irrigation or for other Purposes - Egypt Country Report.*" (AHT 2009)

International cooperation agencies have also published a number of reports on assessments and lessons learnt:

- German cooperation (GIZ):
  - "*Decentralized Wastewater Management in Kafr El Sheikh Governorate, Egypt.*" (Wehrle, Burns et al. 2007)
  - "*Decentralized Wastewater Management in Kafr El Sheikh Governorate - Final Results and Lessons Learnt.*" (Jacoby 2012)
- Dutch cooperation:
  - "*Report on Wastewater Treatment Plants and Proposals for the Environmental Programme of FaWUOP.*" (Wickett 2007)
  - "*Identification of Sewerage Solutions for Small and Remote Villages - Draft Study to Assess the Social Feasibility of Community Owned Communal Sewerage Systems.*" (El Shorbagi 2008)

  - "*Drinking water supply and sanitation programme supported by the Netherlands in Fayoum Governorate, Arab Republic of Egypt, 1990-2009."* (Netherlands 2011)

- Swiss cooperation:
  - "*Egyptian-Swiss Development Fund - Final Report 2009*." (ESDF 2009)
- World Bank:
  - *"Assessment of Existing Sanitation Situation and Solid Waste Condition Report"* (Ahmed Abdel-Warith Consulting Engineers and ARCADIS Euroconsult 2007) for the *Integrated Sanitation & Sewerage Infrastructure Project* (ISSIP)
  - "*Estimating relative benefits of differing strategies for management of wastewater in Lower Egypt using quantitative microbial risk analysis (QMRA)*" (Evans and Iyer 2012)
- KfW:
  - *"Governorates of Sharkiya, Gharbeya, Damietta and Beheira. Improved Water and Wastewater Services Program"* (Technology Enterprises BCT 2007) for the *Improved Water and Wastewater Services Program* (IWSP)

A few PhD dissertations have been written on the topic:

- *"Policy Analysis and Development for Liquid Waste Management in Rural Egypt"* (Gemmell 1992)
- *"Comparative Study to Evaluate Different Technologies for Sewage Treatment in Rural Areas in Egypt"* (Ibrahim 1995)

Finally, there is a number of publications assessing the performance of different technologies where data on raw influent can be found:

- "S*ustainable technologies for domestic wastewater treatment in rural areas and small communities for appropriate agriculture use"* (Abdel Wahaab 2010)
- *"Evaluation of wastewater treatment technologies for rural Egypt"* (El-Gohary, Abou-Elela et al. 1998)
- *"Anaerobic Biodegradability and Treatment of Egyptian Domestic Sewage"* (Elmitwalli, Al-Sarawey et al. 2003)
- "*Evaluation of decentralized treatment of sewage employing Upflow Septic Tank/Baffled Reactor (USBR) in developing countries*" (Sabry 2010)
- *"Integrated waste management for rural development in Egypt"* (Shehata, El-Shimi et al. 2005)

2.2 Identification of small-scale initiatives

So-called "decentralised" initiatives have been identified all over Egypt through interviews with key-stakeholders and literature review. The following Affiliated Companies have been visited in the first place for deeper discussions: Beheira, Gharbeya, Kafr El Sheikh, Dakahlia, Damietta and Beni Suef.

The literature review concerns three levels: 1. Reports of Egyptian projects, collected from the different key-stakeholders and at Chemonics library; 2. International reports concerning MENA region; 3. Scientific literature, mainly found in academic journals.

The main selection criterion is related to scale: we started with initiatives serving up to 15,000 inhabitants. The entire country has been considered as such existing initiatives are scarce and not limited to the delta.

The list of initiatives is given in Appendix 1 (section 7.1), indicating the location, type of technologies, designer and/or implementing programme and the current manager.

2.3 Selection criteria

The initiatives have been pre-selected according to the following criteria:

1. Size: **initiatives serving up to 15,000 inhabitants**.
2. **Technical diversity:** The different technical initiatives developed in Egypt have to be analysed, in order to assess their appropriateness in different contexts. Some initiatives have been developed only on a pilot scale; in that case, our role will also be to assess how these can be implemented on a larger scale and what it implies in terms of management. For example, we identified conventional treatment systems (sewers and activated sludge), waste stabilisation ponds, different sewer systems, anaerobic and compact aerobic treatment units (both latter currently being optimized at research scale in Egyptian Universities, but still lacking the opportunity of large-scale implementation).
3. **Managerial, financial and institutional diversity:** Such projects have been implemented by different development agencies and governmental entities, leading to a variety of approaches regarding community participation, CDA creation and handing over to Affiliated Companies. As this seems to be the critical factor in Egypt, a selection of different settings will help us to identify what works, what doesn't and why.
4. **Failed projects:** This will give information on what should absolutely not be done. Initial research shows that there are many different initiatives that have failed in the past, although not easy we will try to assess the main patterns and reasons for system failure.

Data availability and access do not play a major role for selecting a case.

2.4 Evaluation of selected initiatives

The selected initiatives have been evaluated based on literature review, interviews of main stakeholders, field visits and sample analysis. The evaluation has been made according to a comprehensive questionnaire, assessing all the component of a sanitation system (see Appendix 2).

Each visit was attended by a member of ESRISS, an external senior sanitation expert and a person concerned by the initiative (designer, leader, manager and/or member of the Affiliated Company). Each time, two or three samples (at least the influent and effluent) were taken to give a snapshot on the performance of those treatment units. Those samples have been analysed by an accredited lab (National Research Centre, under supervision of Prof. Fatma El Gohary).

In the end, the information collected has been gathered in factsheets.

2.4.1 Evaluation questionnaire

The evaluation questionnaire (see Appendix 2 - section 7.2), to be used as a guide in semi-structured interviews, is designed to assess all the components of the sanitation system, from the technical parameters to the financial sustainability and social acceptance. Particularly important is the notion of "enabling environment", which characterises the conditions which are necessary for the success of an initiative. The evaluation criteria have been divided into nine categories:

- **Engineering & Operations**: the technical factors, along the project cycle (design, construction, O&M, performance, site).
- **Environmental factors**: external factors influencing the sanitation system (physical and human geographical factors, quality of services).
- **Nutrient recovery & Reuse options**: reuse practices
- **Financial arrangements**: costs, financial sustainability, contracts
- **Management scheme**: ownership, roles and responsibilities
- **Institutional arrangements and government support**: role of institutions, influence, application of laws and regulation
- **Socio-cultural acceptance: awareness, behaviour & participation**: socio-cultural factors, users' priorities, level of awareness, level of participation
- **Impact on area served**: actual impact of the sanitation system on the quality of environment; relevance of the investment
- **Future perspectives**: improvements, replication, collaborations

With this questionnaire, we aim to find out hints which will ease the understanding of the complexity of each initiative and the different reasons that led them to their current status. It gives also hints of what the "enabling environment" for rural sanitation in Egypt should be.

3 Discussion of identified challenges and recommendations

Based on numerous interviews, field visits, literature reviews and evaluations we have been able to analyse the main success and failure factors of small-scale sanitation in the Egyptian context. We classify the factors according to the enabling environment framework (cf. §1.3) and technical questions.

3.1 Technical factors

Technical factors affecting the success or failure of a system are diverse, but most failure factors can be attributed to poor design, poor construction or poor maintenance. They also often reflect a lack of consideration of the particularities of the local context. Small-scale sanitation definitively needs approaches that better reflect the realities on the ground.

In what follows, we will neither go into the details of each particular design nor identify mistakes, but rather identify general trends and common shortcomings.

3.1.1 Design parameters

Design parameters are too often taken out of the bookshelf or from Codes of Practice. Most of the time, they are not adapted to the specificities of the Egyptian rural context, but correspond to urban areas (from Egypt or high-income countries). The Egyptian village differs considerably from those contexts in various ways:

1. **Concentrations are higher** (especially COD and BOD) as water consumption is usually lower than in urban areas, especially where the water supply is still not optimal.
2. **Extra loads** have to be taken into consideration, especially those from animals and small-scale industrial activities (e.g. milk factories and dairy processing).
3. **Inflows are highly variable** in time and quantities and there is no buffer effect such as in big urban treatment plants; thus, peak loads are higher and can have more impact. Next to that, the influent characteristics are subject to change after introduction of a sanitation system in the village, e.g. due to change in consumer behaviour, increased water consumption, washing machines instead of canal washing, creation of small-scale industrial activities at household level.
4. **Content of inert materials** may be higher due to non-asphalted roads and farm activities.

An extensive literature review has shown a **lack of baseline data** characterising sanitation in rural villages (practices, water consumption, wastewater production, flows, loads). Designers do not have values at hand which can help them design a tailor-made sanitation system in such a context, taking into account the various factors influencing the quantity and characteristics of the wastewater to be treated. As a consequence, most initiatives until now were not dimensioned according to the actual wastewater to treat.

There is also a lack of baseline data for **forward planning**, i.e. studies which describe how settlements may develop and under which driving forces: how improvements in water supply influences wastewater volume; a clear strategy for water supply improvement; patterns of housing development (vertical, horizontal,...); development of small-scale industries; strategy for management of those small-scale industries (source treatment or treatment at WWTP). Such baseline data would help to forecast potential developments and design WWTPs accordingly; of course, it implies coordination between the relevant institutions.

Some WWTPs have been **overloaded** from day one, others a few months or years later (e.g. in Mit Dafr and several WWTP built under LDII-P). This can be explained by the following factors:

1. **Population increase** in rural villages has been underestimated
2. **Water consumption increase** related to improvements in water supply and wastewater collection in the past decades has been underestimated
3. Population increase is often followed by **economic development**; for example, once a certain population threshold is reached, it is probable that somebody will start a small-scale **dairy processing** enterprise in the village and other small-scale industrial activities will appear.
4. **Animal manure** if often not taken into account
5. People have communicated a population number lower than the actual one in order to fall within the range of the donors' selection criteria

On the contrary, some other WWTPs have been largely overdimensioned because of the lack of baseline data; in that case, consultants take very high values to avoid any risks. This precaution costs a lot of money for no added value and threatens cost-effectiveness of small-scale systems.

In general, both for the large or small-scale WWTP, there is a **lack of flow measurement**. WWTPs are designed on the basis of very rough estimation and once they are constructed, inflow is usually not measured. In such cases, it is difficult to dimension a WWTP correctly and to monitor its performance, as this means that even the theoretical hydraulic retention time is unknown.

A reason frequently mentioned for failure of WWTPs is that "people dump manure in the sewer network". This is not a fatality, but needs to be planned ahead: either loads from animals have to be taken into account in the design values, or an alternative should be provided to the farmers. Raising awareness is not enough if people have no other choice. For example, it is illusory to ask people to go and bring liquid manure several hundred meters from their house on a daily basis. In this case, a communal collection system should be organised.

Extra loads from local industrial activities should be analysed before starting to design a WWTP and future economic developments should be anticipated. In the case of GIZ waste stabilisation ponds in Moufty, a major breakdown occurred in 2010-2011 due to the start of a small milk factory in the village. It shows that such activities may have disastrous effects on small-scale treatment unit. Specific solutions should be designed for them.

The way in which **storm water** is managed also has an influence on the design. If storm water is diverted into the sewer network, as observed most of the time, the system should be able to cope with high amounts of **inert materials**. The primary settling step should be adapted and O&M procedures designed accordingly.

3.1.2 General design features

Concerning the detailed design of the existing initiatives, two main weaknesses have been observed in a number of initiatives:

1. **Lack of hydraulic design**: this applies especially to waste stabilisation ponds. It is clear that the position of inlet and outlet of the ponds has not been studied and that major short-circuiting is happening; this was particularly obvious when the colour of the influent was significantly different than the colour of the water in the pond. Besides, a better positioning of the inlets and outlets, the placement of a few baffles may also greatly improve the mixing within the ponds and thus, the hydraulic retention time and performance of the system (Shilton and Harrison 2003; Shilton 2005).
2. **Lack of proper sludge management**: in most cases, no solution has been provided for sludge management, so that it accumulates in the system, threatening its overall performance. Often, it is dumped in the nearest drain, jeopardising the positive impact of the plant itself. The operators usually do not know when and how to pump the sludge properly, which reduces the performance of the treatment units. This is true for most technologies, be it anaerobic baffled reactors, UASBs, or waste stabilisation ponds.

The use of anaerobic treatment as a first step offers good potentials for both on-site and off-site sanitation (Abdel Wahaab and Mohy El-Din 2011). Designers should opt for technologies such as ABR or primary settlers. Research in NRC showed that a primary settler followed by downflow hanging sponge (DHS) has the same performance as that of an UASB followed by DHS (Fatma El Gohary, personal communication). However, implementation of DHS at a full-scale seems to be costly, and another media (such as plastic chips) should be considered.

Based on experience and research results, UASB is not recommended for ezbas; it is premature in the current situation (Dr. Rifaat Abdel Wahaab, personal communication). It has to be mentioned however, that UASB is a very effective technology, which works well in many countries. Solid-liquid-gas separation is however very sensitive and necessitates great care. It is probably this component that led to problems in Sanhour (Fayoum); NRC discovered that the UASB itself was performing well, and that the main shortcomings were in the trickling filters.

Three strategies have been tried to **cope with high groundwater tables**: (i) construction of the whole system above ground (cf. Al Raed system, ABR in Sharaf El Din, Tarek Sabry's pilot in Zenein); (ii) build embankments for the ponds/tanks to be at a higher level; (iii) construct retaining walls and groundwater drains to protect the infrastructure against groundwater (both latter seen in Aldar-GIZ first Waste Stabilisation Ponds). It is dubious that the latter is really useful, but it is surely quite expensive.

Previous experience shows that it is advantageous to keep the treatment units above the groundwater table. At the same time, cost reduction imposes to use gravity. Very often, it is possible to use materials excavated on one side to elevate treatment units on the other side. It is also advantageous to build the drying beds at a lower level than the treatment units in order to facilitate desludging.

3.1.3 Environmental factors affecting the price of infrastructure

Several typical features of the Nile Delta may increase the cost of infrastructure and may threaten cost-effectiveness of small-scale infrastructure:

1. High groundwater table, often up to one meter below ground level
2. Clayey soils
3. Limited availability of land (see §3.1.4 below)

High groundwater table may significantly increase the price of underground works, such as sewer network, tanks and ponds, because it implies continuous pumping during the construction phase. It also means that the infrastructure must be very robust, in order not to allow infiltration of groundwater for the decades to come. Clayey soils also increase the price, as it is much harder to dig into it; it takes more time and energy.

Strategies to cope with high groundwater tables are described in the previous paragraph.

3.1.4 Availability of land

Land availability is one of the major constraints in the Nile Delta. However, a few initiatives have implemented treatment systems with a large footprint, namely waste stabilisation ponds and constructed wetlands. While these systems are without any doubt well suited for desert areas and Upper Egypt, their application to the Nile Delta is inappropriate, for two main reasons:

1. **Land in the Nile delta is both expensive and precious** to farmers, who usually own only small holdings. Experience shows that it is very difficult to find the required land in the region, and, if it is available, the price is usually very high. This limits the replication of such expensive systems.
2. **Lack of flexibility of the systems**: it is very difficult to extend such systems, as it implies buying further large tracts of land next to the existing WWTP, or to upgrade them, as they then become very expensive. Consequently, if the quantity of wastewater needing treatment rises, e.g. due to population increase

or water consumption increase, it is difficult to adapt. This may lead to overloading and failure of the system.

3.1.5 Cost comparison

In general, a major shortcoming in project development is that only the design and construction costs are considered, but not the entire ***life-cycle* costs**, i.e. the long-term perspective taking into account all the costs incurred and the benefits received over the total duration of the project for the entire planning horizon. This includes the land, but also the O&M costs. With this perspective in mind, it will often appear that what was told to be the most cost-effective in terms of design and construction is actually more expensive in the long-run than other systems. Or, when considering the existing initiatives, that “cheap” options end up being the more expensive options. Dynamic cost calculation have to be considered, based on realistic/actual unit costs and life time for system components.

Price of land is often not mentioned in the capital costs related to each treatment system. It can be understood as some projects rely on the fact the communities will *provide* land to the project *for free*. However, whatever price is paid by the implementing agency, land always has a *value* that has to be taken into account when selecting technical options, especially when talking about “low-cost” or “cost-effective” technologies. In some cases, the price of the land is **higher** than the treatment system itself. In the Nile Delta, we can assume that if the price value of land is included, waste stabilisation ponds are not a cost-effective option anymore.

3.1.6 Quality of the work

Heterogeneous quality of work has been reported in the water and wastewater sector. It seems that some contractors are not reliable and don’t deliver work with the quality required, which can threaten even the short-term performance of infrastructure. Moreover, some consultants and contractors seem to confound “low-cost” with “low-quality” (see §3.3.4 and 3.4.6). Notwithstanding the pressure for small-scale sanitation systems to be affordable, they need to be constructed in a quality as good as in bigger systems, if not better, as less effort and resources is usually provided for O&M of small rural systems.

3.1.7 Hindrances for innovation

Several parameters seem to hinder innovation in small-scale sanitation systems:

1. “Business as usual”: consultants tend to minimise their efforts and produce the expected outcomes in the shortest time possible. There is also a tendency to recycle designs from the 70s or the 80s, without taking into consideration the technical improvements and scientific advances made since then.
2. There is no “learning culture” and constructive criticism, i.e. consultants are not encouraged to improve from one project to the next. Moreover, there is a tendency to privilege relationships (“habibee economy” - see §3.4.6) over quality of work.

3. Local culture tends to be very hierarchical and based on seniority; there is little room for the younger generation to design and implemented systems according to the most recent state of the art.
4. The legal and regulatory framework, especially the Codes of Practice, tend to discourage consultants and contractors to be innovative (see §3.3.1)
5. Some consultants tend to make patents on their systems; it can hinder replication and innovation by others.

At the same time, lack of lessons learnt and the lack of close monitoring sometimes lead to very quick and unjustified judgements on and rejection of new technologies in case of malfunctioning. This is done without a deep analysis of why those systems are not functioning properly. For example, some promising systems, such as UASB and small-bore sewers are now widely discredited in the Egyptian context, even if they work in other countries. This discourages consultants and contractors to build them, as they subsequently estimate the risks to be too high.

3.2 Government support

Unless there is a governmental commitment towards increasing community participation and decentralisation of service provision, translated into national sector policies and strategies, community-based projects will be isolated and vulnerable (Lüthi, Morel et al. 2011). This is, so far, the reality for all the cases presented in this study.

3.2.1 Rural sanitation strategy

Rural sanitation is now seen as a focal issue in Egypt and there is no doubt that there is awareness of the problem among authorities and a will to find solutions.

However, as a matter of fact, the status of rural sanitation in the Nile Delta has not evolved much in the last decades. The main argument given by the authorities is the limited financial resources and the need to prioritise investments. It is fully understandable that in a vast country like Egypt, where needs for sanitation coverage are huge, priority is given first to urban areas and big settlements, and then to rural areas and small settlements. This strategy is reflected in the Master Plan of HCWW.

If this strategy is logical, it also means that most rural areas will be left untouched for the next two or three decades, in a situation that is worsening every year due to demographic pressure, rising groundwater levels and water consumption, and saturation of soils through wastewater. **Temporary solutions should be found** to alleviate this burden and ensure a smooth transition until those settlements can be linked to a formal treatment plant in the long-term.

The National Rural Sanitation Strategy (HCWW 2008) goes in this direction and was the first to propose a conceptual framework. The strategy aims “to ensure public health and [safe/healthy] environment, and protect water resources through the provision of safe and effective wastewater and solid waste collection, conveyance, treatment, and disposal services to all Egyptian rural communities” until 2040, the target year.

However, this document does not provide practical guidance on how to help rural areas in the short and medium-term and is currently under revision under the responsibility of HCWW and GIZ (outcomes expected by the end of 2012). The next version will hopefully be more oriented towards practitioners.

Two main views currently dominate the debate on the best strategy to adopt for rural areas:

1. Everything shall be connected to big centralised WWTPs sooner or later. In this perspective, governorates have been divided into clusters, whose shape and boundaries are still changing.
2. The government shall provide the service to all Egyptians for free and it is not the role of the communities to be responsible for rural sanitation.

There is however an obvious lack of finances and skilled labour to do so in the coming years. The economic and political crisis following the Revolution will certainly not contribute to advancing this process. The sector is suffering from inefficient replacement and rehabilitation programs, poor periodic maintenance and a shortage of technical expertise which results in increasing water loss, frequent interruption of service, lack of trust, quality concerns and billing system deficiencies (MoHUUD 2010).

3.2.2 Government policy for full-cost-recovery

On top of that, the Egyptian Government seems reluctant to take the necessary measures to achieve full-cost recovery of the water and wastewater sector. Raising water and wastewater bills up to what it actually costs is certainly an unpopular measure under the present conditions, which neither the old regime nor the currently fragile institutions was/are ready to take. It is a pity, as people are certainly able to understand that water and wastewater service has a cost, as well as driving a car or using a cell-phone. **Without achieving full-cost recovery, it is illusory to think about achieving full coverage in rural sanitation,** as every new infrastructure basically increase the burden of the debt, which in turn has an impact on its proper O&M.

A consequence of those low-tariffs is that people are not encouraged to take the initiative of building their own system, with which they would certainly have to pay more to maintain it, and prefer to wait for years for government intervention. On the other hand, communities that decide to pay more may face difficulties with the legal and regulatory framework (see §3.3).

There is also a lack of political will from the Government to help HCWW to punish illegal connections and collect water bills, which has become an increasing problem since the Revolution. Besides, there is a lack of will to enforce environmental laws, leaving villagers free to contaminate surface waters, groundwater and the air indiscriminately.

Also, leak detection systems and more water meters would certainly contribute to alleviate this situation.

3.2.3 Policy for decentralisation

Finally, there is clearly reluctance towards decentralisation and delegation of power. We could not observe a proven political commitment to decentralise decision-making and promote community participation, as necessary adaptations of the legal and regulatory framework have not been taken (see below). For it to work, it should be supported at the highest levels of government and the top management of sector agencies. As decentralisation is not translated into national sector policies and strategies, community-based projects implemented so far remained isolated.

As stated by (Hvidt 2004), we should keep in mind that GoE may accept projects without necessarily supporting them, especially when it is not asked for a monetary contribution, as it relies heavily on projects proposed by donors. This phenomenon may have played a role in GIZ's Kafr El Sheikh project (Eisele 2011).

Thus, if the government acknowledges the problem, it shows little support to actually solve it.

3.3 Legal and Regulatory framework

There are different aspects to be considered in the legal and regulatory framework:

1. Standards and Codes of Practice
2. Tariff regulation
3. Possibility to decentralise responsibilities
4. Contract management and responsibilities of consultants and contractors
5. Enforcement of laws and regulations

For the legal framework and regulatory framework to contribute to the enabling environment, it must be transparent, realistic and enforced (Lüthi, Morel et al. 2011).

Until now, a small-scale sanitation system ready to be replicated at scale in the Nile Delta has not been found, despite several initiatives in the last 20 years. A reason for that may be the institutional and regulatory frameworks do not encourage innovation, namely:

- NOPWASD is very conservative in its designs and codes of practice; very little space is given for innovation.
- In this context, consultants are prone to strictly follow the codes of practice, in order to be covered in case of failure. Innovative consultants should be encouraged by the implementing institution, for example with the latter covering the risk.

3.3.1 Standards and Codes of Practice

In terms of standards, Law 48/1982 regarding the protection of the river Nile and waterways from pollution is the most important in this context. It provides the standards that must be respected (parameters and values). Basically, these standards can only be reached after a secondary treatment and can be considered as quite strict and unrealistically high, especially when considering the bad quality of receiving water bodies in the Nile Delta.

If they may be understandable for big WWTPs, these standards are less appropriate for small-scale systems. As a matter of fact, they jeopardise the implementation of a sound and realistic rural sanitation strategy and the replication of cost-effective, small-scale sanitation systems. Indeed, it is difficult to keep the costs low if those standards are to be met in a small community. As mentioned in a report for the European Commission (AHT 2009): "As is the case in other MEDA countries, standards which are unrealistically high and unachievable for some countries within a certain time can be counterproductive as they could encourage illegal irrigation. Hence, they should gradually be adapted to a more stringent level parallel to the strengthening of competent authorities. On the other hand, health based standards do not allow any transition period."

Several voices have risen to advocate for a **"primary treatment for all", rather than a "secondary treatment for a few"**. It is clear that a primary treatment for all would have a much bigger impact in terms of pollution reduction. There is clearly a need to adapt standards to the rural sanitation context. For example, a moratorium could be declared on those standards for rural areas, allowing in a first phase to serve all the villages with primary treatment. Then, in a second phase, treatment could be upgraded to reach these standards.

Fortunately, the decree 402/2009, issued by MWRI to decrease the legal concentrations of nitrogen and phosphorus in the WWTP effluent (thus implying tertiary treatment) has been withdrawn in autumn 2011, under the pressure of HCWW and a consortium of consultants and academics. This decree gave evidence to the lack of pragmatism in some institutions, and the lack of coordination prevailing.

The following are the most important Codes in our field (EcoConServ 2007):

- Ministerial Decree 135/1999: Code for Design and Execution of Sanitary Appliances in Buildings. The Code, amongst others, describes necessary wastewater treatment stages, control methods and disposal alternatives.
- Ministerial Decree 286/1990: Code for Design and Execution of Water Supply and Wastewater Piping Networks, describes amongst others the pipes foundation design, design of accessories such valves, manholes, and oil traps.
- Ministerial Decree 169/1997: Code of Practice for Wastewater Treatment Works. It defines the hydraulic, construction and electromechanical design considerations.

The laws and decrees regulating the disposal and reuse of wastewater in Egypt, as well the regulations contained in the Code for the Reuse of Treated Wastewater in Agriculture (501/2005) can be found in (Abdel Wahaab and Mohy El-Din 2011) and (IRG 2010). This code is under revision at the time of writing.

The existing Codes of Practice, which regulate the engineering design and construction specifications of wastewater collection and treatment utilities, also constitute a hindrance, as they are very conservative, not up-to-date and not always adapted to the Egyptian context. Many consultants are reluctant to implement something which is not in the Code of Practice, as they would have to bear a heavy burden in case of failure. As such, they are real barriers to innovation.

Tina Eisele reports the following example, based on an analysis of GIZ case studies in Kafr El Sheikh (Eisele 2011):

> *“ During many consultations it was mentioned that the small bore sewers, which are applied in some of the villages, are met with refusal. It is crucial to mention that although the construction of small bore sewers is said not to follow Egyptian standards, this is actually untrue. Rather, this kind of system is not listed in the code. This doesn’t imply that its construction is illegal. However, as mentioned, small bore sewers run the risk of being rejected, especially by persons who are not in favour of the system as a whole. In this regard it can be recommended to adjust the code so as to overcome such perceptions, which in a worst case scenario may be cumbersome. “*

It is now the role of EWRA to work “in close cooperation with the Ministries of Health, Environment and MWRI to update the relevant Egyptian standards” (MoHUUD 2010).

3.3.2 Tariff regulation

Tariffs are currently one of the major problems of the water and wastewater sector in Egypt. As it is well recognised by the MoHUUD, “a major review of the tariff system is required” (MoHUUD 2010). Tariffs are very low[1] and money collected is far from achieving full or even partial cost recovery. This contributes to the financial difficulties of the Affiliated Companies, with the majority being unable to meet even their operating costs (Chemonics Egypt 2009; MoHUUD 2010). The Egyptian water and wastewater sector is heavily subsidised and institutional representatives argue that it is difficult to raise taxes under the current socio-economic situation.

EWRA has undertaken an initiative to define sector policies, which, among others, aims to “achieve financial sustainability while maintaining the role of the state in protecting low-income people” (MoHUUD 2010). The same document states that EWRA will be responsible to set the economic tariff, which shall reflect the actual cost of the service and include capital and operation costs, while the government will set the social tariff for the “first domestic class”, and other classes if needed, to ensure the protection of low-income groups (which would de facto continue to be subsidised).

The current situation does not facilitate small-scale rural sanitation:

- on the one hand, small-scale rural sanitation systems need to achieve full-cost recovery, as they can rarely rely on the government in case of failure, as the latter has limited financial resources and tends to prioritise investments for big infrastructure.

[1] For households, the price of water is LE 0.23 per m^3 of consumption of water up to 20 m^3 per month and LE 0.65 per m^3 above a consumption of 20 m^3 per month. Wastewater charges consist of a surcharge of 35% of the water charge (Chemonics Egypt, 2009).

- on the other hand, governmental agencies refuse to raise taxes in a village having such a system, based on the principle of equity; this means that in order to reach full-cost recovery, a CDA or a NGO has to raise extra money from the community.

This translates to the fact that a community who wants its own sanitation system has to pay a higher price than the rest of the population. As a consequence, many communities prefer to wait for the government to connect them to a centralised system (i.e. in which case they would pay less) rather than taking an initiative, which threatens up-scaling of small-scale initiatives. The problem is that they may have to wait a very long time, which of course has a significant impact on the environment. In the end, they have to choose between "bear the existing conditions for some years or decades and pay less" or "pay more and improve their standards of living in a short time".

Water tariffs should be reviewed and gradually increased to socially acceptable levels to achieve appreciation of the value of water by the population, decrease water consumption, and on long-term achieve cost-recovery for O&M and investment costs. In general, for the water and wastewater companies an increase in cost recovery and the gradual reduction of subsidies will raise the efficiency of operators (AHT 2009).

3.3.3 Legal basis to decentralise responsibilities to communities

In general, we can say that the legal framework does not encourage delegation of responsibilities to the communities and decentralisation in general, as Egypt remains a much centralised state.

In the case of rural sanitation, a crucial point is the legal basis that a community have to manage totally or partly a sanitation system in case it is willing to do so. GIZ analysed the legal basis of Community Development Association (CDA) for their projects in Kafr El Sheikh (Wehrle, Burns et al. 2007): CDAs are defined in detail by decree no. 178/2002 of 23 October 2002, embedded in Law 84/2002, on "Non-Governmental Societies and Organisations", issued by the Minister of Insurance and Social Affairs. According to this decree, associations, and therefore CDAs, have the authority to work on different activities for the development and improvement of their particular village (Article 48). According to Article 59 of Decree 178/2002, an association may, for consolidation of its financial resources and in order to realise its social purposes, amongst others, set up service and productive projects.

However, an association cannot penalise bad payers or violating acts, as it does not have any judicial authority (Wehrle, Burns et al. 2007). The required juridical body is presented by a Regional Union, and its establishment is required by Law 84/2002, Article 65. For the CDA, the responsible Regional Union is the Local Village Unit (LVU). To chase debtors, violating acts, and other issues, the CDA needs to inform the LVU.

This situation limits the power of the CDAs and has to be identified as a constraint, which can be exemplified by the following (Eisele 2011):

> *" As described [in El Moufty], some villagers are misusing the system and dump animal manure into it. The CDA cannot penalise the individuals who are*

> *misusing the system. Instead, it should report back to the police and the LVU, which should then take necessary action. This didn't happen due to social circumstances. The whole situation developed as a result of a big issue, as the MoHP, the responsible body for water quality monitoring, identified the effluent as not meeting the required quality standards, and, according to Law 4/1995 and Decree 338/1195 on Environment[2], had to penalise the "responsible" person. In the eye of the governmental body, the CDA, in particular the head of the CDA, is responsible, as the CDA is responsible for the system, and not the actual violator. In turn, the chairman of the CDA was to pay a fine and/or be sent to prison – and left the CDA. "*

This experience shows that the legal framework does not encourage communities to take the initiative of operating their own management system. On the one hand, the CDA does not have the legal power to punish misuse, and on the other hand, it is itself accused and charged in case of misuse and bad performance. It is clear that, in view of such a case, nobody is keen to take the lead for such an initiative.

Clearly, if the legal framework is not adapted to give more power and responsibility to communities, alternative management schemes have to be found, giving the main responsibility of the infrastructure to a governmental body (see §3.4).

3.3.4 Contract management and responsibility of consultants and contractors

A major problem with small-scale sanitation is that low-cost is often associated with low quality. It is difficult to find good consultants and contractors to do the job, because, with little costs and little budget, such projects are often financially not attractive. What is more, because of the diversity of the small settlements and the need for case-by-case, tailor made design, they usually require a lot of efforts for moderate consultant fees.

Another challenge is to make contractors accountable and to be able to control them (see also §3.4.6). Contract management has been one of the major problems in GIZ experience in Kafr El Sheikh: "*Contract management for the sites under construction (since 2008) has been deficient and progress at the construction sites has been slow. […] most of the delay must be attributed to inefficient contract management*" (Jacoby 2012).

The main question is how to get good quality for this type of small work. Here are a few potential answers:

- **Make attractive packages**: mandates should be given for several villages at the same time, to increase the amount of the mandate and reduce the global effort that the consultant has to produce (economy of scale for consultants).
- Increase responsibility and accountability: responsibility is major problem, as people tend to protect themselves and reject the responsibility on others in case of failure (see also §3.4.6). This is encouraged by a lack of supervision and a lack of clear roles and responsibilities. Design-build-operate contracts should

[2] Main concerned Articles of Law 4/1995: Articles 69, 71, 72, 78, 79 (on Protection of Water Environment from Pollution), and Article 84 Bis (on Penalties). Main concerned Article of Decree 338/1995: Article 58 (Eisele, 2011)

be encouraged, as, logically, people who have to operate the system will take care of having a good design and avoiding construction defaults. If the three components are separate, we may end up with poor design, poor construction and poor O&M, with the three main responsible persons blaming each other for the system failure.

- Write appropriate contracts and detailed tender documents for this scale: contracts should not contain gaps that contractors can use to excuse low-quality work. Roles and responsibilities should be clearly defined, with the possibility to have a clear arbitration.
- ***"Performance-based contracts*** *should always be preferred over relational (i.e. time-based) contracts with both consultants and contractors, as any relational contractual element reduces the incentives for keeping delays at a minimum*" (Jacoby 2012).
- "*Preference should be given to regional contractors instead of national contractors based in Cairo. […] It is expected that regional contractors will show more commitment to complete a project as they can have future benefits and (direct) interest in the development of the region.*" (Jacoby 2012)

The ideal scenario is to have tender guidelines (or tender document templates) encouraging sustainable small-scale systems (see also §3.4.7), and encouraging specialists to apply.

3.3.5 Enforcement of laws and regulations

In the current context, most environmental laws are not enforced. It is also very difficult to collect taxes. This is a real problem for the functioning of HCWW and its Affiliates, and jeopardise a quick development and upscaling of rural sanitation.

It is also to be noted that if the law is usually not enforced on non-complying big governmental treatment plants, it is enforced on small community-led WWTPs. Independent small-scale treatment plants are particularly the target of controls, which can lead to problems, as shown in El Moufty (Kafr El Sheikh). This is due to the different legal basis and the special protection from which governmental agencies benefit; it is very symptomatic of the lack of will from the government to encourage a more pragmatic and citizen-driven improvement of the sanitary conditions in rural areas (see also §3.2).

3.4 Institutional arrangements

The application of community-centred approaches requires an institutional environment within which the various institutional levels can function effectively (Lüthi, Morel et al. 2011). The main stakeholders in our case are the national governmental institutions, the Affiliated Companies in the governorates, the regional and local authorities (city council, omdas, sheikhs baladi), community development associations (CDA), the private service providers, the donor community, consultants & contractors, research institutions and, some cases, thematic NGOs (e.g. specialised in environmental or educational projects). All those stakeholders have different interests and perspectives, but they are all necessary for the functioning and replication of any rural sanitation model.

Prior to defining institutional arrangements for one's project, it is important to understand the current roles, responsibilities and capacities (strengths, weaknesses, potentials) of the different stakeholder groups, their influence, their interest and importance in participating in the project (Lüthi, Morel et al. 2011). This assessment helps to identify opportunities and build upon existing links and capacities. The main question related to current institutional arrangements are who has decision-making authority in service provision and to what extent does the current institutional framework allow for delegation of responsibility and authority to other levels (as discussed above in §3.2 and 3.3). It is also very important to investigate the linkages and relationships between and within institutions and how they interact and coordinate action together, for example between Affiliated Companies and communities and between national line agencies and research sector.

3.4.1 Institutional setup of the water and wastewater sector

The least that we can say is that the institutional setup in the Egyptian water and wastewater sector is complicated. Currently, more than ten ministries are involved in the sector and its management.

A recent policy document from the Ministry of Housing, Utilities and Urban Development (MoHUUD 2010) states clearly as an important institutional challenge the "**lack of clarity in the definition of the roles of the principal sector organisations** (EWRA, HCWW, Affiliated Companies and NOPWASD) and the supporting and relevant entities (Ministries of Environment, Health, Local Development, Finance and Economic Development)." Until now, planning and the establishment of water related policies mostly happened independently and individually within each ministry (Eisele 2011). In August 2012, HCWW, NOPWASD and EWRA have been taken out of MoHUUD to form a new Ministry of Water and Wastewater Utilities. This gives hope for a more efficient management of the sector in the future.

The main bottleneck so far is clearly the weak relationship between HCWW and NOPWASD and lack of cooperation of the latter. In such circumstances, it is clear that the current division of responsibilities, with planning and operating for the HCWW and implementing for NOPWASD, leads to conflicts, waste of time and money. It also hinders HCWW to go ahead with sound planning and strategy, as it still has to bear the burden of past decisions from NOPWASD; rural sanitation is also concerned. With this setup, there is very little or no incentive for the implementing agencies to provide value for money, as they do not carry the burden of bad designs and poor quality constructions. HCWW is even forced sometimes to refuse the hand-over of constructed WWTPs, because of the bad quality of construction. ISSIP Project Identification Reports show some good examples of those shortcomings within the areas under the project's responsibility (Hydroplan and EnviroConsult 2011).

In general, there is a significant **lack of cooperation and communication** between the different institutions in charge of the sector. In particular, we can mention the Ministry of Water Resources and Irrigation (MWRI), which sets the standards for municipal effluent discharge, the Ministry of Health and Population (MoHP) (amongst others sets standards for drinking water quality, and is, together with the MWRI, responsible for monitoring, sampling and testing of drinking water and effluent quality - in this regard, it can order the closure of any facilities that fail to meet the standards), the Ministry of State for Environmental Affairs (MSEA) (among others responsible for environmental monitoring and enforcement of environmental law) and its executive is the Egyptian Environmental Affairs Agency, EEAA. This weak cooperation and coordination makes the creation of a sound planning and regulatory framework for rural sanitation virtually impossible.

It is for example a reason why Egypt is still following a politics of “everything or nothing”, and that some institutions prefer the discharge of raw waster in the environment rather than encouraging partially treated waste water. It is also a reason why it is very difficult to implement IWRM (Integrated Water Resources Management), which would be very beneficial to the country and the Delta in particular to encourage water use in a rational way in densely populated agricultural areas. In her report, Tina Eisele states clearly that “*the coordination of the different stakeholders and therefore the coordinated creation of an enabling environment can be seen as one of the main challenges*” [for IWRM implementation] (Eisele 2011).

The World Bank has tried to increase interactions between HCWW, NOPWASD and MWRI by linking the irrigation project IIIMP with the sanitation project ISSIP, which are aimed to improve the quality of water of two canal command areas in the Delta with an integrated water resource management approach. So far, interactions and synergies between the two components seem to be difficult. An improvement of the coordination between the three agencies would be highly beneficial, especially for rural sanitation, as MWRI has a very important presence on the ground and has the experience of building water user associations. MWRI itself launched a few small-scale sanitation trials (Abdel Kareem Issa, Fayoum; Sharaf El Din, Beheira; Senbo, Gharbeya), but those projects seem to remain totally independent from HCWW and Affiliates’ business. A sound rural sanitation strategy will certainly pass by binding the strengths and resources of both institutions.

3.4.2 Linkages between private service providers / NGOs and line agencies

Sanitation in unsewered areas is mostly governed by stakeholders totally independent from HCWW. For before the creation of HCWW, the field was under the responsibility of City Councils and freelance private entrepreneurs. In some cases, emptying trucks belonging to local authorities or private stakeholders empty the on-site sanitation systems (septic tanks and *bayaras*); in other cases, freelancers make a living from maintaining informal sewer networks. Even if this system is economically viable, it poses a threat to the environment, as discharge is uncontrolled and the loads dumped in nature remain untreated.

Sometimes, unsewered systems are as good as sewered systems, and it can be argued that, in some areas of the Delta, it would be more economical to improve the emptying business than linking remote villages to a sewer network (HCWW 2008). Even if this concept is mentioned in the National Rural Sanitation Strategy of 2008, it seems that, on the ground, HCWW and its Affiliates are still not much involved into on-site sanitation management. However, in the middle-term, it would certainly be very beneficial to involve the rural service providers and provide them infrastructure to discharge their loads safely.

It is reported that it is difficult to find NGOs that have the capacity to lead sanitation projects in the Nile Delta. It may be different in Upper Egypt (e.g. Together Association is developing, with quite a promising approach). If strong NGOs are found, it would be very beneficial for line agencies to team up with them. By carrying on the necessary awareness raising and capacity building in rural areas, such NGOs can relieve and assist line agencies. However, until now, initiatives from private stakeholders and NGOs seem to be totally disconnected from the line agencies.

The most sustainable of the case studies investigated are those designed, built and operated by the same person or organisation. Abdel Kareem Issa and Al Raed system in Kafr El Hamam are still in a good shape several years after implementation. Even if recent, Together Association's WWTP in Sheikh Yacoub is also well monitored. This advocates for Design-Build-Operate (DBO) models, which, in case of wide-scale replication, could take the form of Public-Private Partnership (PPP) or Build-Operate-Transfer (BOT) agreements.

Besides, Chemonics reports that *Damietta Governorate successfully used a private company to manage eight village wastewater treatment plants for five years until its governmental staff was sufficiently trained* (Chemonics 2006).

3.4.3 Management capacity of communities

As shown by different case studies (GIZ in Kafr El Sheikh, ESDF in Kom el Nagar), communities lack capacities to operate a full sanitation system by themselves. Supervision by either the Affiliated Company (as is the case in Sheikh Yacoub, Beni Suef) or by a private stakeholder (as in the Al Raed case in Sharkiya) is necessary, at least for performance monitoring and support in case of major breakdown. Communities need also to be accompanied of a longer period of time by a strong organisation, be it an NGO (like Together Association in Beni Suef) or by private consultants (like RODECO in Kafr El Sheikh). Of course, there are also exceptions such as Abdel Kareem Issa, where a particularly motivated villager is able to manage a small-scale treatment unit on his own.

Community Development Associations (CDA), considered as NGOs in Egypt, are a fundamental component of all community-based projects (cf. GIZ and ESDF). In these projects, the existence or the creation of a CDA in the community was a prerequisite. CDAs are based on the willingness of a few community members to do something for the community and are very variable entities, which makes all projects relying on them very different in nature. In particular, CDAs vary in terms of legitimacy, popularity, influence and overall performance. Some of them are very active and well recognised, whereas others are only registered without any concrete action.

Thus, selection of villages based on the quality of their CDA is key for the implementation of small-scale projects (see also §3.7.2). The different case studies of GIZ in Kafr El Sheikh and the case studies of ESDF in Gharbeya and Qena show how CDAs can vary and the importance of their strength and legitimacy for the success of the projects. In Kom El Naggar, the community did not trust the CDA, so that they ended up handing over the WWTP to HCWW. In Om Sen, the community is split in two, resulting in conflicts.

El Moufty is rich in lessons learnt on shortcomings of a fully community-based approach (Personal communications, 2011):

1. *A CDA in full charge of a system will have a conflict of interest being part of the community while having to take strong actions against an offender/misuser, who might be a relative of one of the CDA members (especially when that member is the chairman) or an active community member.*
2. *Without proper involvement of HCWW or Affiliated Company in the management of a system the CDA and O&M contractor will mainly be interested in a proper functioning of the sewer network as that will affect the community directly, but proper functioning of treatment plant is hardly any concern for them. As long as the treatment plant flows, they will be satisfied; quality of effluent is no concern.*
3. *O&M contractor ignores instructions from Affiliated Company as long as he is paid by CDA and as long as CDA is not exposed to strong measures from Affiliated Company to take actions.*

What is more, "a*lthough the payment moral in the pilot villages has been to some degree satisfactory, financial sustainability may be threatened by the fact that the CDA is also in weak legal position with regard to the enforcement of payments*" (Jacoby 2012).

Many projects did not manage to create ownership (by people and/or institutions). There is definitely a lack of institutionalisation of the community-based approaches.

3.4.4 Management interface between communities and institutions

Until now, there is **no or very little interaction between Affiliated Companies and the leaders of small-scale sanitation initiatives**. Either they are managed independently, or they are handed over to Affiliated Companies, which then take over full responsibility (like in Kom el Nagar). This situation threatens the wide-scale replication of small-scale models. As a matter of fact, it is not possible in the current situation for Affiliated Companies to manage dozens of small treatment plants given current staffing levels; on the other hand, experience has shown that communities cannot manage such systems independently.

Management of small-scale sanitation systems requires innovative schemes. There is a **need for a dual management scheme**, sharing roles and responsibilities between the governmental agencies and the communities. The NGO Together Association has opened the way by making an arrangement with Beni Suef Affiliated Company for a monthly effluent quality monitoring. In Kafr El Sheikh, RODECO and GIZ are also working on a formal dual management. Until now, the case studies show that **the management model is highly dependent on who finances and who owns the infrastructure**. A new policy framework would be required to encourage links between HCWW, Affiliated Companies, communities, private stakeholders and NGOs, so that any stakeholder interested in improving sanitation can benefit from a minimum support from HCWW.

It should also be noted that management schemes are very much linked to financial schemes. Both are constrained by the current governmental mindset and legal and regulatory framework (see §3.3.2). It means for example, that an appropriate management scheme may not be able to guarantee full-cost recovery due to existing policies. It is clear that both have to be considered at the same time; full-cost recovery is a must for sustainability.

3.4.5 Linkages between research sector and line agencies

The relationship between research and line agencies in Egypt has two sides. On one side, most senior managers of HCWW also hold a Professor position in a university, as well as the main consultants, and the professors of sanitary engineering also represent the core of HCWW's Steering Committee. On the other side, it seems that the results and findings of research in Egypt are not translated into better policy and/or strategy. An indication for this is the fact that there have been a lot of pilot trials in Egypt, especially in the field of small-scale sanitation (e.g. in NRC), but very few have been scaled up (cases Dr. Tarek Sabry, Prof. El Hosseiny and Ahmed Eissa - Al Raed).

Considering the cycle of local technological development (Figure 3), it appears that the major bottleneck is the translation of pilot technical concepts into industrial products. Industrial design and marketing skills are needed. Academics should team up with industrial partners, but they often lack the financial capacity to do so. Support from external agencies is needed, as well as governmental support to foster the initiatives and link the relevant stakeholders. Line agencies should take the lead of piloting full-scale implementation of promising initiatives.

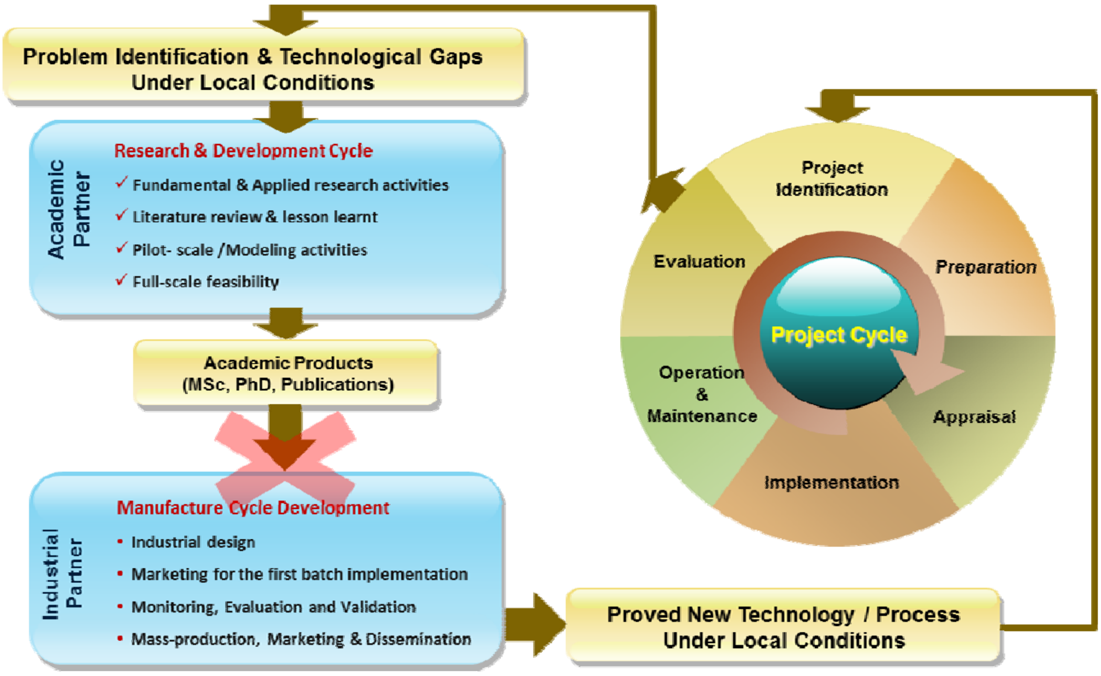

Figure 3: Cycle of new technology development for small-scale WWTP under local conditions, featuring the current bottleneck in Egypt (scheme: Dr. Moustafa Moussa)

A big gap has also been reported between research and policy-makers. Policies and strategies often do not match scientific state of the art and rational thinking. A good example of this was the recent decree on tertiary treatment, which was finally withdrawn under the pressure of consultants and academics.

Unfortunately, research institutes themselves tend to work in isolation; there is little exchange and a lack of a national platform/network for experience and information. This phenomenon may be reinforced because most professors are mainly consultants (see also §3.1.7).

3.4.6 Managing consultants and contractors

Building infrastructure in Egypt is not an easy task, and it is not unusual to find defaults during and after construction, which may severely impact the proper functioning of the infrastructure. This is usually the starting point of the so-called "**blamogramme**", a skilfully thought system where everybody can blame somebody else for the defaults and malfunction, so that in the end, it is not the responsibility of anyone. Roles and responsibilities for consultants and contractors are not defined enough.

Next to that, some contractors have been known for major delays and unjustified renegotiation of price, based on the following trick: they start building the high-added-value components and once they have done it, they renegotiate the price for the lower added-value ones. As nobody else is willing to get these low-value components only, the financer is forced to stick to them and enter their game.

Unjustified drastic price hikes have also been observed for the replication of the same model, during successive bidding processes (e.g. GIZ model in Kafr El Sheikh), which could be the hint of a trust between some consultants. As mentioned by Jacoby (2012), "*the tendering processes were characterized by a lack of transparency, which led to unreasonably high bids for the World-Bank-funded facilities although technical modifications in comparison to earlier designs were kept to a minimum.* […]*Though some rises in price obey to external factors that cannot easily be influenced (e.g. inflation of material prices, price hikes in land prices), other costs are more closely related to the tender and contract management*."

Next to the problem of the definition of roles and responsibilities, there is obviously also a lack of control, regulation and accountability of the sector. Several explanations can be proposed:

- project cycle (design, construction, O&M) divided between different institutions, namely HCWW and NOPWASD (see §3.4)
- tendency to choose different consultants for the feasibility studies and for implementation, i.e. tendering is done separately for design and construction; this requires an inordinate amount of time to complete projects and can make it difficult to pinpoint problems, as each contractor will blame on the other (Chemonics 2006); it reduces accountability and strengthen the "blamogramme".
- so-called "Habibee society" and "Habibee economy", where everything works through "friends" network and where people protect each other (see also §3.7.4); possibility of conflict of interests.
- small sector, where everybody knows everybody and where key-players play a dominant role.
- difficulty in seeing mistakes as a valuable experience and source for improvement
- initiators (donors, governmental institutions) and consultants tend to privilege their image and hide problems; reasons for failures are often not (seriously) investigated and rarely published (see also §3.7.4).

Transparency is the key for a sound development of rural sanitation. Any trial or pilot is a valuable experience and the designer/implementer should be encouraged. Focus should be put on the dissemination of information, so that systems can improve quickly, for the sake of the rural population. Transparency also implies "justice", "fairness" and "accountability".

3.4.7 Role of donors

Donors have a major role to play for the success of any infrastructure, as they decide what they want to finance, how much funding will be disbursed and which components a project should have. The specificity of small-scale sanitation is that it cannot be seen as technical projects only. Importantly, the implementation should be preceded by a good assessment of the initial situation, accompanied by awareness-raising and capacity-building, and followed by regular monitoring. If donors do not push for these components, they will be overlooked by the consultants of the sector, whose speciality is purely technical. The lack of an integrated approach is, in our view, a major failure factor in the field.

Unfortunately, allocated budgets often only cover the cost until the completion of the construction phase. O&M, and potential problems, are then fully delegated to HCWW. This issue is accentuated by the local institutional setup (see §3.4.1).

Many donors do not have or do not impose an integrate approach of sanitation systems. It is well known that some major donors only invest in infrastructure and let considerations such as O&M, community participation, capacity-building or monitoring to other donors, if any. This may end up with brand new WWTP which lack both financial, human resources and skills to be operated properly and poses an ever-increasing financial burden on HCWW.

Donors tend also to emphasise the amount of infrastructure built (marketing), but not the amount of *functioning* infrastructure after five years. Projects hardly ever publish an evaluation according to performance indicators. There is no component of monitoring, documentation of lessons learnt after the implementation.

Donors influence success with their bidding and tendering procedures. If their bidding procedures are too complicated, projects will always be grabbed by big consultants that know how to deal with them. We may then end up with consultants that are specialists in donor requirements, but not in small-scale sanitation. Donors should facilitate bidding by smaller stakeholders with promising activities.

At the same time, the type of bidding and tendering process influence the price and thus the replication potential of a system. It is well-known that consultants tend to put different prices to different donors, according to their reputation in money allocation and project monitoring. The way the project is tendered has also a major influence: if the whole project is delegated to one single contractor, he will tend to give a package price, which is usually much higher than the sum of the components. For the price to remain fair, **infrastructure tendering procedures should be divided into components or packages, each of them managed by appropriate suppliers**. This also has a positive impact on the quality of materials and work, as monitoring is closer to the ground. The main drawback is that it implies more work for the donor.

GIZ experience provides useful lessons learnt (Jacoby 2012):

- *" Tender bids for construction activities should be checked on their balance. In the past,* ***bids for the systems under construction were very un-balanced****, i.e. less significant parts of the system were priced high and rapidly constructed and paid, while essential components of the system were lowly priced and are not yet constructed with the contractor not showing much interest to complete.*
- ***Open tenders are preferable*** *over restricted procedures so that it becomes more difficult for few companies to collude in order to increase the price. No such case has been confirmed in the past, but the actual risk has to be taken into account.*

- ***Updating and systematizing the cost of construction material and labour*** *in a comprehensive standard bill of prices would be worthwhile effort (not only for decentralized wastewater systems but infrastructure construction in general) in order to make offers more comparable, keep tenders more transparent, and possibly avoid inscrutable price variations. "*

Of course, such practice should also be endorsed and integrated by the governmental agencies as, nowadays, role of donors often resume to transferring money or basket funding.

Lack of coordination is also observed on the donor side. There is often competition between donors and little integration. The European Union is trying to improve this by sustaining a donor platform in Cairo.

3.4.8 Institutional memory

The literature review done for this study showed how difficult it is in Egypt to access relevant information. We see different reasons for this:

- no free-access and centralised library at HCWW; the only comprehensive library is managed by Chemonics Egypt.
- culture of secrets, "information is power": knowledge and experience tend not to be disseminated. There is also a tendency not to divulgate reports, either because they contain some criticism, or because they may be reused later on.
- lack of lessons learnt, due to various institutional and socio-cultural factors (see §3.7.4); a lot of projects did not have a proper follow-up, usually because there no funding provided.
- lack of archiving culture: documents are scattered, usually in hard copy, among different sector stakeholders.

The difficulty to find reports and documents is of course accentuated by the fragmentation of the sector among the many stakeholders and by the recent reform of the sector (HCWW per se exists only since 2004).

Whatever the reasons, transparency and dissemination of lessons learnt are a necessary first step towards the replication and a key to the improvement of such important but fragile systems. Otherwise, the same mistakes will be done over and over again. If reports are available, it allows consultants to take them as a basis and, for each mandate, build upon and go beyond. There is no need to continuously reinvent the wheel.

It would be very beneficial for the sector if HCWW would play a greater role here as a national knowledge platform and would gather all the reports and studies done in the last 20 years in one library and, even better, put them on their website for free access.

3.5 Skills and capacity

Something often heard in Egypt is that "WWTPs are run by unskilled labour who do not have the capacity to perform proper O&M", hence the encountered problems. *Regardless of the institutional setup, lack of trained operators and inadequate maintenance budgets are major limitations for successful plant operations* (Chemonics 2006).

Different approaches are possible to improve the situation (Abdel Wahaab and Mohy El-Din 2011):

(i) Applying treatment systems which require low levels of maintenance and control,

(ii) **Enforcing service contracts** for regular maintenance by skilled operators and manufacturers,

(iii) Forming an appropriate **operator organization** and,

(iv) Establishing **regular training programs for plant operators**.

It is clear that the lack of skilled labour is a major issue for the wide-scale replication of a system. However, the skills and capacity necessary for rural sanitation is not limited to workers. It concerns all the stakeholders of the sector: governmental institutions, consultants, contractors, NGOs, private stakeholders, donor... Rural sanitation necessitates specific skills because it needs specific solutions. A specialist of urban systems may not have much experience in building or running a small-scale rural system. This has to be taken into account when setting up a small-scale project.

Small-scale sanitation is often assimilated with "simple O&M", which is usually the case. In general, there is not much to do on a daily basis, and the permanent presence of a technician is not required (and if a technician is appointed, his cost will be too high and his job unattractive). Very often, in such an infrastructure, there isn't even a space for him to stay. As a consequence, O&M is often delegated to a neighbour or a farmer. If this person can do what he is asked to, he often does not understand why he does it and the chemical and biological processes that are at stake. If this person is not closely monitored, there is a great risk that he won't manage the system properly. **This strongly advocates for regular visits of a technician from the Affiliated Company. If there are a significant number of small-scale systems, the Affiliated Company should even have specialised technicians**.

The case of Abdel Kareem Issa shows the benefits of good capacity-building. The person in charge of the system is a neighbour and part-time farmer. He knows how the system works very well, and even his child has quite a clear idea. As a consequence, the system functions well, except the tricky desludging. The counter example was found in Maimun: on the four persons present on the plant, none of them new how the system was functioning, to an extent that they even could not indicate to us which pipe was the inlet and which pipe was the outlet. It was a total black box for them. No wonder that the entire system was a total collapse, with an anaerobic effluent of an aerated filter!

Capacity building should particularly be considered at the governorate level (not only for small-scale systems). We noticed that there are **hardly skills available for**

monitoring treatment plants. Massive data is collected but rarely analysed; flows within WWTP are usually not measured, so that nobody knows what arrives in the plant and what is the retention time in each of the treatment units; processes are often not well understood, which could explain the poor sludge management; laboratories are still not fully reliable. It is a major headache to try and obtain data from Affiliated Companies.

Infrastructure has to come along with awareness raising among the population concerned. People often don't understand the processes at stake. They see septic tanks or ponds as "magic boxes" able to treat anything. This could be one of the main causes of the dumping of manure in the sewers, which is recognized as a major problem in rural Egypt by most experts interviewed.

Awareness raising and information is also necessary to convince employees of the Affiliated Companies of the benefits of small-scale sanitation. Such an approach should be considered as a paradigm shift for them, hence big efforts will be needed for advocacy.

Finally, a major problem that faces institutions trying to build capacity: the **brain drain** to the Gulf and western countries of skilled Egyptian labour. As somebody stated: "Egypt lacks skilled sanitation engineers, but most sanitation projects in the Gulf are led by Egyptians."

3.6 Financial arrangements

Finance is always a major topic for implementation and replication of infrastructure. Because they serve small communities, small-scale systems should be low-cost, if they want to be replicated and if participation from the community is expected. In the case studies investigated, most of the systems have been financed either by the government or foreign donors with, for a few projects, the participation of the community up to 10% of the costs. Not only the technical solutions have to be context-specific but the funding and cost-sharing arrangements must be so as well (Lüthi, Morel et al. 2011).

When estimating the project costs, all aspects must be taken into account, such as hardware costs (including extension and upgrading), land, training, social marketing programmes, administration, knowledge development and information sharing and any O&M needs (Lüthi, Morel et al. 2011). A life-cycle cost approach should be adopted (see §3.1.5).

There are common problems limiting the financial sustainability and long-term operation of service provision (Lüthi, Morel et al. 2011), some of which are present in Egypt as well:

- Limited institutional capacity to mobilise funds (e.g. via taxes) and to collect fees (see also §3.2.2)
- Limited autonomy of public or private service providers to generate sufficient funds to ensure that existing systems are properly managed (see also §3.3.3)
- Nature of ownership (land and infrastructure)

- Users' willingness to pay is generally confined to the parts of the urban infrastructure that will directly benefit their neighbourhood; users tend to be less willing to cover full recurrent costs for off-site treatment and disposal; for example, in the Nile delta, people are often willing to invest in a sewer network, but not in a treatment unit (see also §3.7.2)).
- Some communities are waiting for the government to supply services and do not take any initiatives themselves (see also §3.7.2).
- Financial management of funds in the water and wastewater sector is often not fully transparent, which may lead to unrealistic prices for small-scale systems.

Some surveys have been conducted in order to find out people's willingness to pay; results show that users are generally ready to pay higher tariffs for wastewater services, either to be connected or, where connection to service is already established, for better and more reliable services (Chemonics Egypt 2009).

3.6.1 Capital costs

As shown in §3.1.3, 3.1.4 and 3.1.5, small-scale sanitation is not for free. However, for a system to be replicable, capital costs should be kept low. If the environment cannot be changed, there are ways to improve financial management, especially by dividing projects in components that allow better monitoring of expenses.

A big challenge in Egypt is to get the ***real* price** of the system, i.e. what it actually costs in terms of materials and human resources, *without* overheads. This is basically what communities or governmental agencies should pay if they want to implement a system.

GIZ experience in Kafr El Sheikh is emblematic as the price tripled between the first pilot of El Moufty, where costs were closely monitored, and the last cases, with a different financial management; increase of material costs cannot explain this explosion alone (see §3.4.6).

The case studies show that the **some of the cheapest (and most sustainable) are those designed, built and operated by the same person or organisation** (Abdel Kareem Issa, Kafr El Hamam, Sheikh Yacoub). In these three cases, the consultant/company/NGO worked closely in the field with several local contractors and suppliers, they divided their systems into different components and identified the best contractors and suppliers for each; they were not directly backed by big international donors (see also §3.4.2).

On the other hand, most small-scale infrastructures built by a consultant and given to a third party for O&M can be considered to be a failure or are close to being abandoned. One of them never even started operations.

So far, all the initiatives are isolated, with a maximum replication of eight WWTPs for GIZ in Kafr El Sheikh. None of the initiatives in Egypt has benefited from **economies of scale**, where a wide-scale replication by the same stakeholder could take place; wide-scale replication could play a big role in lowering the price, because it allows (i) to produce "en-masse", even at the factory level in case of prefabricated units; (ii) to capitalise on experience gathered and the built capacities and, (iii) to benefit from skilled labourers specialised in the installation and the operation of the system.

If community-based scenarios are considered, experience shows that the community should cover a part of the capital costs, in cash and/or in labour. Global experience proves that it is the only way to increase ownership. It is a standard practice in Egypt for beneficiaries to pay all the costs of on-site facility construction, whether a vault or a septic tank, and to pay for sewer connections to public systems, if available (HCWW 2008). There is willingness to bear or participate in costs of sewer system construction in areas with high subsurface water levels. In fact, most community-wide informal sewer networks have been financed by the local community without government or donor assistance.

However, initiatives in Egypt show that community-based initiatives face many problems (see section §3.4.3). Potential financial arrangements have to be planned along with the definition of the management scheme and institutional arrangements as well as the legal and regulatory framework (see §3.3.3). Indeed, the community may be willing to contribute to capital costs, but not towards regular O&M costs, as seen in Kom El Nagar, considering that they paid enough already.

3.6.2 O&M costs

It is clear that a major shortcoming in Egypt is full-cost recovery and, hence, the financing of O&M (see also §3.2.2). The case studies investigated show that without an extra financial input from the communities for the regular O&M of their infrastructure, proper maintenance will not be possible. The cases of El Moufty and Abdel Kareem Issa show a success with full-cost recovery for O&M (not including capital costs). In the GIZ model, each household pays from 7 to 10 EGP per month for the O&M of the system and a provision in case of breakdown. It is a little bit more that the governmental water and wastewater fee, but still not much. Especially, it is much less than in unsewered villages, where households have to pay costly emptying services several times a month.

This should be a major driver for small-scale rural sanitation in Egypt: in the middle and long-term, households pay less if they are properly served. Unfortunately, the legal and regulatory framework still does not encourage extra tax leverage for communities to ensure full-cost recovery of their system: either the infrastructure belongs to the government and people pay the standard fee (on an equity principle) or it is run independently, and any agreement can be designed between a CDA and the Ministry of Insurance and Social Affairs. However, in the latter case, the power of CDA to collect fees effectively is very weak (see §3.3.3). Besides, the mindset of governmental agencies still focus on the fact that the State shall provide the service to all Egyptians and it is not the role of the communities to manage rural sanitation (see §3.2.1).

When setting up projects, donors and/or governmental agencies should make sure to plan for O&M. They should make sure that stakeholders in charge have the capacity to pay. For community-based systems, ESDF tried to implement revolving funds (e.g. in Fayoum and Gharbeya). It can be a good alternative if the CDA in charge is honest and trusted by the community.

3.7 Socio-cultural factors

Socio-cultural factors are mindsets, engrained habits and behaviours. Small-scale sanitation, per definition, is closer to people, closer to settlements (even sometimes inside) and closer to communities. As such, it is much more sensitive to socio-cultural factors than big centralised treatment plants, which are somehow "far from the eyes, far from the heart". The success of small-scale sanitation is very dependent on the support and behaviour of the inhabitants, especially regarding O&M and their practices with solid waste, manure, and small industries. But the success of its implementation is also much dependent on the mindset of the authorities and the employees of the governmental agencies.

3.7.1 Dealing with the environment

Seeing the amount of trash along the roads of the cities and villages and in the canals, it is obvious that cleanliness of the environment is of no great concern for the population. Observing women washing dishes and vegetables in the middle of floating trash, it is obvious that a big part of the population is not aware of the level of contamination of the environment and the associated health risks; people do not make the link between the diseases they have (especially worms and diarrhoea) and the quality of the environment. In such conditions, it is not surprising that most of the population does not really care for wastewater treatment and, if they want to get rid of it because of the mud it can generate or infiltration in house walls, they have no interest to treat it (see also §3.4.3).

Small-scale sanitation definitely needs a big effort in information and awareness raising. This situation also advocates for an integrate approach of *environmental sanitation*, linking solid waste to wastewater in the sensitisation programmes.

3.7.2 Commitment of CDA / villagers

Communities and CDAs vary from the one to the other (see also §3.4.3). In particular, notable differences between people in Upper and Lower Egypt have been mentioned. People in Upper Egypt are generally thought to be much more involved in community development, whereas people from the Delta are more individualistic and don't want to carry any responsibility. The Egyptian-Swiss Development Fund (ESDF) made this experience, as its WWTP in Upper Egypt could be run by the CDA itself, whereas CDAs in the Delta tended to hand over this responsibility to the government, leading to O&M problems (ESDF planned to build 7 WWTPs in the Delta; in the end, only 4 were built, of which 3 have been handed to NOPWASD and are not working properly to this day) (ESDF 2009).

The strong community structure, where many people are bound by family ties, can lead to conflict of interests or conflict of conscience. The case of El Moufty showed that the CDA could not take action against misusers, as they were relatives (see §3.4.3). As Jacoby (2012) mentions, "*solidarity and collective action are important success factors of the CBA and they are supposed to correlate with a certain pressure on the CDAs and mutual social control regarding the adequate use of the system. However, it has also* *been the case that the same principles acted a protection shield for mis-users (e.g. in Moufty where the milk-lab discharged its wastewater into the system with full knowledge of family-related CDA members)*". On a different register, the Kom El Dabae case showed that CDA members felt obliged to provide work for unemployed community members, leading to overstaffing and financial unsustainability.

What is more, people from the Delta have been spoilt by international aid, which is not the case in Upper Egypt, typically neglected by international agencies. Consequently, they tend to wait for international or governmental action instead of taking initiative or responsibilities themselves.

3.7.3 Lack of O&M culture

As mentioned earlier, many on-site and large scale sanitation systems are currently not working properly because of lack of O&M.

The Austrian geographer Hans Bobek introduced a concept to explain the first reason: "Rent Capitalism" (*Rentenkapitalismus*). Most Egyptians don't own what they use (e.g. land or residential property). Their assets are owned by an oligarchy living in big cities like Cairo, totally disconnected from the field. This oligarchy is only interested in collecting money from their assets, refusing to reinvest any money or time to improve them. On the other hand, the renters don't want to invest either, as they are not the owners. In the end, the assets depreciate slowly but steadily. Hans Bobek states that this attitude is deeply carved in the local culture and still has much impact today (and as a matter of fact, a lot of people in Egypt are still only "renters").

3.7.4 Lack of lessons learnt

Dissemination of lessons learnt is a major shortcoming in the Egyptian context. As a consequence, it is difficult to build on existing experience, improve and innovate.

We can articulate the following reasons:

1. Per se, very few lessons learnt have been drawn or recorded.
2. There is a lack of institutional memory and archiving (see §3.4.8). Reports are difficult to obtain.

The main reason for the lack of lessons learnt may be that **"failure" and "mistake" tend to be taboo words** in the Egyptian mind frame. On the one hand, Egyptian society is a "habibee society", where nobody criticises each other openly. This is seen as a major bottleneck, as constructive criticism helps to improve oneself. On the other hand, the competitive environment is rather destructive than constructive. In such conditions, it is very difficult to analyse failures and mistakes openly and draw lessons learnt. It results in a **lack of learning culture in institutions**. As a consequence, the shortcomings of some pilots/trials have not been analysed, preventing others to benefit from this valuable experience.

It is the same with most of the data produced, which seemed to be coined under "**secret defence**". We can imagine two explanations: either this data actually does not exist, or a thorough analysis would reveal major gaps.

This lack of a culture of learning and drawing up lessons learnt is also bound to general behaviours of consultants, contractors and donors. On the one hand, consultants and contractors tend to be **very conservative** in order to minimise risk and recycle designs to minimise their efforts; on the other hand, donors usually do not follow-up once the infrastructure is built and do not disseminate the lessons learnt, which in turn does not encourage consultants and contractors to improve. Donors are sometimes also afraid for their own image and, in order to hide project failures, may avoid publishing anything negative.

3.8 Synthesis table of challenges and opportunities

	CHALLENGES	*OPPORTUNITIES*
TECHNICAL FACTORS	**Design parameters:** - lack of baseline data (characterisation and quantification of rural wastewater, water consumption, description of villages and existing practices) for dimensioning systems adapted to rural villages; design parameters not adapted to the specificities of the Egyptian rural context - underdimensioning leading to poor performance or overdimensioning leading to high costs and sometimes also reduced performance - lack of baseline for forward planning, i.e. how settlements, water consumption and small-scale industries develop - high population growth, leading to quick overload if underestimated - high water consumption, increasing as the water supply improves; future water supply improvements must be taken into account - lack of flow measurement (even in big treatment plants); inflows highly variable, not buffered as in urban contexts - higher concentrations in rural contexts - manure dumped in the sewer system, often not taken into account in the design - dairy factories and other small- and medium-scale “industrial” activities may imply extra peak loads; future economic development must be anticipated. - high concentration of inert material, like sand, mainly due to non-asphalted roads - no storm water drainage system: stormwater is derived into the sewer network, carrying sand and mud. A stormwater overflow is needed in front of the treatment units - high groundwater table and/or clayey soils leading to higher construction prices **General design features:** - lack of hydraulic design - lack of proper sludge management (desludging, treatment and disposal)	- *Sequence the system into different components, whose design and implementation can be delegated to experts that really master their respective component (especially the anaerobic unit)* - *Prefabricated units are a promising alternative, saving time and money and increasing quality control.* - *The Egyptian industry has the capacity to produce prefabricated units* - *Close monitoring of the upcoming small-scale initiatives to create a strong baseline on rural wastewater quantities and characteristics*

	CHALLENGES	OPPORTUNITIES
TECHNICAL FACTORS (follow)	**Environmental factors influencing the cost of infrastructure:** - high groundwater table - type of soil (sometimes clayey in the delta) **Availability of land:** - land is both expensive and precious - difficulty to extend WWTPs with large footprint; limited flexibility **Cost comparison:** - focus on construction cost only, and not on entire *life-cycle* costs. - cost of land often not taken into account when comparing technologies **Quality of the work:** - some consultants and contractors seem to confound "low-cost" with "low-quality" - some contractors are not reliable and don't deliver work with the quality required - lack of quality control by concerned stakeholders **Hindrances for innovation:** - lack of learning culture and constructive criticism; focus on "business as usual" - contractors shy away from innovative systems; they tend to be very conservative; this may be encouraged by the legal and regulatory framework and agencies like NOPWASD. - culture based on seniority; young people have difficulties to impose their ideas - consultants who tend to make patents and sell their system as a whole (or as a turn-key system) - systems judged without thorough analyses (e.g. UASB and small-bore sewers)	
GOVERNMENT SUPPORT	**Rural sanitation strategy:** - wide-spread view that everything shall be connected to big centralised WWTPs - wide-spread view that the government shall provide everything and that it is not the role of the communities to take over rural sanitation - lack of strong rural sanitation strategy	- *Rural Sanitation has high political priority* - *Revision of the National Rural Sanitation Strategy* - *On-going work on Rural Master Planning by HCWW and GIZ*

	CHALLENGES	*OPPORTUNITIES*
GOVERNMENT SUPPORT (follow)	- economic and political crisis, accentuated by the Revolution - lack of finance and skilled labour **Policy for full-cost recovery:** - lack of GoE political will to raise water and wastewater fees to achieve full-cost recovery - lack of political will to use the police to enforce environmental laws and collect water bills - little means for leak detections and water flow measurements, leading to lump sum payments that are below the actual consumption and high non-revenue water **Policy for decentralisation:** - reluctance for decentralisation and delegation of power	
LEGAL AND REGULATORY FRAMEWORK	**Standards and Codes of Practice:** - standards are not adapted to the rural context and are difficult to meet with cost-effective systems - Codes of Practice are not updated and may lead to design mistakes. - some low-cost options are not in the Codes of Practice (e.g. small-bore sewer systems) - the regulatory framework encourages consultants and contractors to apply strictly the Codes of Practice in order to cover themselves. **Tariff regulation:** - very low water tariff, which does not allow full-cost recovery - difficulty to raise taxes in the current context - dilemma for communities between "bear the existing conditions for some years or decades and pay less" or "pay more and improve their standards of living in a short time". **Legal basis to decentralise responsibilities to communities:** - legal framework does not encourage delegation of responsibilities to the communities and decentralisation in general (overly centralised state) - associations (e.g. CDA) cannot penalise bad payers or violating acts, as they do not have any judicial authority **Contract management:** - low-cost often associated with low-quality - need to sell small-scale projects in packages, to make them financially more attractive	- *New Water and Wastewater Sector policies developed by EWRA and GIZ, focusing on water tariffs* - *Revision of Code of Practice for sewer networks* - *Revision of the Code for Reuse*

	CHALLENGES	OPPORTUNITIES
LEGAL AND REGULATORY FRAMEWORK (follow)	- need for adapted contracts which increase the responsibility and accountability of consultants and contractors **Enforcement of laws and regulations:** - difficulty, in the current context, to enforce environmental laws and collect taxes - managers of government-owned WWTPs are protected, but not private ones.	
INSTITUTIONAL ARRANGEMENTS	**Institutional setup of the sector:** - number of different Ministries involved in the WW sector makes initiatives complicated; lack of clarity in the definition of the roles & responsibilities of the principal sector organisations - lack of coordination among Ministries, especially between HCWW and NOPWASD (and MWRI) - general lack of communication and exchange of information between and within institutions - lack of transparency and dynamism of NOPWASD - lack of institutional framework specific to small scale sanitation - politics of "everything or nothing" that hinders the development of intermediate solutions **Linkages between private service providers/NGOs and line agencies:** - HCWW is not responsible for collection and treatment from on-site sanitation systems; unsewered systems are not considered as proper sanitation systems - Missing link between on-site sanitation service providers and line agencies, as well as between NGOs and line agencies **Management capacity of communities:** - communities lack capacities to operate a full sanitation system themselves; supervision and support is necessary - wide variability of CDAs, making a careful selection crucial - potential conflict of interest between CDA and misusers from the community - lack of power of CDAs **Management interface between communities and institutions:** - no management interface between communities and Affiliated Companies - no or very little interaction between Affiliated Companies and the leaders of small-scale sanitation initiatives.	- *New Ministry of Water and Wastewater Utilities encompassing under an independent umbrella HCWW, NOPWASD and EWRA.* - *Dual management model investigated by RODECO-GIZ and HCWW's legal advisers* - *HCWW will progressively uptake former NOPWASD responsibilities (timeframe not yet determined)* - *Attempts of HCWW to synergise with communities*

	CHALLENGES	OPPORTUNITIES
INSTITUTIONAL ARRANGEMENTS (follow)	**Linkages between research sector and line agencies:** - gap between governmental agencies and the research sector (e.g. academics and policy-makers) - need for the line agencies to encourage research and pilot full-scale implementation, and bridging the gap between academics and engineering consultants; academics often lack the technical skills to implement a system at full-scale and the financial power to do so - research institutes themselves tend to work in isolation - most professors are mainly consultants **Managing consultants and contractors:** - lack of control and regulation of the sector - loose definition of roles and responsibilities, implying a lack of accountability and that, in the end, everybody can blame somebody else - tendency to choose different consultants for the feasibility studies and for implementation, which reduces accountability and strengthen the "blamogramme" - project cycle (design, construction, O&M) divided between different institutions. - so-called "Habibee society" and "Habibee economy", where everything works through "friends" network and where people protect each other; possibility of conflict of interests. - small sector, where everybody knows everybody and where key-players play a dominant role. - lack of transparency in the sector: no dissemination of information; difficulty in seeing mistakes as valuable experience; special "arrangements" within institutions and consulting companies - collusion between consultants leading to drastic price hikes - nobody to push consultants to improve from one project to the other **Role of donors:** - many projects focus on infrastructure and lack an integrate approach of sanitation - ToRs written by donors often fail to include important aspects such as capacity-building, O&M and system monitoring or those components end up neglected when implementing the project. Donors are often satisfied with the appearance of the WWTP on the inauguration day	

	CHALLENGES	*OPPORTUNITIES*
INSTITUTIONAL ARRANGEMENTS (follow)	- initiators (donors, governmental institutions) and consultants tend to privilege their image and hide problems; reasons for failures are often not (seriously) investigated and rarely published - bidding and tendering procedures that are too complicated for small-scale sanitation and increase the costs, hindering replication potential. - if the whole project is delegated to one single contractor, he will tend to give a package price, which is usually much higher than the sum of the components; this threatens cost-effectiveness and makes control of expenses and quality more difficult - lack of cooperation between development agencies (though a donor platform exists) **Institutional memory:** - lack of institutional memory; lack of detailed reports on lessons learnt - no centralised library at HCWW - lack of follow-up of projects	
SKILLS AND CAPACITIES	- availability of skilled human resources is limited - lack of capacity-building; capacity-building is needed, even with simple systems - lack of skills specific to small-scale sanitation systems among the consultants and contractors- wastewater sector largely dominated by technical engineers, lacking the integrate approach of sanitation systems (i.e. including financial & management schemes and socio-cultural acceptance) - limited capacities available within the Affiliated Companies, especially for monitoring of plants (data are collected, but rarely analysed; treatment processes are often not understood); awareness raising about the benefits of small-scale sanitation are needed. - awareness of the population - brain drain	- *Training centres implemented by Dutch cooperation and USAID (e.g. in Beheira)* - *Training budgets in large donor-funded projects*
FINANCIAL ARRANGEMENTS	**Capital costs:** - difficult to get the *real price* of the system, without overheads; the system should be divided in smaller components in order to facilitate the monitoring of expenses - contractors that raise prices to unrealistic heights (link to risk covering and sometimes collusion/corruption) - economy of scale is lacking so far	- *Possibility to finance water meters for the project area* - *Connected households pay less than unconnected ones; this is a strong incentive for improvement*

	CHALLENGES	*OPPORTUNITIES*
FINANCIAL ARRANGEMENTS (follow)	**O&M costs:** - no full cost-recovery because of very low water tariff, difficulty to collect water bills, high non-revenue water - equity principle that prevents HCWW to collect extra money in communities to cover O&M of decentralised WWTPs - without an extra financial input from the communities for the regular O&M of their infrastructure, proper maintenance is not possible	- *Slow rise of the water tariffs*
SOCIO-CULTURAL ACCEPTANCE	**Dealing with the environment:** - lack of education in rural areas, lack of awareness about hygiene and environment quality **Commitment of CDA / villagers:** - villagers are very interested in wastewater collection, but not so much in treatment; their priority is the construction of a good sewer network - lack of awareness on the actual price of water and wastewater service and lack of willingness to pay (even if the capacity to pay is there, as shown by the money spent for mobile phones) - communities from the Delta have been "spoilt" by international aid - people from the Delta are very individualistic - lack of initiatives in community development **Lack of O&M culture:** - lack of O&M culture ("rent capitalism") **Lack of lessons learnt:** - dissemination of lessons learnt is a major gap - "failure" and "mistake" tend to be taboo words - culture of secret regarding information; "information is power" - lack of follow-up from donors and implementing agencies; donors or implementers are sometimes afraid for their own image and, in order to hide project failures, may avoid publishing anything negative.	- *GIZ and ESDF community mobilisation experience*

Table 1: Challenges and opportunities of rural sanitation in Egypt

4 Further practical recommendations

In Chapter 3, the different challenges facing small-scale sanitation have been discussed, and general recommendations to the sanitation sectors have been proposed. The following chapter goes into the details of the practical implications of these challenges on the design, implementation and operation of small-scale sanitation systems. It is directly related to the tasks of consultants working on such projects, providing practical recommendations on how to proceed.

4.1 Enabling the development of sustainable small-scale systems

The key recommendations, developed further, to enable the development of sustainable small-scale systems and wide-scale replication can be summarised as follows:

1. Devise & adopt a **mass-production strategy** for small-scale sanitation; explore the concept of locally produced **prefabricated units**
2. Privilege **modular systems**
3. Create and expand a **strong data baseline** for rural settlements
4. Standardise the realisation of **thorough case-by-case preliminary assessments** and primary data collection
5. **Adapt the terms of references, procedures and contract management** to the specific case of small-scale sanitation
6. **Centralise O&M skills**, either in special units in HCWW and Affiliates, or through a subcontracted private company.
7. **Disseminate lessons learnt** and create on online-library**.**

4.1.1 Wide-scale replication approach vs. individual trials

Mainstreaming small-scale wastewater-treatment solutions is one of the key elements for sustainable infrastructure development (Gutterer, Sasse et al. 2009). This report shows that all small-scale sanitation initiative so far remained isolated and have failed to be replicated. There was little buy-in from HCWW and its Affiliates, and no institutionalisation of the approach. Until now, the sector is stuck in a **vicious circle**: isolated initiatives serve as prototypes and, as such, cost of lot of money; they are then considered as too expensive, and are not replicated.

In order to develop a model for wide-scale replication, **HCWW must adopt a clear strategy** going in this direction. It is a **virtuous circle**: if there is a clear strategy for wide-scale replication, then it is possible to propose and enable mass-production approaches, which will open the local market for prefabricated units. In this case, the Company would achieve economies of scale, with a model that is significantly cheaper and of better quality than those built on a one-by-one basis. This approach would be manageable by specialised staff in each Affiliate or by a private company subcontracted by HCWW.

Once a clear strategy is developed, **Codes of Practice** and relevant documents should be adapted accordingly (cf. §3.3.1).

4.1.2 Creating a strong baseline

A data baseline for rural areas should be created, comprising wastewater quantities and characteristics according to settlement features (cf. §3.1.1). Research institutions, such as NRC, should be involved. The cost of such studies is negligible compared to the total investment in wastewater infrastructure and will be largely compensated by the economies they generate. The close monitoring of the next small-scale sanitation initiatives would also deliver a good insight into flow and load patterns.

Practically, this means that the Affiliated Companies should carry out the following actions, under the central monitoring of HCWW:

1. **Water flow measurements**: measure water delivered to each settlement (water meter at the “entrance” of each settlement); this measure will also help in tracking non-revenue water.
2. **Wastewater flow measurements**: measure flows at the inlet and outlet of plants; this will help assess the performance and the retention time of wastewater and, hence, help to optimise the performance of WWTPs.
3. **Collect and analyse** the measurements at the inlet of the treatment plants in rural areas (inflow, standard parameters); these data can deliver important information on the variability of wastewater production and characteristics.
4. Keep a good **record of water bills**
5. Organise all the data **in a computerised form** (e.g. Excel), in a way that facilitates analysis

There will always be site-specific data that have to be collected on a case-by-case basis (see §4.3), but the introduction of a data baseline would provide valuable support for future work of consultants and sector experts. The main idea is that if the baseline provides good first estimations for each type of settlement, the consultants would then only have to assess a few parameters in the targeted villages to have an idea of the quantities and characteristics of the wastewater they have to treat, and regarding the perspectives of future development (§4.2.2 below).

It is clear that in order to create such a baseline, preliminary **capacity-building** of research departments of Affiliated Companies and Rural Sanitation Units (RSU) is necessary.

4.1.3 Improving the terms of reference and procedures

Project failures often take root at the initial design stage of a project and in the standard project documents (e.g. Project Appraisal Document – PAD; Terms of Reference – ToRs; Procurement Rules). These documents must be adapted to small-scale sanitation in order to ensure the implementation of sustainable and cost-effective systems, as pointed §3.3.4 and 3.4.7. In what follows, a few complementary key points are highlighted:

1. In the Terms of Reference, impose an **integrated approach**; the management scheme, institutional setup, O&M plan and financial arrangements allowing full-cost recovery should be secured before proceeding for construction; a check-list may be integrated in the ToRs
2. Strengthen overall **monitoring** (of planning, implementation and performance); capacity-building for monitoring should be an integral part of each project, especially which data to collect, how to collect them and, above all, how to **analyse** them. Monitoring is a must. No monitoring means a high risk of inefficient management and corruption.
3. Set **performance indicators based on an integrated approach**; projects should publish evaluations according to these performance indicators
4. Privilege **design-build-operate-transfer** procedures. This way, the designer can deal with local contractors, share his know-how and make sure that the infrastructure are up to the latest standards; he is then also responsible for the functioning of the infrastructure and cannot blame anybody else in case of collapse (thus avoiding the traditional "blamogramme" game – see §3.4.6).
5. When tendering, **break the system into smaller components**, to facilitate the monitoring of expenses and avoid unrealistic prices and cost overruns. This will also allow to employ specialised contractors for each component.
6. **Work closely on the field with local contractors** rather than one big national- or governorate-level contractor. This way, one single contractor is not given too much power, which would lead to a dependency relationship (see §3.4.6). Contract management should be adapted accordingly (cf. §3.3.4).
7. Egyptian partners should ensure they are in the driving seat when tendering contracts. Donors' backup should not be visible until the end of the construction, as their name can have an inflationary effect on the price.
8. Try to involve academics in the project development and monitoring and encourage up-scaling of successful pilot projects. This will help fill the existing gap between research institutes and implementation stakeholders.
9. Procedures should enable and foster the development of **new approaches**, such as the standardisation of treatment units and opening a market for prefabricated treatment units (see §4.2.4 below)
10. Impose the dissemination of **lessons learnt** in the terms of reference.

4.1.4 Need of coordination with MWRI

MWRI is an unavoidable stakeholder in the field of rural sanitation (cf. §3.4.1). They are also carrying out research projects on small-scale sanitation (e.g (El Gammal 2011), current project with JICA, research on drain quality enhancement). Future collaboration would be beneficial for a number of reasons:

- Check possibility to use the small drains for discharge and the status of the small *mesqas*.
- Opportunity of polishing in the small drains, investigated in the past by MWRI
- MWRI owns a lot of land along the drains, sometimes made available for wastewater treatment (e.g. pilot plants in Sheikh Yacoub, Beni Suef Gov.)

4.1.5 Dissemination of lessons learnt

Available data and knowledge should be widely disseminated (cf. also §3.4.8). It is strongly recommended that an **online library** with all reports of the sector be created, **hosted on the HCWW website**. It would be a small investment with big potential savings (e.g. by avoiding to pay consultants three times for similar reports).

4.2 Planning a cost-effective system

Cost-effectiveness should be a top priority in all the steps of the project cycle. It has different aspects, from a cost-efficient design, to a cost-efficient implementation and, later, operation.

4.2.1 Assessment of the existing situation and anticipation of future developments

Thorough **preliminary assessments** (see §4.3), which lead to realistic design parameters (cf. §3.1.1) are a key cost-effectiveness factor, as they allow **dimensioning as close as possible to the needs**. In the past, faulty dimensioning of infrastructure due to the lack of consideration of the actual situation has cost a significant amount of money to the country, in capital and operational costs, and threatened the replication of small-scale systems. Besides, infrastructure that is over-dimensioned risks reaching the full life expectancy (especially specific components like pumps) far before they reach their design capacity; over-dimensioning may also lead to reduced performance.

In parallel, a good **forward planning** is necessary, in order to anticipate future developments and design the system accordingly. It is illusory to plan for the horizon 2050 for such small settlements. Development of ezbas is highly heterogeneous and depends on a number of factors that are difficult to predict. Some will remain small and some others will expand quickly. Modular, flexible systems need to be privileged in order to cope with the high uncertainty of future developments (cf. next §). Realistically, in this context, infrastructure should not be built for an horizon further than **15 years**. However, space for future extension should be planned from the beginning ; infrastructure can then be extended when and if needed.

A few development patterns can be observed:

- Developments along canals, drains and main roads (e.g. Iz. Bullis, Gharbeya - *30°58'14.32"N ; 30°54'52.07"E*)
- Settlements in the middle of agricultural land tend to densify within their boundaries and privilege vertical development (e.g. Iz. Sameeha - *31° 4'8.17"N; 30°23'39.73"E*)

Forecasts should be based on a study on how the settlement under investigation may develop and under which driving forces:

- Potential improvements in water supply, strategy of HCWW for water supply enhancement;
- Probable housing development (vertical or horizontal expansion);
- Potential development of small-scale industries; strategy for management of these industries (source treatment or treatment at WWTP) need to be included in the design.

4.2.2 Modularity and standardisation

Cost-effectiveness can be improved with the adoption of **modular and standardised systems** (such as proposed by BORDA, see Figure 4 and Figure 5). The number of units can then be chosen as close as possible to the population to be served. The modules have a small spatial footprint and can be integrated in unused spaces (alleys, roads, parking areas, private yards, etc.), **saving valuable agricultural land**. Besides, it is easy to connect or add new modules for new developed areas.

Standardisation of the modules is a key ingredient for a wide-scale replication, as it leads to economy of scale, and reduces time for construction and staff requirements. It is a good way to increase infrastructure quality, reduce costs, save time and avoid problems with contractors. Such an approach is currently implemented by BORDA in Indonesia and the *Consortium for DEWATS Dissemination* (CDD) in India. If a significant number of units is needed, the possibility to open a market for prefabricated units in Egypt will become feasible (see §4.2.4).

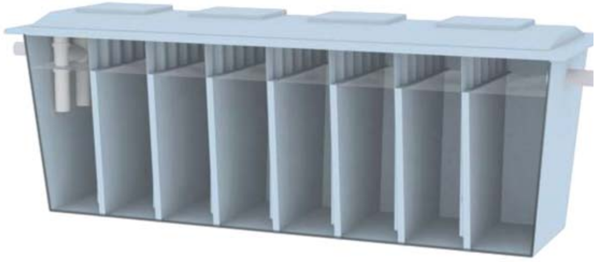

Figure 4: ***A prefabricated anaerobic baffled reactor, aimed to treat about 10 m^3/day (drawing: courtesy of BORDA[3])***

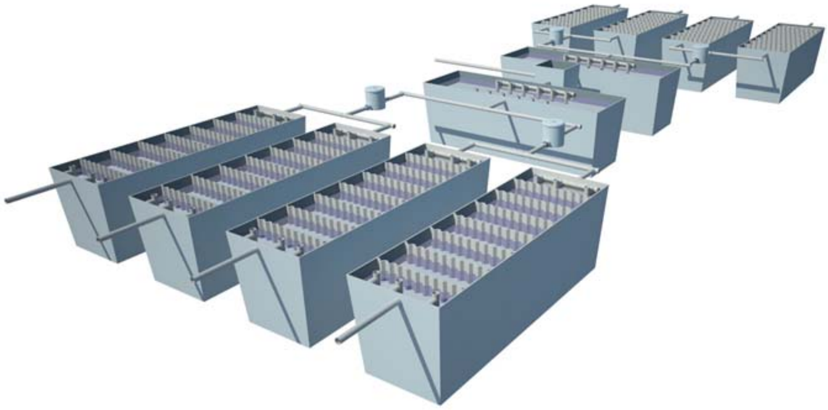

Figure 5: ***Example of modular prefabricated treatment units, consisting of 2 prefabricated settlers and 8 prefabricated anaerobic baffled reactors (ABR), treating about 80 m^3/day (drawing: courtesy of BORDA[3])***

4.2.3 Tailor-made design

Cost reduction can be achieved by adapting the system closely to the settlement characteristics, in order to **avoid drain or canal crossing** and to **reduce the length and depth of sewers**. **Use of small drains for polishing**, instead of pumping wastewater kilometres away, should also be considered. In-stream post-treatment techniques should be investigated (such as filtering with rice straw, as studied in the National Research Centre).

Shallow-sewer systems should be used wherever possible, as they reduce implementation and operation costs (for further advantages, see §4.4.2). To this aim, the scenario of dividing villages into relevant smaller areas should be considered. Figure 6 and Figure 7 compare a centralised sewer system with several sub-systems connected to treatment units placed in different locations (to be noted that the figures show tentative locations of treatment units, but do not reflect their actual footprint).

[3] Drawings from *BORDA (2012), Prefab-DEWATS - The new prefabricated modular solution for decentralised wastewater treatment*, Brochure.

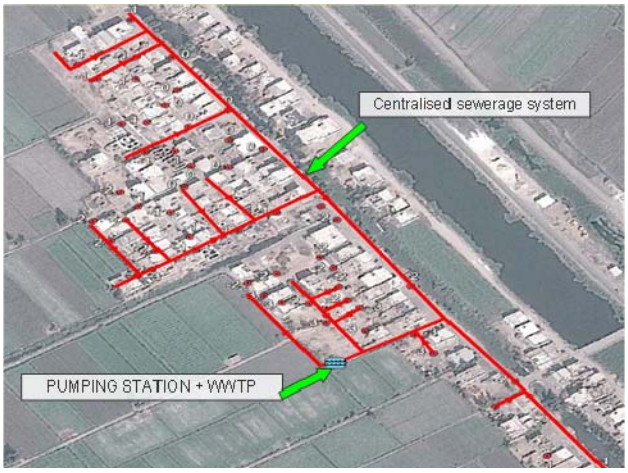

Figure 6: ***Centralised scenario with conventional sewer system (drawings: ISSIP PM/TA)***

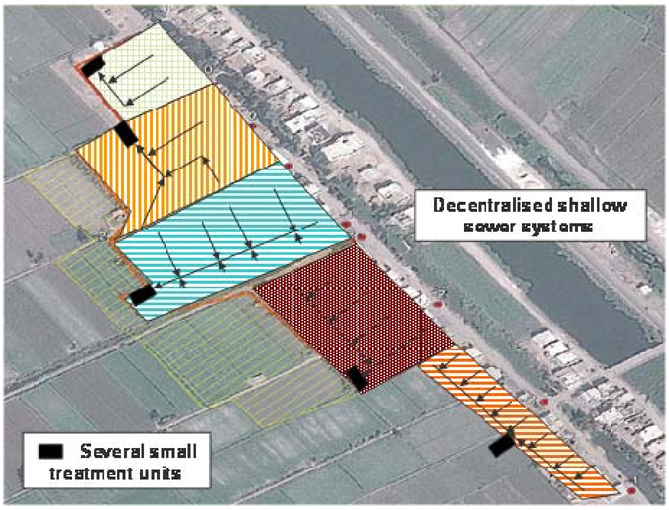

Figure 7*:* ***Decentralised scenario, featuring several shallow sewer systems and modular treatment units. Case study of Iz. Islah, Beheira (drawings: Jörg Haucke)***

4.2.4 Making a business case for prefabricated treatment units

This report strongly advocates the adoption of a business approach and the **opening of a market for prefabricated treatment units**. As it is a commercial product, they have a fixed price and avoid a lot of hassle with building contractors. There are already successful examples around the world, such as the prefabricated DEWATS units from the German NGO BORDA[4] in Indonesia (BORDA 2012). Prefabricated units can be made out of different materials: (i) in plastic or fibre glass, such as implemented in Indonesia by BORDA (see Picture 1)or proposed by the Dutch company Bucon[5] ; (ii) in precast

[4] www.borda-net.org
[5] www.bucon-industries.nl/index.aspx?contentid=667

concrete, such as those tried out by the German company Hering International in South Africa[6]; (iii) using metal sheets, such as implemented by Al Raed[7] in Egypt and neighbouring countries (cf. case study of Kafr El Hamam, Sharkiya). According to BORDA trials, fibre glass seems to be the best material for such units.

Picture 1: Prefabricated ABR (©BORDA)

Such prefabricated units could **easily be manufactured in Egypt**. The idea is to have a modular system with several units of different sizes (e.g. for 250 population-equivalent (PE), 500 PE and 1000 PE) that can be combined; this would allow a maximum of flexibility and the adaptation of the system to each village on a case-by-case basis. Technical modules can be for example: (i) modular primary settlers and anaerobic baffled reactors (BORDA 2012); (ii) physico-chemical settling and oxidation modules (cf. Al Raed's Kimatech 2000).

Another advantage of this model is that the company marketing these prefabricated units can also **endorse O&M**, on a **public-private partnership basis (PPP)** as done by Hering in South Africa, or on a private basis as done by Al Raed in Kafr El Hamam. A **Build-Operate-Transfer (BOT)** setup is also possible.

If produced in **large quantities (economy of scale)**, the price of prefabricated units could become very attractive. Besides, it would encourage an efficient O&M service conducted on a PPP base or by the Affiliated Companies. There is a potentially huge market in Egypt and small-scale sanitation could create **a lot of job opportunities** in production and implementation.

Local contractors would be in charge of preparing the space for the units and building the sewer network. Time and money allocated for the price negotiations and construction monitoring of the treatment units could be saved. Those mobilisation costs currently carry a big weight in the capital costs of infrastructure.

Finally, the development of a strong private sector niche for small-scale rural sanitation would alleviate the governmental agencies, who have currently to set their priorities on large-scale infrastructure (see §3.2.1). It implies however also that HCWW and Affiliates endorse a strong regulatory and monitoring role of this strategy. A private sector-driven approach requires strong public agencies to succeed.

[6] www.heringinternational.co.za
[7] www.alraed.com.eg

4.3 Case-by-case preliminary assessment of ezbas

Rural sanitation projects need a site-specific approach. It cannot be assumed that each village/ezba has the same characteristics and will experience the same developments. Consultants should assess each village/ezba separately before making any design. Such an assessment is the result of a careful collection of primary and secondary data, which should be cross-checked and critically analysed.

4.3.1 Assessment of available data

There is little available information on small settlements and ezbas. Main sources of information are old maps and recent Google Earth satellite images. Some data is available from various governmental bodies, but **their reliability is questionable**.

In such a dynamic environment, it is very important to be **very cautious and systematic with data**. The date of maps and satellite images should always be clearly indicated. It should be also clear when, how and where the data has been collected (especially population figures). Providing data without any sourcing may be very misleading. **Any estimation should always be explicitly justified**.

4.3.2 Characterisation and categorisation of ezbas

Ezbas in the Nile Delta are quite heterogeneous. It is important to identify their main features, as it impacts on the planning and design parameters. Here are a few relevant differences from one village to the other:

- close to a main canal or drain vs. surrounded by agricultural land
- «nucleus» vs. «linear» shape
- divided by various numbers of smaller drains and canals
- high density vs. low-density housing (e.g. influenced by distance between houses, presence of yards, number of floors)
- different small-scale industrial activities: cattle farms, chicken farms, plastic granule factory, cheese factory
- informal sewer network (or “groundwater lowering” network) vs. bayaras or both

Pictures 2&3: *example of a dense settlement with buildings of two storeys or more (Iz. Sameeha, Beheira) and an example of a low-density settlement, with sufficient space and one-storey buildings mainly (Iz. Islah, Beheira)*

4.3.3 Specific challenges of Nile Delta villages

The various challenges regarding wastewater collection, transport and disposal have to be taken in to account, namely:

- High groundwater table, affecting houses through rise of water into the walls by capillarity; complication with underground works
- Concern of people that any deep trench in the street may lead to building damage
- Loss of agricultural land due to overflow of wastewater from bayaras or infiltration of wastewater into the soil, leading to salinization and sterilisation of surrounding land
- In some villages, presence of “informal sewer networks” or “groundwater lowering sewers” which often do not work properly but make the installation of a proper sewer system more complicated.
- Poor quality of existing infrastructure (broken piping systems, open or broken manholes used for dumping, cracks in concrete structures)
- High loads from animals in households, cattle farms and small dairy factories.
- Lack of solid waste management
- Sewer networks need to deal with rain episodes

4.3.4 Minimal set of data to be collected

The heterogeneity of settlements and the lack of reliable data show the necessity to assess each village on a case-by-case basis involving field visits. A minimum set of data has to be collected if an appropriate, tailor-made design is to be implemented and the specific inflow, loads, wastewater quantity and characteristics are to be correctly assessed. The list below features information to be collected and observations to be made during a preliminary assessment.

Most information can be collected with the interview guides provided on ESRISS webpage (www.sandec.ch/esriss) and transect walks through the villages with villagers and representatives of the village authorities.

A. Population number

1. Necessity to estimate the population of each village through a survey; numbers provided by the Local Units, mainly from 2006, are not reliable and not updated at all. Population numbers need to be cross-checked with estimation from different angles.
2. Counting houses on satellite images is not enough; the average number of people per house varies a lot, as housing types vary from one village to the other type (density, number of floors).
3. Need to be very careful with the dates of statistics, maps and satellite images.

B. Current sanitation status

1. Informal sewers (if sewers, degree of functioning)
2. On-site sanitation systems
3. Small-scale sanitation service providers
4. Money flows related to sanitation (e.g. amount of money paid per household per month to empty bayaras or maintain sewers)
5. Reuse practices
6. Storm water management
7. Presence of “community champions” (e.g. CDA, charismatic leaders)
8. Willingness to improve of the population
9. Marks of structural damage due to high groundwater table

C. Forward planning of future developments:

1. Observe current **development patterns** (settlements in the middle of agricultural land tend to densify within their boundaries and privilege vertical development; developments along canals, drains and main roads). Villages will not all grow with the same rate and in the same way.
2. **Planning horizon**: set shorter planning horizons to what is realistically foreseeable.
3. Take into account neighbouring villages; if they are very close, they should be served by the same scheme.

D. Parameters influencing wastewater characteristics

1. Water consumption, itself influenced by:
    - Quality of water supply system (e.g. sufficient pressure 24/24)

- Presence of functioning (informal) sewer network
- Type of on-site sanitation system : sealed / unsealed bayara; infiltration capacity of the ground

Search for two types of data, in order to cross-check the data reliability,

(i) water delivered; these data should be available at the Affiliated Companies (however, it is often not available for each individual settlement)

(ii) water bills; this data should be available at the Affiliated Companies; it is recommended to ask also about this information in a preliminary household survey.

2. Alternative water sources (e.g. wells, canals)
3. Average number of cows per inhabitant
4. Animal manure management practice
5. Presence of small-scale industry:
   - Information about existing small-scale industries (cattle farms, chicken farms, cheese factory); specific solutions for the treatment of those effluents need to be integrated in the planning
   - Presence of factory related to solid waste (e.g. plastic granules production) may offer an opportunity to improve solid waste management and reduce the risk of dumping in the wastewater system

E. Disposal sites:

1. Necessity to identify all drains and canals (incl. small ones), as pumping to main drains would be a very expensive option;
2. Investigate the opportunity to use the small drains present around villages to polish the effluent

F. Environmental factors

1. Groundwater table
2. Type of soil
3. Topography

4.4 Design recommendations

The following paragraphs complete §3.1 by providing our own suggestions on which systems should be chosen, based on experience and the observations made in Egypt.

4.4.1 Combination of technologies

Combinations of technologies to be applied greatly depend on site-specific factors (Tilley, Lüthi et al. 2008; Lüthi, Morel et al. 2011). There is **no one "magic-bullet"** solution for all settlements. Initial budget, available skills and budget for O&M, as well as land availability are major decision factors. It is worth comparing different options, with **life-cycle cost analysis**, without forgetting to include the price of land (cf. §3.1.5).

In what follows, we present a selection of potential technologies, to be combined according to the local project context (see Figure 8). The selection of these technologies is based on lessons learnt from Egypt and relevant international experience. Details on each technology can be found in Eawag/Sandec's *Compendium of Sanitation Systems and Technologies*[8] *(Tilley, Lüthi et al. 2008)*. Applicability to the Egyptian context of technologies followed by a question mark needs to be investigated in more details.

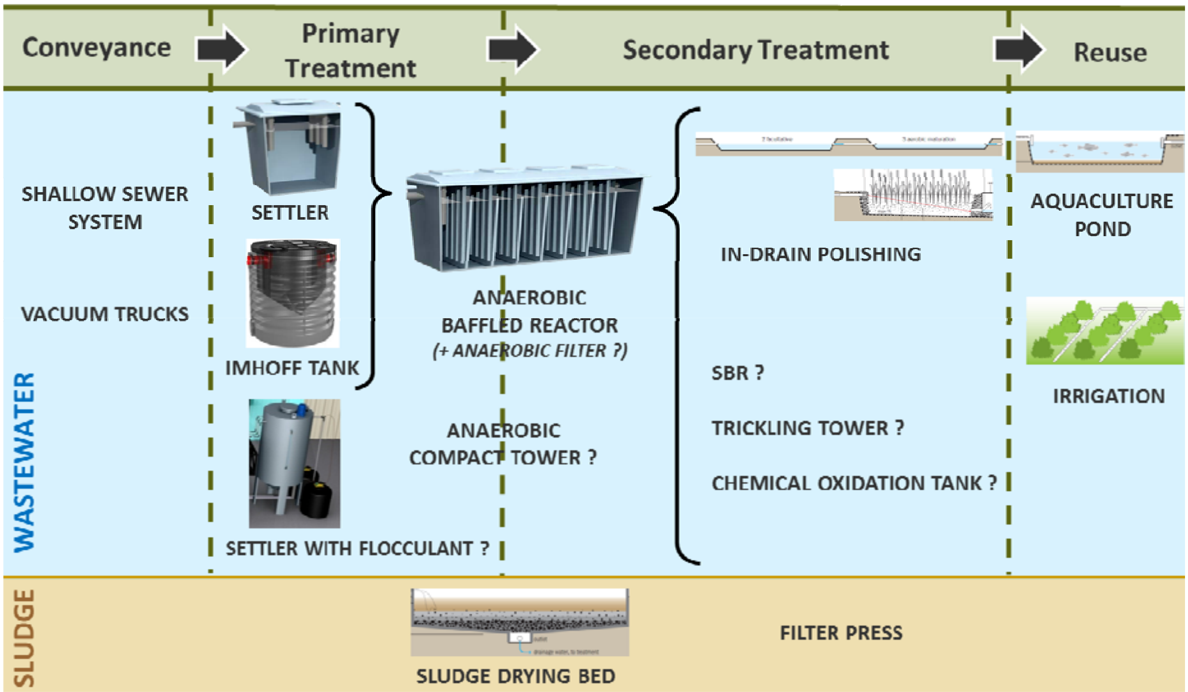

Figure 8: Potential options for the Nile Delta context

[8] To be downloaded under: www.sandec.ch/compendium

It has to be mentioned that the secondary treatment may be very expensive for comparatively little further load reduction. A pragmatic approach would be to serve all villages with well-designed anaerobic systems first, and add an aerobic step later on if needed. Nowadays, anaerobic systems may have alone the necessary performance to reach Law 48. An excellent example of an optimised anaerobic system has been developed by Eng. Nanchoz Zimmermann (Autark Engineering[9]). It features a **settler, ABRs and anaerobic filters** (see Figure 9). Design details have been optimised, as well as the start-up of the system. The management of the first six months are of utmost importance to reach the optimal performance.

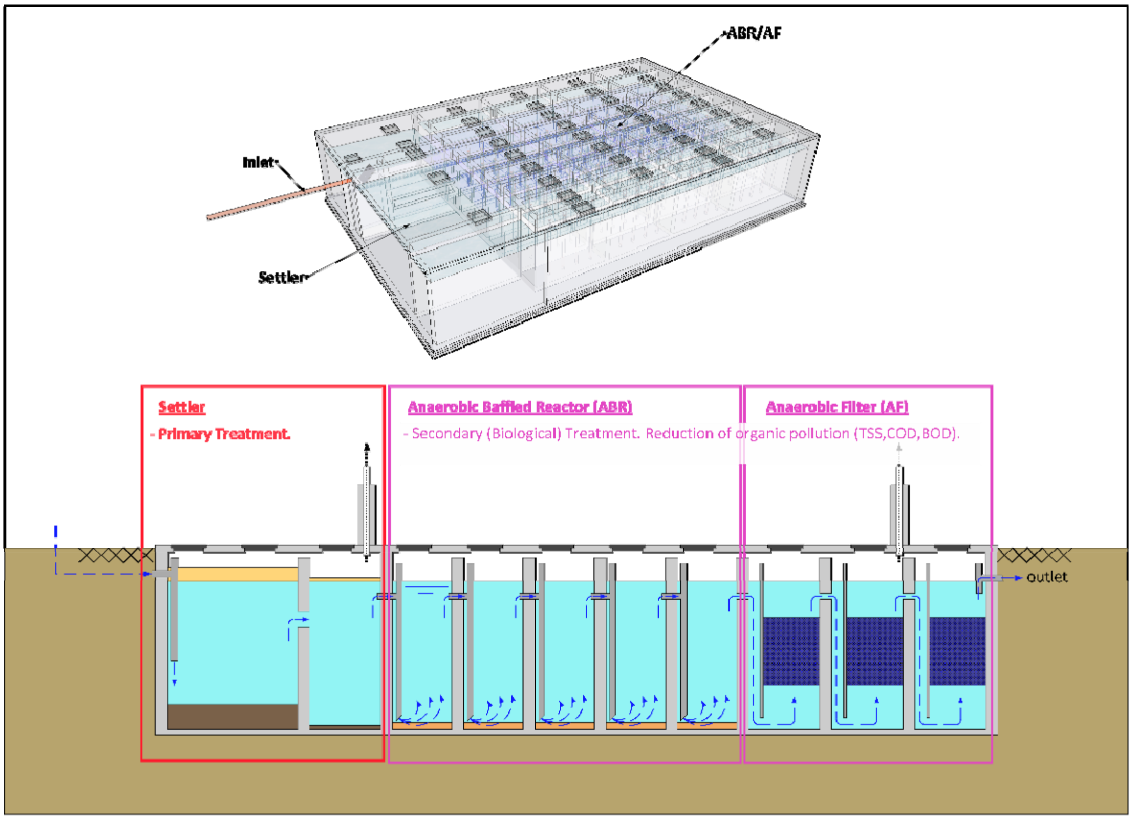

Figure 9: An optimised anaerobic treatment system (©Nanchoz Zimmermann[9])

ABRs may reduce up to 90% BOD and produce a well-digested sludge, due to the long sludge retention time (1-2 years). The system shown in Figure 9 is a variant of a DEWATS system, such as initiated by BORDA.

Field research from BORDA on ABRs so far shows quite a high tolerance to loading and flow fluctuations concerning effluent concentrations with Sasse's design (5–6 compartments, design upflow velocity 1 m/h - see (Gutterer, Sasse et al. 2009)). In the

[9] www.autark-engineering.ch

Nile Delta, where rain episodes are rare but sometimes intense, a **stormwater overflow** should be added in front of the system

If **small drains** are present around the ezbas (i.e. drains with width of 1-5 m), they may be adapted to provide further polishing, as natural wetlands or sequence of ponds (**in-drain treatment**). In any case, it is recommended to use them as discharge points. If aquaculture is practiced in the village, as is often the case in Kafr El Sheikh Governorate, the treated wastewater can be further polished in **fish ponds**. This would provide extra income to the WWTP operator and further treat the effluent, by, among others, removing part of the nutrients still contained in the water.

Sludge should be removed every 1-3 years and further treated. Desludging depends on the accumulation rate in the reactors; it generally concerns the first reactors (settler and maybe the first 2 ABR chambers) though, at times an accumulation in the last ABR chambers can be observed (BORDA, personal communications). Once the sludge is removed, it first has to be dehydrated, either on **drying beds**, or if available, by **filter press**. Then, it can be dried further for better parasite removal, mixed with compost or burnt. It has to be noted that sludge from drying beds is still not safe for reuse, as the parasite eggs it contains are still active. A drying period of six months is necessary to completely deactivate them. As mentioned in §3.1.2, sludge management is currently a major issue in Egypt and needs to be addressed urgently.

A solution to be followed up, currently developed in South Africa, is a sludge pelletiser, using the Ladepa process[10]. Such a machine dries, hygienises and transforms sludge into small pellets which can be used as a fertiliser or soil conditioner.

As for collection and transport of wastewater, **shallow sewer systems** (= simplified sewer systems = condominial systems - see *Compendium of Sanitation Systems and Technologies*, pp.83-84) are recommended, for the reasons mentioned in §4.4.2. Their cost is much lower than conventional ones, with much less risks of clogging than with small-bore sewers. Small-bore sewer (= solids-free sewer = small diameter = variable grade gravity sewers) systems have not a good record in Egypt, mainly because of bad design and misuse. They should be avoided.

With simplified sewers, expensive manholes are replaced with simple **inspection chambers**. Each discharge point is connected to an **interceptor tank** to prevent settleable solids and trash from entering the sewer. Building a small inspection chamber in front of each house is also a good way to monitor the behaviour of users and identify potential misuse. Good design of inspection chambers is critical; proper maintenance even more so. A simplified sewer main can still be placed at a shallow depth providing it is placed away from traffic.

Systems can be built in different ways, according to local conditions. The ABR may be placed above-ground. The main advantage is that it is much easier to monitor and desludge (as is also the case for settlers and Imhoff tanks). The pump is placed before the treatments units, and the liquid moves down by gravity towards the outlet. On the other hand, the advantage of an underground ABR is that it is the effluent of the ABR,

[10] Brochure on the South African sludge pelletiser: http://www.parsep.co.za/pages/Detritus%20Brochure.pdf

almost solid-free, which is pumped, and not the raw wastewater. It avoids a lot of problems with pumping and increases the longevity of pumps.

In that case, it is worth investigating the use of an **airlift pump**[11] (or: "geyser pump", "mammoth pump"), which uses air to lift water, thus increasing its oxygenation before the trickling filter. Such a pump can be **solar-powered**.

Rapid Sand Filtration is not recommended in the Nile Delta context. The constant operational control, need for a dosing device and strict adherence to charging intervals make vertical filters less suitable for DEWATS (Gutterer, Sasse et al. 2009).

Even if considered as a must by the Egyptian wastewater sector, **chlorination of the effluent is not recommended at all**. It is almost never done properly and results in environmental damage rather than preservation, in an environment where the quality of the receiving water body is often much worse than an non-chlorinated effluent. Chlorination of effluent prior to final disposal is a major technical problem for two reasons: (i) a shortage of chlorine makes it difficult for both water and wastewater plants to meet their supply needs; (ii) chlorine in effluent can be harmful to aquatic life in the discharge body (Chemonics 2006).

4.4.2 Advantages of shallow sewers

Choosing a combination of technologies such as illustrated above gives flexibility to the planner. As the system is modular, use of space can be optimised. Spaces like courtyards, parking lots or even streets can be used to host units. The treatment system can be divided in several units, such as illustrated in Figure 7, page 64. This way, the planner can adapt at best to the configuration of each village, taking into account the available spaces, barriers and distances.

The use of shallow sewers should be encouraged. They have the following advantages:

- Less depth and width of sewers, leading to significant money savings, especially through less excavation. Excavation in Nile Delta villages may be quite difficult and costly because of the high groundwater table.
- Less depth also reduces the risk of groundwater infiltration in the sewer system
- Reduce the risk of structural damage of buildings due to groundwater lowering; this is a concern expressed by inhabitants themselves.
- Maintenance of sewer system easier due to shallow depth
- O&M is easy and can be done by local people
- Access chambers: manholes are not required if sewers are laid at shallow depths and are replaced by access chambers, much cheaper and which enable pipes to be cleaned without the need for a person to enter the chamber (Parkinson, Tayler et al. 2008).

[11] For more information on airlift pumps: http://en.wikipedia.org/wiki/Airlift_pump and http://www.nesc.wvu.edu/nsfc/Articles/SFQ/SFQw02_web/SFQw02_NewPump.html

Dividing settlements in relevant clusters facilitates the use of shallow sewers and has further advantages:

- Even in small villages, a depth of sewer of 4-5 m is easily reached with a minimum slope of 1%; dividing villages in several parts helps to reduce the maximum depth.
- Conveyance of wastewater is possible through gravity flow most of the time
- Avoiding expensive crossing of drains and canals
- Failure of the sewer system, pumping station or treatment infrastructure will affect only one area
- Future village extension will be served by additional units; such an approach adapts well to unpredictable settlement expansion . New areas are in all case difficult to connect to an existing sewer system (shallow or conventional), as it a new pumping station and the existing sewer system diameters may not be sufficient to accommodate the extra loads.

Design flexibility is key to optimise the capital investment.

4.5 Management and financial scheme

4.5.1 Roles and responsibilities

Reviewing the existing sanitation initiatives of the recent past, it is clear that an innovative management scheme is essential. The management model to be selected is highly dependent on who finances and who owns the infrastructure (see §3.4.4). In the case of ISSIP, the infrastructure is financed by the Egyptian Government and thus the assets will belong to the latter. The communities in turn are expected to provide the land for free. An extra monthly contribution may be requested to achieve full-cost recovery (cf. §3.3.2 and 3.6.2).

The scenario in which a given community is responsible for the entire management of the treatment system has shown its limitations in GIZ’s experience (cf. §3.4.3). HCWW and its Affiliated Companies must carry the responsibility for the performance of WWTPs.

In the current situation, it is not possible for Affiliated Companies to manage dozens of small autonomous treatment systems; on the other hand, experience shows that communities cannot manage such systems on their own. There is a need for a **dual management scheme**, sharing roles and responsibilities between the governmental agencies and the communities. It cannot be expected that Affiliated Companies will employ permanent staff in tiny ezbas. Communities should at least be responsible for the O&M of the sewer network. It should not be a problem, as it is already the case in the communities which built an informal sewer system, or “groundwater lowering system”.

Affiliated Companies should be at least responsible of the following tasks:

- **Monitoring the implementation**

- **Water quality monitoring**: sample the effluent at least once a month and analyse it in the district central laboratory.
- **Repairs in case of treatment failure**: only engineers from HCWW have the required skills to understand the treatment processes and identify the problems
- Centralised management of **spare parts**
- **Capacity-building** and **training of technicians**: skilled technicians constitute one of the major gaps in the current sanitation sector.
- **Sludge management** handled by the Affiliated Company

The main question is who will carry out the daily O&M of the treatment units. There are two main options:

1. Affiliated Companies **employ and train community members**; these employees are under the supervision of a unit within the Affiliated Company, specialised in small-scale systems, which takes care of the tasks listed above, monitor the employees and pays a visit at least once a month. Those employees should be organised in an association, meeting once or twice a year to receive further training and exchange experience.
2. **Public-Private Partnership (PPP)**: A private company is created, to which the Affiliated Companies can subcontract the O&M of decentralised systems. This company centralises the staff, equipment and know-how.

Clear ToRs that are binding must be defined.

Dual management model (RODECO-GIZ)

RODECO and GIZ made a study, unpublished so far, investigating management models for their new WWTPs in Kafr El Sheikh. Results are featured in (Jacoby 2012). On the contrary to El Moufty, those are financed by a loan to GoE, which means that they will be owned by HCWW and not by the community. However, the community is still making a contribution, especially the land. RODECO and GIZ benefited from inputs from Mr Osama Shalaby, legal adviser to HCWW, and Mr. Mohanad Hassan, Foreign Contracts Consultant in HCWW, regarding legal advice.

The model currently preferred features shared management and hence shared responsibilities for proper functioning. CDA as dual owner gets permission from KWSC to manage the network through a protocol with KWSC, while the latter will be in charge of O&M of the WWTP; the CDA covers the financial management and hires an O&M contractor for the network.

4.5.2 Full-cost recovery

Implementing an innovative management scheme to **achieve full-cost recovery** for decentralised sanitation systems is a priority. Experience shows that with the current water and wastewater taxes, full-cost recovery is not possible (see §3.2.2, 3.3.2 and 3.6.2). It also shows that community members may be willing to pay more than the taxes and that the necessary amount to achieve full-cost recovery is usually significantly below the amount currently spent to desludge on-site sanitation facilities. As such, it is recommended to investigate in each village how much each household spends on average per month to prove the savings potential of the new system.

Water bills are already collected by the Affiliated Companies at the household level in each village. Thus, a collection system is already in place. The main question is to know if Affiliated Companies are legally able and willing to collect extra amounts of money to achieve full-cost recovery for the smaller treatment systems. Another question mark is also to ensure that the extra money collected in decentralised villages is then spent in the same villages, and not used for other activities. A proper mechanism should be put in place for decentralised schemes.

A second option is that money could be collected by CDAs, which will then transfer part of it to the Affiliated Companies. Experience in the Delta shows however, that it is difficult for CDAs to collect money, as there a lack trust among people (see §3.4.3). People may sometimes trust the Affiliated Company more. This question has to be answered on a case-by-case basis.

In case of an unsewered system with septage transported by trucks, households must pay a fee to the community development association (CDA) or HCWW, plus the emptying fees of their on-site sanitation infrastructure, paid directly to the emptiers. Money flows in this case must be further analysed. Emptiers should have incentives (e.g. financial or regulatory) to bring the septage to the correct treatment site or discharge point.

Whatever financial scheme is chosen, **full financial transparency** is required, in order to create a climate of trust, among people, and between people and governmental agencies. Communities need to have a view on the accountancy of their sanitation system. It can increase their willingness-to-pay if they know how the money is used and are ensured that it does not disappear to fill other budget holes.

This also means that a **thorough financial analysis** is needed from the start, to predict how much users will have to pay. Financial implications of the project should be clear to each stakeholder **from the beginning** and all of them should agree and engage consequently. It is too late to deliberate these issues once the infrastructure is already implemented.

4.5.3 Link collection systems with manure and solid waste management

It may sometimes be difficult to get people to pay for wastewater treatment only. It has been proposed by Hans Husselman (Rodeco) to couple the fee for wastewater treatment with a fee for solid waste collection, as a package. This way, collection is easier and the sanitation services are widened. This solution is recommended, as solid waste management is a major issue in most villages and threatens wastewater collection systems. What is more, solid waste collection could be carried out by the same team taking care of the sewer network, thus giving them a full-time job.

Manure could also be added to this scheme, in villages where villagers do not reuse it themselves.

5 Conclusion

There is a clear demand to properly dispose of wastewater in small communities of the Nile Delta. So far, some of them tried to solve their problems by constructing informal sewer systems. Such a solution solves the problem in the short-term, but often leads to new problems. This wastewater is not treated and ends up in the surrounding water bodies, unfortunately – and against the law – often in canals for irrigation.

If a good, cheap system is available, people will readily replicate it. An example of the same phenomenon is given by the pumps to increase water pressure in the households. It is not particularly cheap, but people do pay for it. The willingness to pay for simple, maintenance-free and reliable solutions is there. There is a market, but, so far, no reliable system to copy.

Consultants and contractors should be enabled to go beyond “business as usual”. Even if the Egyptian Code of Practice authorizes to build huge infrastructure for tiny settlements and, de facto, backs up consultants who do so, it is time to think out of the box and go for more appropriate , tailor-made approaches. Conventional wisdom says that “contractors do not like to go for small-scale systems because there is little money to make for a big effort”. Actually, small-scale sanitation is a profitable business. Not because of each unit, but because of the economies of scale that can be achieved.

For this reason, it is key to standardise small-scale sanitation systems. Standardisation means reduction of costs and an increase in quality. It also enables centralised management, by specialised units in the Affiliated Companies or by a private company subcontracted by HCWW. We also strongly advocate for the prefabrication of treatment units in Egypt, following the model developed by BORDA. Prefabricated units are ideal for small settlements. Prefabrication opens up the possibility to serve a lot of villages at low cost. A strategy in this direction is needed from HCWW, which would open the path to fruitful public-private partnerships, allowing the Egyptian industry to produce such units at scale.

Modular, flexible systems should be encouraged. It would make the best use of the scarce free spaces in and around Nile Delta villages and reduce construction costs by reducing sewer length and depth and avoiding obstacles such as canals and drains.

Small-scale sanitation demands pragmatic answers. There is definitely a need for the concerned Ministries to sit together and develop a more enabling environment to solve the Delta’s environmental sanitation challenges. Laws, regulations and Codes of Practice need to be adapted to this specific context. An incremental approach should replace the current “all or nothing” philosophy. It does not make much sense to spend significant amounts of money to reach standards that a far beyond the quality of the drains, and even canals. Hopefully, the new political situation will help break the institutional deadlock working against pragmatism and problem solving. There is also a need for a better integration of the different stakeholders of small-scale sanitation by HCWW. Communities, NGOs, private sector providers and individuals who wish to build sanitation systems should be supported and a national platform should be created.

Small-scale sanitation needs a differentiated, case-by-case approach. Differences between settlements are much bigger at a small scale. These differences mainly relate to population density, housing typology, quality of drinking water systems, number of animals and the potential of future developments. These differences have a major impact on the design of a sanitation system. For this reason, it is of utmost importance to have a good general knowledge of Nile Delta ezbas, with their characteristics and specificities, and to ensure a comprehensive preliminary assessment in each village before going to the detailed design phase.

Donors also have an important role to play to foster integrated approaches for small-scale sanitation systems, by drafting realistic terms of reference and adapting their tendering and bidding procedures. The non-technical components should be considered as a must and more flexibility is necessary to enable the emergence of innovation and cost-efficient designs, something that is currently discouraged. Donors also have an important role in assisting sector coordination and filling the gaps between the different sanitation stakeholders.

Finally, rural sanitation needs lessons learnt. Several projects have been completed by different organisations and Ministries, but lessons learnt are few and far between. Solutions need to be built incrementally and it is normal not to achieve full success initially in such complex environments. Failures should be documented and analysed, in order to avoid them in future. We strongly recommend HCWW to create an online library and repository on its website, to collect reports and experiences done in Egypt. It would help any motivated agency, NGO, interested private service providers or individuals to tackle rural sanitation challenges. Full rural sanitation coverage can only be achieved by linking the strengths of the different stakeholders of the sector.

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7 Appendix

7.1 List of existing initiatives

Initiatives considered during this assessment:

Governorate	Village / Ezba (District)	Technology	Designer / Reference
Beheira	Sharaf El Din (Zawayt Gazal)	Anaerobic Baffled Reactor (ABR)	Ahmed Fadel
Gharbeya	Mashal / Kom El-Naggar (Bassyun)	Activated sludge	M. Abdel Azeem / Moh. Abdel Wahaab ?
	Senbo	Dual Biological Aerobic Filter (DBAF)	M. El Hosseiny
Fayoum	Zawyat El-Karatsah WWTP	Compact anaerobic tower: upflow anaerobic sludge blanket + anaerobic filter + trickling filter + sand filtration	Tarek Sabry
	Abdel Kareem Issa (Sanhorus)	Upflow Septic Tank / Baffled Reactor (USBR)	Tarek Sabry
Beni Suef	Sheikh Yacoub (Fashn)	Primary settling tanks + aeration + subflow planted gravel filter + oxidation channel	Together Association (Sameh Seif Ghali)
	Maimun (Markaz El Wasta)	On-site collective septic tank with gravel filter + aerated filter at WWTP	HBRC (Hisham Abdel Halim, Moh. Nazih)
Sharkiya	Kafr El Hamam (next to Zagazig)	Kimatech® (Prefabricated unit based on physico-chemical treatment)	El Raed Co.
Dakahlia	Meet Dafr	UASB + Downflow Hanging Sponge (DHS)	Rifaat Abdel Wahaab/ NRC
	Samaha	Constructed wetland	M. Bahgat, Maher Fares
	Meet Mazah	Waste stabilisation ponds	Prescott (Newcastle University)
Damietta	24 villages	Various technologies	NOPWASD (LIFE project)
Kafr El Sheikh	Various ezbas (incl. El Moufty, Om Sen, El Koleea)	Waste Stabilisation Ponds (WSP)	M. Abdel Azeem (for GIZ)
Qena	Kom El Dabae	WSP, small-bore sewer sytem (SBS), forest	M. Abdel Azeem (for ESDF)
Giza	Zinin WWTP	Pilot compact anaerobic tower with biological filter	Tarek Sabry
	NRC	Pilot UASB + DHS Pilot Primary sed. + DHS	Fatma El Gohary, Hamdi Ibrahim, Ahmed Tawfik

Existing sanitation initiatives in small and mid-sized settlements in Egypt:

Nr	Governorate	City/village (District)	Technology	Designer / Programme	Management
1	Alexandria	Japanese University (Burg al Arab)	Pilot of primary sedimentation with plate settler + DHS	Dr. Ahmed Tawfik	Ahmed Tawfik
2	Alexandria	?	Wetlands for polishing the effluent of a pilot biotower (?)	Funded by USAID	?
3	Beheira	Sharaf El Din (Zawayt Gazal)	ABR	Prof. Ahmed Fadel	MWRI
4	Beni Suef	Noweira	Septic tank (3 chambers, 1 anaerobic + 2 filters) + vegetated gravel channel	Egyptian Water Partnership with CEDARE	
5	Beni Suef	15 villages	Communal septic tanks with 2 upflow gravel filters or sand filters or treatment using gravel bed hydroponics (GBH)	ESDF with CARE Egypt	CDA
6	Beni Suef	Maimun (Markaz El Wasta)	Septic tank + SBS	Hisham Abdel Halim	Beni Suef AC
7	Beni Suef	El Gehad	DBAF for 1'800 cap.	Dr. El Hosseiny (Ain Shams)	?
8	Beni Suef	Sheikh Yacoub (Fashn)	Primary settler, aeration, three-step sub-flow constructed wetland, oxidation channel	Together Association (Sameh Seif Ghali)	CDA
9	Dakahlia	Meet Dafr	UASB + Downflow Hanging Sponge	Prof. Rifaat Abdel Wahaab /NRC	Prof. R. Abdel Wahaab
10	Dakahlia	Meet Mazah	Waste stabilisation ponds	Dr. Prescott (Newcastle University)/ WHO	Dakahlia AC
11	Dakahlia	Gezirat Al Qebab, Al Qebab Al Kubra, Al Qebab Al Sughra	Extended aeration	ESDF	Dakahlia AC
12	Dakahlia	Samaha	Constructed wetland	Prof. M. Bahgat, Maher Fares	Dakahlia AC
13	Damietta	24 villages: Adliya (WSP-visited), Daqahla (aerated WSP), etc.	WSP, modified aerated WSP, submerged fixed film reactors, oxidation ditches and extended aeration	Basic Village Service (BVS), Local Development II Provincial (LD II-P), funded by USAID	Damietta AC
14	Fayoum	Abdel Kareem Issa (Sanhorus)	USBR (<5000 pers.)	Dr.Tarek Sabry	Abdel Tawab
15	Fayoum	Aazab	ABR	Ahmed Fadel	?

Nr	Governorate	City/village (District)	Technology	Designer / Programme	Management
16	Fayoum	Kalamsh (500 m3/d), Abu Dayhoum (100 m3/d) at Markaz Atsaa	Kimatech® (Prefabricated unit based on physico-chemical treatment)	El Raed Co., Ahmed Eissa	?
17	Fayoum	Bany Shaitan (Sanhorus)	Primary settler, aeration, three-step sub-flow constructed wetland, oxidation channel	Together Association (Sameh Seif Ghali) sponsored by Japanese Embassy	CDA
18	Fayoum, Beni Suef, Sohag, Qena, Aswan	Numerous villages; in Fayoum: Zawait Al Karadsa and Al Khawagat	Anaerobic filters *("communal septic tank", "Improved/advanced septic tank")*	Sherif Sadek, funded by CARE International, constructed until March 1998	Households
19	Gharbeya	Subrakas	DBAF (biological aerobic filter) (<15'000 pers)	Dr. El Hosseiny (Ain Shams)	?
20	Gharbeya	Damanhour El Wahsh	? (< 15'000 pers,)	Dr. El Hosseiny (Ain Shams)	?
21	Gharbeya	Senbo	600 m3/day (about 10'000 capita)	Dr. El Hosseiny (Ain Shams) - LIFE Project USAID	
22	Gharbeya	Mashal / Kom El-Naggar (Bassyun)	Activated sludge for small community (oxidation ditch) + waste collection and co-composting with rice waste	NOPWASD / ESDF	CDA
23	Gharbeya	Seguin el Kom (Kotour)	ABR (communal, for 120 persons)	ESDF	?
24	Gharbeya	Nawag	Small-bore sewer system + conventional WWTP	Ahmed Fadel	Gharbeya AC
25	Giza	NRC (El Behoos)	Pilots with very diluted water: - UASB + DHS - Primary settler + DHS	Prof. Fatma El Gohary	Prof. Fatma El Gohary
26	Giza	Zinin WWTP	Pilot compact anaerobic tower with biological filter	Dr. Tarek Sabry	Dr. Tarek Sabry
27	Ismaliya	Abo Halifa (100 cap) + Ezbet El Arab (200 cap) (Tal El Kebeer)	USBR	Tarek Sabry	?
28	Kafr El-Sheikh	Om Sen (Al Riad)	WSP (GIZ community-based model)	Prof. M.Abdel Azeem - Aldar	CDA
29	Kafr El-Sheikh	Al Koleaa (Al Hamool)	WSP (GIZ community-based model)	Prof. M.Abdel Azeem - Aldar	CDA
30	Kafr El-Sheikh	Al Kafr El Gedid (Kafr El Sheikh); Kozman (Qaleen); Om Elshour (Al Hamool); Al Handaoaa (Biala Sheikh)	WSP (GIZ community-based model)	Prof. M.Abdel Azeem - Aldar	?

Nr	Governorate	City/village (District)	Technology	Designer / Programme	Management
31	Kafr El-Sheikh	El Moufty	WSP (GIZ community-based model)	Prof. M.Abdel Azeem	CDA
32	Kafr El-Sheikh	Nobaraiah, El Sayed, El Badawy	DBAF (biological aerobic filter) (<15'000 pers)	Dr. El Hosseiny (Ain Shams)	?
33	Luxor	El Tood Elodisal	Biological filter (< 15'000 pers.), unsewered system (DBAF ?)	Dr. El Hosseiny (Ain Shams)	?
34	New Valley (Wadi el Gedid)	El Bashandy; Asmant; El Sheikh Wali; El Maasara	Oxidation ponds (cap ?), trees, solid waste management and composting	ESDF	Bashandy CDA with O&M trust fund
35	Qena	Dandara	Domestic ABR with upflow gravel filter *("Biological Reactor"),* SWM	Sherif Sadek (ESDF)	Households
36	Qena	Kom El Dabae (Nagada)	Shallow sewer system + oxidation pond + forest	Prof. M. Abdel Azeem / ESDF	CDA
37	Sharkiya	Ezbet Ekady (Zagazig)	ABR	Prof. Ahmed Fadel	MWRI
38	Sharkiya	Kafr El Hamam (Zagazig)	Kimatech® (Prefabricated unit based on physico-chemical treatment)	El Raed Co., Ahmed Eissa	Al Raed with CDA

Initiatives selected for further study (highlighted rows: 31, 35, 36, 38)

ESRISS' Evaluation Questionnaire
for small-scale sanitation initiatives

Name of interviewer (اسم المحاور):………

Date(التاريخ):……

Participants to the visit(المشاركين فى الزياره):…………………………………………………………………………………………

……

Signature(الأمضاء):…………………………………………………

CASE STUDY EVALUATED

- Location (ezba/village, markaz, governorate): …………………………………………………(عزبه/قريه-مركز-محافظه):الموقع

……

- Technology: ………:التكنولوجيا
- Leader of the initiative: …………………………………………………………………………………………:قائد المبادره
- Designed by: ………:المصمم
- Design capacity / actual inflow : ………………………………………………………………………:قدرة التصميم
- Constructed by: ……………………………………………………… ……………………………………………من قام بانشاءها
- Operation started in: ……………………………………………………………………………………………:وقت بدء العمليه
- Financed by: ……………………………………………………………………………………………………… ..:مموله من
- Plant manager (+ contact): …………………………………………………………………………………:رئيس المحطه

1 Engineering & Operations -الهندسه و العمليات

DESIGN التصميم

1.1 Design of treatment plant تصميم محطة المعالجه

a. Design capacity: ا- قدرة التصميم
→ Area covered by WWTP - Number of settlements served المساحه المغطاه من المحطه-عدد المنازل المخدومه

→ Population equivalent served (n° inhabitants, n° households) عدد السكان و المنازل المخدومه

→ Wastewater produced / capita / day مياه الصرف الناتجه/فرد/يوم

→ Design capacity vs. actual inflow قدرة التصميم بالمقارنه بالتدفق الحقيقى

b. Design parameters: معايير التصميم

→ Volume of wastewater to treat حجم المياه للمعالجه

→ Hydraulic retention time (HRT) in each treatment unit HRT فى كل وحدة معالجه

→ Influent loads: COD, BOD5, TSS, Total-N, Total-P, E.Coli, parasitic ovae كمية العناصر فى المياه الوارده

c. Sewer / collection system: الصرف/نظام التجميع
→ Type of sewer and/or number of pumping trucks نوع الصرف و/او عدد عربات المضخات

→ If sewers: network length, depth, number of pumping stations, type of manholes / inspection chambers, sump (including depth) للصرف الصحى: طول الشبكه-العمق-عدد محطات الرفع(الضخ)-نوع غرف التفتيش-المستنقع(عمقه)

→ Structure of the network هيكل الشبكه

d. Presence of industrial wastewater (if yes, type(s) of industry) وجود مياه الصرف الصناعيه(اذا وجدت,نوع الصناعه)
e. Quantity of sludge, sludge management strategy, treatment technology كمية الحمأه,كيفية ادارته و تكنولوجيا المعالجه

f. Surface area of system infrastructure مساحة البنيه الأساسيه
g. Particularities معلومات اضافيه

1.2 System flexibility: ability of the system to cope with changing contexts/conditions
مرونة النظام(القدرعلى التعامل وع الظروف المتغيره)

1.3 Disposal: التخلص من:
a. Treated wastewater مياه الصرف المعالجه
b. Sludge الحمأه

1.4 Any problems with design ? هل توجد اى مشاكل فى التصميم؟

CONSTRUCTION
البناء

1.5 Plant construction process — عملية بناء المحطه

- a. Name of consultant and contractors — اسم الأستشارى و المقاولون
- b. Availability of material & technologies — توافر المواد و التكنولوجيا
- c. Construction problems (quality of work, materials) ? — مشاكل فى البناء(بالنسبه لجودة العمل و المواد)

O&M
التشغيل و الصيانه

1.6 Management of the system — ادارة النظام

- a. Organisation in charge: who makes decisions? — من المسؤول؟من يتخذ القرارات؟
- b. Different managers for sewers, WWTP and disposal ? — المسئولين عن المجارى,محطة معالجة مياه الصرف والتخلص منها؟

1.7 Activities and schedule, monitoring scheme — الأنشطه و الجدول و مخطط المتابعه

1.8 Consumables: a. Electricity; b. Chemicals; c. Spare parts management

المواد المستهلكه: ا-الكهرباء ب- الكيماويات ج-ادارة قطع الغيار

1.9 Management/staffing, skills, local availability of know-how — **الأداره/التوظيف, المهارات, مدى معرفة العمال بكيفية آداء عملهم**

→ Education, experience, motivation, loyalty, payment of staff — التعليم, الخبره, التحفيز, الولاء,مرتبات العمال
→ Training and capacity building given since the start of the project — التدريب و بناء القدره للعمال منذ بدء المشروع

1.10 Problems with O&M? — هل توجد مشاكل فى التشغيل و الصيانه؟

PERFORMANCE
الآداء

1.11 Physico-chemical parameters: DO, COD, BOD5, TSS, TDS, VSS, Total-N, NH4, NO2, NO3, Kjeldahl-N, Total-P

→ treatment efficiency of the different processes — المواصفات الفيسيقوكيماويه-كفاءة المعالجه للعمليات المختلفه

1.12 Microbiological parameters: E. Coli and parasitic ovae — الماصفات الميكروبيولوحبه: الاى كولاى ز البويضات الطفيليه

1.13 Sludge quality — جودة الحمأه

1.14 Compliance with Egyptian standards (e.g. Law 48/1982) — مطابقة المعايير المصريه (مثل قانون 48 لسنة 1982)

1.15 Performance according to design specifications? — الآداء طبقا لمواصفات التصميم

1.16 Problems related to performance ? Observations ? — مشاكل فى الآداء؟ ملاحظات؟

SITE
الموقع

1.17 Factors for site selection — عوامل اختيار الموقع

1.18 Land acquisition procedure, former owner — اجراءات الحصول على الأرض, المالك السابق

2 Environmental factors — العوامل البيئيه

2.1 Groundwater table — عمق المياه الجوفيه

2.2 Precipitations + seasonality ; storm water management ? — الترسبات, العوامل الموسميه مثل ادارة مياه الأمطار

2.3 Quality of drinking water supply: — جودة مياه الشرب

→ Constant and sufficient pressure ? — ضغط المياه كافى و غير متغير؟

→ Water scarcity problem, seasonality ? — مشكلة نقص المياه و موسميتها

2.4 Topography, natural disaster risks: flooding ? — الطوبوغرافيا,مخاطر الكوارث الطبيعيه

2.5 Demographics — التركيبه السكانيه

→ population within the system boundaries — تعداد السكان فى حدود النطام

→ population density within the settlement — الكثافه السكانيه فى المساكن

→ population growth (annual rate) — الزياده السكانيه(سنويا)

→ Flexibility of WWT ? Capacity to cope with population increase?

مرونة معالجة مياه الصرف؟ القدره على التغلب على الزياده فى السكان

3 Nutrient Recovery & Reuse Options — استعاده المغذيات وخيارات اعادة الأستخدام

3.1 Reuse practices — ممارسات اعادة الأستخدام

a. Sludge — الحمأة

b. Treated wastewater — مياه الصرف المعالجه

c. Energy recovery — استعادة الطاقة

4 Financial arrangements — الماليات

4.1 Source of money: External (donor) contribution and/or internal funds (%) ? — مصدر الأموال: مساهمه خارجيه و/او داخليه؟

4.2 Capital costs (CAPEX) - separating sewer system and WWTP — تكلفة رأس المال-مع فصل الصرف الصحى عن محطة المعالجه

a. Material costs; b. Costs for labourers; c. Costs for consultants and contractors; d. Hidden costs - remarks?

ا-تكلفة المواد ب-تكلفة العمال ج-تكاليف المقاولين و الأستشاريين د-تكاليف اخرى ه-ملاحظات

4.3 Project and mobilization costs — مصاريف المشروع و التحريك

4.4 Operating costs (OPEX) — مصاريف التشغيل

a. Human resources; b. Energy; c. Chemicals ; d. Spare parts; e. Daily maintenance

ا-موارد بشريه ب-الطاقه ج-الكيماويات د-قطع الغيار ه-الصيانه اليوميه

4.5 Sustainability of cost recovery: taxes, fees and tariffs? — استدامة استرداد التكاليف: ضرائب-مصاريف-تسعيرات

→ Is it based on polluter pays principle or other? — هل تعتمد على مبدأ الملوث يدفع ام مبدأ آخر؟

4.6 Main problems associated with cost recovery — المشاكل المرتبطه بأسترداد التكاليف

→ Fee collection? — تحصيل الرسوم

→ Financial/social mechanisms to reach 100% coverage — الآليات الماليه و الأجتماعيه للوصول الى 100% تغطيه

4.7 Design and construction phase — مرحلة التصميم و البناء

a. Contracting and bidding processes, price negotiation — التعاقدات و المزايدات, التفاوض فى السعر

b. Disaggregation level of mandate / full package? — هل يتم تقسيم المهام على مقاولين متعددين ام يقوم بها مقاول واحد فقط؟

c. Local / regional contractor(s) — المقاولون المحليون و الأقليميون

5 Management scheme — البرنامج الأدارى

5.1 Ownership: a. Land; b. Sewer system; c. WWTP — الأمتلاك ا-الأرض ب-نظام الصرف الصحى ج- محطة تحلية مياه الصرف

5.2 Distribution of roles and responsibilities (Affiliated Company, Community Development Association, NGO)

توزيع المهام و المسؤوليات(شركه منتسبه, منظمة تنميه مجتمع, منظمات غير حكوميه)

a. Responsibility for construction (sewer system, WWTP) — مسؤولية البناء (نظام صرف صحى, محطة معالجة مياه الصرف)

b. Responsibility for O&M (sewer system, WWTP) — مسؤولية التشغيل و الصيانه(نظام صرف صحى, محطة معالجة مياه الصرف)

c. Fee collection — تحصيل الرسوم

5.3 Are there local leaders/pioneers/change agents? — هل يوجد قاده,رائدين او مغيريين محليين؟

5.4 How has this village been selected ? — كيف تم اختيار القريه؟

6 Institutional arrangements and government support — الترتيبات المؤسسيه و دعم الحكومه

6.1 Institutional stakeholders involved — الشخصيات المؤثره و المسؤوله المشاركه

6.2 Support and commitment by national/regional authorities; type of support: financial, technical and organisational — الألتزام و التعاون مع المؤسسات المحليه و الأقليميه

6.3 Laws, regulations, environmental standards (enforced?) — القوانين و المواصفات البيئيه(اجباريه؟)

7 Socio-cultural acceptance: awareness, behaviour and participation

القبول الأجتماعى و الثقافى: التوعيه,السلوكيات و مدى المشاركه

7.1 Awareness of the population: دراية السكان

→ manure dumped in the sewer network التخلص من الروث فى شبكة الصرف الصحى

→ solid waste management ? ادارة المخلفات الصلبه

→ awareness of sanitation problems, related health risks مدى الوعى بمشاكل النظافه و الأخطار الصحيه المتعلقه بها

7.2 Awareness-raising component in the project ? عنصر التوعيه فى المشروع

7.3 Community participation in the project ? How ? مشاركة المجتوع فى المشروع؟ كيف؟

7.4 Socio-cultural issues concerning water, sanitation and hygiene القضايا الأجتماعيه و الثقافيه التى تخص المياه و النظافه

a. Perception of faecal matter and urine and their reuse for crop production

مفهوم الناس عن اعادة استخدام مخلفاتهم الصحيه فى انتاج المحاصيل

b. Reputation of the new system/plant: any problems noted the population ?

سمعة النظام او المحطه الجديده. هل هناك اى مشاكل؟

7.5 Users' priorities: cleanliness, health, odors, avoid overflow, get rid of wastewater, quality of the water in drains and canals. اولويات المستخدمين: النظافه, الصحه, الروائح, تجنب الطفح, التخلص من مياه الصرف, جودة مياه المصارف و القنوات

8 Impact on area served التأثير على المناطق المخدومه

8.1 Household coverage rates (total nr of hh and %) نسبة العائلات المخدومه(عدد الأسر و نسبتها)
→ if any: reasons for non-connection اى اسباب لعدم التوصيل

8.2 Management of sludge from on-site facilities (septic tanks, interceptors…)

ادارة الحمأه من المرافق التى توجد فى الموقع(خزان الصرف الصحى مثلا)

8.3 Quality of receiving water body if not directly reused in irrigation جودة المستقبل للمياه اذا لم تستخدم فى الرى
(physico-chemical parameters as in 1.11 and coliforms) المعايير الفيزيقوكيماويه مثل القولونيه الكليه

→ relevance of discharge in water bodies علاقة التخلص من المخلفات فى المسطحات المائيه

9 Future المستقبل

9.1 Any improvement of the system forecasted? هل هناك تحسن فى النظام المتوقع؟

9.2 Any replication under planning? هل هناك اى مخططات للاعاده(التوسع)؟

9.3 Present and future collaborations ? التعاون الحالي و المستقبلى

7.3 People met during the assessment

STAKEHOLDER	POSITION
HCWW	
H.E. Dr Abdelkawi Khalifa	Minister MWSU – former Chairman HCWW
Gen. Seif Nasr Arafa	Chairman
Eng. Mamdouh Raslan	Vice-chairman
Dr. Ahmed Moawad	Head of Technical Sector
Eng. Mounir Hosny	Manager ISSIP Project Implementation Unit (PIU)
Taha El Feel	ISSIP PIU Project Officer
BEHEIRA WaDC	
Eng. Safwat M. Rageh	Ex-Chairman
Mahmoud Mansour	Ex-Chairman.
Eng. Yosry	Ex-Head of Technical Sector and head of RSU
Eng. Mohamed Ghonaim	Head of R&D Sector
Tahany El Banna	Ex-coordinator for international cooperation (now working for IWSP in Gharbeya)
Mohamed Gaber	Coordinator for international cooperation
Eng. Rehab, Ehab, Eslam, Mohamed	Field Engineers
GHARBEYA AC	
Eng. Ayman Abdel Kadr	New chairman, since beginning 2011
Eng. Abdallah El Lethi	Head of RSU
Eng. Mohammed Kadoum	Manager for Industrial WW
Eng. Seif el Nasr	General Manager WW
KAFR EL SHEIKH AC	
Mahmoud Fohad Abdel Ahman	Chairman
Dr. Anwar	Chief Chemist
Dr. Atef	Chemist at Sedi Salem WWTP
Hosny, Ahmed Rezk	Responsible for Al Ryad District (incl. Om Sen)
DAKAHLIA AC	
Ahmed Amdeen; Osman Bechta (ex-Chairman of Gharbeya)	Ex-Chairmen
Eng. Mohamed Ragab	Head of Technical Sector
Eng. Mohamed Walli	Field engineer
DAMIETTA AC	
Eng. Ahmed Kadry	Chairman
Eng. Esaam Sheyel	Head of Technical Sector
BENI SUEF AC	
Eng. Gamal Gaber	Responsible for small-scale systems
Khalaf Baskharon Khalil	Chemist in El Fashn branch, responsible for water quality monitoring in Yakub (Together Association‘s WWTP)
ORDEV, Ministry of Local Development	*Organisation for Reconstruction and Development of the Egyptian Village,* department of the Ministry of Local Development
Dr. Ibrahim Rihan	Chairman, Prof. of rural sociology at Ain Shams University
Eng. Mohamed Ahmed Melouk	General Director of Foreign Relationship and Technical Operation
Eng. Mohamed El Sayed	Head of Technical Affairs
HELWAN UNIVERSITY	
Dr. Moustafa Moussa	Helwan University - ESRISS main academic partner
Prof. Samir Mohamed El-Demerdash	Dean of the Faculty of Engineering at Mataria

GIZ	
Dr. Ernst Döhring	Director of WW Management, based in HCWW
Dr. Hans-Werner Theisen	ex- Director WW Management
Dr. Moataz Shalabi	Project Officer
Tina Eisele	ex-MSc student (in partnership with GTZ) - University of Köln / University of Amman
RODECO Consulting	
Hans Husselmann	Ex-Project Team Leader of RODECO Kafr El Sheikh
Friedrich Fahrländer	Ex-Project Team Leader of RODECO Kafr El Sheikh
Magda Riad	Community outreach specialist
WORLD BANK	
Yoshi Kobayashi	ISSIP Team Leader
Param Iyer	Ex- ISSIP Team Leader
Heba Yakan	Local coordinator ISSIP
Ahmed Atta	Consultant in charge of monitoring WB projects and B. Evans' study - MSc Ain Shams University, searching for PhD
Barbara Evans	Consultant from Leeds University, in charge of QMRA study in Kafr El Sheikh
Caroline Van den Berg	WatSan expert
ISSIP PM / TA	
Eng. Alois Lieth	PM/TA team leader; manager Hydroplan Consult (Germany)
Dr. Walid & Hisham Abdel Halim	Ecoconsult (local consultant PM/TA); for Walid: position in HBRC and Cairo University
KfW	
Claudia Buerkin	Senior Programme Manager
Detlef Gielow	Ex-Project Manager Middle East, economist
Dr. Bernd Wiebusch - KfW	Senior Technical Expert - sanitary engineering - MENA countries
MWRI	*Ministry of Water Resources and Irrigation*
Dr. Hussein El Gamal	Head of the Water Quality Unit
Prof. Ashraf El-Sayed	Deputy Director of Drainage Research Institute, at National Water Research Centre
Dr. Tarek Kotb	General Director Central Unit of IIIMP (Integrated Irrigation Improvement Project
SWISS AGENCIES	
Romain Darbellay	Head of Swiss Programme Office in Cairo
Benjamin Frey	Deputy head of Swiss Programme Office in Cairo
Iman Radwan	Development Programme Officer SECO
Nicole Providoli	1st secretary - delegate economic cooperation
H.E. Dominik Furgler	Ambassador
ACADEMIC CONSULTANTS	
Prof. Fatma El Gohary	National Research Centre Godmother of low-cost sanitation
Prof. Mohamed Kamel Mohamed and Mahdy	National Research Centre, professor of microbiology Assistants
Prof. Ahmed Gaber	Cairo University - Director of Chemonics Egypt
Prof. Mahmoud Abdel Azeem	Ain Shams University / Aldar Consulting Designer of all main decentralized initiatives, e.g. GTZ model
Dr. Tarek Sabry, Ahmed Gendy (assistant)	Ain Shams University, Sanitary & Environmental Engineering, Dept. of Public Works- Specialist anaerobic treatment
Dr. Ahmed Tawfik	Egypt-Japan University in Alexandria, ex-NRC (team Prof. Fatma)

Dr. Saber El Shafai	Assistant Professor at Riad University (Saudi), ex-NRC (team Prof. Fatma)
Prof. Mohamed El Hosseiny Elnadi	Ain Shams University / WEG consulting, Prof. of Sanitary & Environmental Engineering, developer DBAF technology
Dr. Doaa El Sherif	HBRC, Director Urban Training Institute (UTI)
Prof. Maha Moustafa El Shafei, Dr. Walid Abdel-Halim, Dr Amr Hassan, Eng. Mohamed Nazih and Khalid Naguib	Institute of Sanitary and Environmental Engineering, HBRC
Prof. Edward Smith	American University (AUC), Prof. of Environmental Engineering, Dept. of Construction and Architectural Engineering
Prof. Ahmed Fadel	Mansourah University Specialist low-cost technologies
Dr. Holger Pabsch	Managing Director IPP-Consult (Germany) Specialist of sludge humification
Prof. Gatze Lettinga	Wageningen University (Holland) Godfather of low-cost anaerobic treatment
NON-ACADEMIC FIELD EXPERTS	
Randa Helmi, Aziza Shal, Hala Shenouda, Mervat Tawfik	Managers DBA (Development Business Associates), ex-ESDF
Sherif Sadek	Former Project Manager at ESDF for Gharbeya and Qena governorates
Sameh Seif Ghali, Noshi Zaki Ibrahim	Director, resp. Project Manager of Together Association, responsible for a small-scale WWTP in Beni Suef Governorate
Hazem Shawky, Mohamed Mahroos, Ahmed Eissa	Team of Al Raed Company, producing prefabricated physico-chemical wastewater treatment units
Tarek Morad	Deputy Head of Economic & Development Cooperation, Embassy of the Netherlands
Herrie Heckman	Ex-leader at Fayoum WW Affiliated Company
Dr. Hazem Saleh	Team leader at AAW Consulting Engineers
Eng. Mohamed El-Shorbagy	Projects Dept Head at Chemonics Egypt
Mohamed Sabry	Senior Eng. at Chemonics International, Water and Wastewater Sector Support Program
Kathleen Sheridan	Eng. at Chemonics International, Water and Wastewater Sector Support Program
Maher Fares	Consultant, later head of ISSIP office in Kafr-el-Sheikh
OTHERS	
Wolfgang Mayer - Hanns-Seidel Foundation (Germany)	Country Director
Mohamed El Rawady - CEDARE / Egyptian Water Partnership	Project officer
Osamu Tanaka - JICA	Project leader
EAWAG	
Dr. Linda Gaulke	Program Manager (SANDEC) - *Excreta and Wastewater Management* group
Dr. Jochen Markard	Head of *Innovation Research in Utility Sectors* (CIRUS)
Prof. Hansruedi Siegrist	Prof. at Eng. Dept
Jack Eugster Peter Freisler Karin Rottermann	Responsible of laboratory

وتحتاج القوانين واللوائح وقواعد الممارسة الموجودة الموجودة حاليا إلى أن تتواءم مع هذا الإطار. كما ينبغي وضع آليات مبتكرة في مكان بحيث تسمح باسترداد التكلفة الكاملة. ينبغي اتباع نهج تدريجي ليحل محل الفلسفة الحالية "كل شئ أو لا شئ" والتي لم تخدم مصر بشكل جيد. كما أن الإطار القانوني والمؤسسي يجب أن يمكن الاستشاريين من تجاوز سيناريو "بقاء الأمور على حالها". ويحتاج الصرف الصحي في المجتمعات الريفية الصغيرة في مصر إلى حلول واقعية.

يكشف تقييمنا عن عدم وجود بيانات أساسية خاصة بالصرف الصحي في القرى الريفية. أدى ذلك إلى معايير تصميم غير دقيقة، وإلى بنية تحتية أعلى أو أقل من الأبعاد النسبية المحددة، ونحتاج إلى اعتبار روث الحيوانات وما يتدفق من مصانع الألبان كأجزاء من نظام الصرف الصحي، كما يحتاج الصرف الصحي في المجتمعات الصغيرة إلى منهج متكامل يتناسب مع كل حالة على حده ومقترن بإجراء تقييم أولي شامل في كل قرية وهو عبارة عن "سلوكيات سهلة" (مثل مقابلة أولية مع الجهات المعنية ومنظومة الإدارة)، ويجب أن يكون ذلك جزءًا لا يتجزأ من كل تصميم.

إن الجهات المانحة عليها دور هام لتقوم به من أجل تعزيز النهج المتكاملة. ويجب أن تنعكس طبيعة مشروعات الصرف الصحي في المجتمعات الصغيرة في تفعيل الاختصاصات وتقديم العطاءات وتشجيع المنافسات، ويعد من الضروري النظر إلى الأمور غير الفنية على اعتبار أنها أمر لابد منه، لابد من وجود مزيد من مرونة ليمكن ذلك من ظهور التصاميم المبتكرة والفعالة من حيث التكلفة.

وأخيرًا، يحتاج الصرف الصحي في التجمعات الريفية إلى الاستفادة من الدروس السابقة. وقد تم تنفيذ العديد من المشاريع من قبل مختلف المنظمات والوزارات في العقود الماضية، لكن الدروس المستفادة قليلة ومتباعدة، ولابد أن تنبني الحلول تدريجيا، وينبغي توثيق الأداء وتحليله وذلك من أجل تفادي الفشل في المستقبل. وإننا نوصي بأن تنشئ الشركة القابضة بنكًا للمعلومات في موقعها على شبكة الإنترنت، وذلك لجمع التقارير والخبرات التي تكونت في مصر، فإن ذلك من شأنه أن يساعد أية وكالة ذات دوافع أو منظمة غير حكومية أو أي أفراد مهتمين بتناول التحديات التي تواجه الصرف الصحي في المناطق الريفية.

الجوفية نتيجة الري الدائم والإمداد المتزايد بمياه الشرب، مما يؤدي في كثير من الأحيان إلى سوء أداء مرافق المعالجة المتواجدة في الموقع. وحتى الآن، لا يوجد نظام في المجتمعات الصغيرة يمكن تطبيقه (بما يشمله من نظم مالية وإدارية) ومتاح حتى يتم تكراره في مصر. ومعظم المبادرات في المجتمعات الصغيرة في مصر لا تصمد أمام اختبار الزمن أو أنها قد ظلت في مرحلة تجريبية.

نتائج وتوصيات

لقد كشف تقييم الموقف الحالي عن عدم التواصل بين الجهات والمؤسسات العاملة في قطاع الصرف الصحي في مصر، الأمر الذي يؤدي إلى منع التكرار على نطاق أوسع، فحتى الآن، لم يتم وضع أية مبادرة تمت تجربتها في شكل مؤسسي. علاوة على ذلك، أظهرت التجارب أن المناهج المعتمدة بشكل كلي على المجتمعات الأخرى لا تجدي نفعا في المجتمعات المصرية. وعليه فإن من الواضح أن الشركة القابضة لمياه الشرب والصرف الصحي HCWW والشركات التابعة لها يجب أن تلعب دورا محوريا في عمليتي تنمية وإدارة الصرف الصحي في المجتمعات الصغيرة، كما ينبغي أن تعزز التعاون والتنسيق مع الجهات المعنية الأخرى في القطاع (الوزارات والمجتمعات والمنظمات غير الحكومية والباحثين). وحتى الآن، يظل القطاع في حلقة مفرغة، وتظل المبادرات المعزولة هي نماذج بدائية، وعلى هذا النحو فهي ليست ذات تكلفة فعالة ولا تحظى بالاهتمام المطلوب، ويعتبر ذلك مكلف للغاية وعرضة للفشل وبالتالي لا يتم تكراره.

وإنه لمن المطلوب أن تكون هناك استراتيجية حكومية واضحة وأن يتضمن النموذج القابل للتكرار على نطاق واحد توحيدًا قياسيا، ونحن نوصي بأن يتم تصميم وتبني استراتيجية إنتاج شامل للصرف الصحي في المجتمعات الريفية الصغيرة، وأن يتم الاعتماد على الوحدات المسبقة الصنع المنتجة محليا. هناك حاجة إلى توحيد قياسي لنظم الصرف الصحي في المجتمعات الصغيرة، ليؤدي ذلك إلى وفرة في الحجم وخفض في التكاليف. ويجب أن تكون هذه الأنظمة معيارية ومرنة. إن استخدام الوحدات مسبقة الصنع والتي يمكن أن تصنع بسهولة في مصر بشكل جزئي أو كلي يعد ميزة إضافية. والتوحيد القياسي يعني أيضًا أنه يمكن إدارة النظم من قبل وحدات متخصصة في الشركة القابضة ممثلة في الشركات التابعة أو عن طريق إحدى شركات القطاع الخاص المهنية بعد أن تتعاقد مع الشركة القابضة.

المنهجية

لقد استخدمنا أساليب متنوعة في بناء تقييمنا :(الأول) إجراء مقابلات مع الجهات المعنية في القطاع، وذلك للتعرف على المبادرات السابقة وجمع البيانات المتفرقة والمعرفة والخبرة المتاحة. (الثاني) الأبحاث والدراسات السابقة. (الثالث) اختيار أبرز المبادرات وأبرز الزيارات للحقول وأفضل استبيان وتقييم فعلي لنماذج التكنولوجيات المطبقة في الريف المصري بالاستعانة بمعامل قسم بحوث تلوث المياه بالمركز القومي للبحوث (NRC) .

إن الإطار الأساسي للتحليل هو نظام بيئي مناسب، فهو يرتب العناصر التي تؤثر على نجاح وفشل المشروع إلى ستة عناصر أساسية هي : الدعم الحكومي والإطار القانوني والترتيبات المؤسسية والمهارات والقدرات والترتيبات المالية والقبول الاجتماعي والثقافي. وهكذا، يتم تقييم كل عناصر أنظمة الصرف الصحي بشكل شامل، ويتم تحليل العوامل الفنية بشكل منفصل.

وفي الجزء الأول من التقرير (الفصل الثالث) تتم مناقشة التحديات التي تم تصنيفها عنصرًا بعنصر، ويتم وصف التحديات الرئيسة التي تمت ملاحظتها، كما يتم طرح اقتراحات من أجل التحسين. ويتم تجميع هذه التحديات في جدول ويوضع في نهاية كل فصل. بعد ذلك نجد الجزء الثاني (الفصل الرابع) يقدم توصيات عملية في تصميم مشروع صرف صحي في المجتمعات الصغيرة. وهذا يرتبط مباشرة بمهمة جعل الاستشاريين ينفذون مشاريع في القطاع مثل مشروع (ISSIP) .

خلفية

تعد منطقة دلتا النيل منطقة صعبة، كثيفة السكان، وفيها ضغط متزايد على الأراضي الزراعية، ويزداد الطلب على المياه مع ارتفاع معدل النمو السكاني. ويتم الآن تزويد قرى دلتا النيل بالمياه، لكن القليل من هذه القرى يستفيد بالفعل من تجميع ومعالجة مياه الصرف الصحي. وهناك طلب واضح للتخلص من مياه الصرف الصحي بشكل صحيح في المجتمعات الصغيرة، علما بوجود شبكات عشوائية أو نظم شبكات صرف صحي "لخفض منسوب المياه الجوفية". وخلاف ذلك، فإن الناس يعتمدون على خدمات الصرف الصحي الموقعي، وفي كلتي الحالتين يتم التخلص من مياه الصرف الصحي والحمأة في أقرب مياه (في مصرف أو غالبًا وبشكل غير قانوني في الترع) أو مباشرة في الحقول الزراعية، وفي نفس الوقت يزداد الوضع سوءًا بسبب ارتفاع مناسيب المياه

الملخص التنفيذي

إن هذا الملخص هو نتاج *المشروع البحثي المصري- السويسري لتطوير أنظمة الصرف الصحي المستدامة* (ESRISS - www.sandec.ch/esriss)، وهو مكون بحثي موازي *لمشروع البنية التحتية المتكاملة للصرف الصحي* والممول من قبل البنك الدولي (ISSIP) ، وتتم إدارته من قبل *المعهد السويسري للعلوم والتكنولوجيا المائية* (Eawag) بالشراكة مع *الشركة القابضة لمياه الشرب والصرف الصحي* (HCWW) وممول من *وزارة الاقتصاد السويسرية* (Seco). وهذا الملخص إنما هو موجه بشكل رئيس إلى كل الجهات المعنية في قطاع الصرف الصحي وصانعي القرار والوكالات الحكومية والاستشاريين والأكاديميين المعنيين بالصرف الصحي في التجمعات الريفية الصغيرة بشكل عام. ومع ذلك، فإن بعض التحديات المصنفة قد تتعلق بقطاعات أخرى أيضا، كما أن خبراء التنمية قد يجدون في هذا التحليل نظرة مفيدة إلى بعض مميزات البيئة المصرية.

الأهداف

لقد أدى تحليل واسع للقطاع وقائم على إجراء لقاءات مع معظم الجهات المعنية في القطاع بالقاهرة (وزارات ومرافق عامة ومؤسسات بحثية واستشاريين) إلى استنتاج مفاده أن هناك حاجة كبيرة إلى تطوير إجراءات فعالة وغير مكلفة وبيئة ملائمة ونظم صرف صحي في المجتمعات الريفية الصغيرة قابلة للتكرار في القرى التي لا تشملها خطط مركزية على نطاق واسع في الحاضر أو المستقبل. وعندما نقول " المجتمعات الريفية الصغيرة" فإننا نشير بذلك إلى "قرى أو كفور يصل تعداد سكانها إلى 5000 نسمة، وقد تم الأخذ في الاعتبار هذا الاحتياج في مشروع ISSIP حيث الحاجة في الوقت الحالي لإيجاد حلول لقرى يصل عدد سكانها إلى 1,500.

ويعد تطوير نموذج قابل للتكرار على نطاق واسع هو الهدف النهائي للمشروع ESRISS، ومن أجل تحقيق ذلك ،كانت الخطوة الأولى هي تحليل الخبرات السابقة في مجال الصرف الصحي في المجتمعات الصغيرة في مصر، وفهم الأسباب الكامنة وراء النجاح والفشل، وهذا الملخص هو نتيجة لهذا التحليل، ويقدم عرضا شاملا لكل العوامل التي أثرت في نظم الصرف الصحي في المجتمعات الصغيرة مع طرح توصيات لمشاريع مستقبلية.

ا لصورة الموجودة على صفحة الغلاف: مشهد في قرية أبو درة بمحافظة البحيرة (فيليب ريمون)

مصدر هذا التقرير:

Reymond Ph., Abdel Wahaab R., Moussa M. (2012), *Small-Scale Sanitation in Egypt: Challenges and Ways Forward*, Eawag, Cairo

تم تجميع نتائج هذا التقرير في بحث ملخص لورقة السياسة: الصرف الصحي في المجتمعات الريفية الصغيرة في مصر: عشر نقاط للمضي قدمًا

يمكن تحميل جميع هذه الأبحاث من: **WWW.SANDEC.CH/ESRISS**

الصرف الصحي في المجتمعات الريفية الصغيرة في مصر: التحديات وسبل المضي قدما

فيليب ريمون   د. رفعت عبد الوهاب   د. مصطفى موسى

ESRISS: المشروع البحثي المصري ـ السويسري
لتطوير أنظمة الصرف الصحي المستدامة

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