Estimation of the wastewater quantity and characteristics

in Al Gozayyera village (Ismailia)

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Appendix to this report:

- Factsheet of the current situation in Al Gozayyera (result of the tool)
- Field notes from Al Gozayyera field trip (24.06.2014)
- Excel-based model (Excel sheet)

Rationale

The SWIM Project in Al Gozayyera, Ismailia Governorate, aims at implementing and piloting a context-appropriate small-scale sanitation system. The need was expressed to estimate the wastewater quantity and characteristics to be treated after the construction of a sewer network, in order to determine design parameters reflecting the site-specific conditions. The tool recently developed in the ESRISS Project allows such forecasting. The final decision remain however in the hands of the designer, as the tool is only at the beginning of its validation process.

Methodology

In a first step, the preliminary assessment report elaborated for the SWIM Project by Dr. Ghodeif was reviewed. Based on that, complementary data collection was carried out on 24th June 2014 through more than 20 household surveys randomly distributed in the whole village and an interview with the Sheikh el Balad.

The data collected from Dr. Ghodeif's report and from the field were then entered into the Excel-based tool developed by the ESRISS team (sent separately to this report). The first step (sheet "General Information") gathers the information from Dr. Ghodeif's report and the Sheikh el Balad. The second step compiles the results from the household survey. In the third step, the values for the key parameters are calculated from the various sources of information and the different results are compared side-by-side. The value deemed most realistic was then determined by the ESRISS team as "Selected value". Based on that, the model calculated the estimated wastewater quantity and characteristics, featured on the sheet "RESULT". The data describing the current situation are synthesised in a factsheet.

Finally, the estimation of the wastewater quantity and characteristics in future scenarios was done by changing the selected values in the third step, "Crosschecking and estimation of key parameters".

Results

Situation after the construction of the sewer network

The selection of the values for each of the six key parameters in Step 3 is based on the following rationales:

- Based on the counting of the houses on Google Earth and the number of inhabitants per building, we estimate the current population to be more than 1,138 inhabitants, up to 1,700. However, in order to take into account the fact that a certain percentage of the population spends most of its time out of the village, we set this value at 1,250 inhabitants.
- The idea of the SWIM Project is to serve the whole village with a sewer system.
- The current water consumption is very low, sometimes as low as 30 L/cap/day. This is mainly due to the very bad quality of the water supply, with most people using tanks as intermediate storage. We estimate that the average water consumption after building the sewer system will be around 50 L/cap/day, if the water supply is not improved.
- There are very few animals in the village, only 0.02 cattle per capita. This means that cattle will not have a significant impact on wastewater characteristics. What is more, the cattle owners in this village all reuse the liquid animal manure together with the solid animal manure (cow dung). We thus estimate that once the sewer network will be built, only 10% of the liquid animal manure will be discharged into it.
- As the groundwater level is quite deep, there is no risk of groundwater infiltration into the sewer network.
- Regarding greywater, we estimated that 95% will end up in the sewer network.

Based on these assumptions, the tool calculates the following sewage quantity and characteristics in 2015, after the construction of the sewer network, as shown in Table 1.

Table 1: Estimated wastewater quantity and characteristics after completion of the sewer network (in 2015)

Model estimation		Daily average		Morning peak	
Parameter	**Unit**	Conc.	Precision	Fact.	Conc.
Flow	m3/day	**70**	20%	1.6	**110**
Flow	L/min	**50**	20%	1.6	**80**
COD	mg/L	**1600**	30%	1.3	**2090**
BOD[1]	mg/L	**820**	30%	1.2	**980**
TS[2]	mg/L	**3680**	30%	1.5	**5520**
TSS	mg/L	**490**	30%	1.4	**690**
TN	mg/L	**250**	30%	1.4	**350**
TP	mg/L	**21**	30%	1.4	**30**

[1] *Value estimated based on COD and the typical ratio COD:BOD (cf. Baseline Data)*

[2] *Value estimated based on TSS and the typical ratio TS:TSS (cf. Baseline Data)*

Scenarios for 2030

Assuming a population of 1,250 inhabitants in 2014 and a growth rate of 3.5% per year, as shown in Dr. Ghodeif's report for 2005, the population in 2030 should be around 2,170 inhabitants. We assume that by then, the drinking water supply will be improved and that Gozayyera's inhabitants will have a typical water consumption of 100 L/cap/day. The results given by the tool based on these values are provided in Table 2.

Table 2: Estimated wastewater quantity and characteristics in 2030

Model estimation		Daily average		Morning peak	
Parameter	**Unit**	Conc.	Precision	Fact.	Conc.
Flow	m3/day	**220**	20%	1.6	**350**
Flow	L/min	**150**	20%	1.6	**240**
COD	mg/L	**880**	30%	1.3	**1150**
BOD[1]	mg/L	**450**	30%	1.2	**540**
TS[2]	mg/L	**2030**	30%	1.5	**3040**
TSS	mg/L	**270**	30%	1.4	**380**
TN	mg/L	**140**	30%	1.4	**190**
TP	mg/L	**11**	30%	1.4	**16**

[1] *Value estimated based on COD and the typical ratio COD:BOD (cf. Baseline Data)*

[2] *Value estimated based on TSS and the typical ratio TS:TSS (cf. Baseline Data)*

Assuming a population of 1.9% per year, as given in the Code of Practice, the population would reach around 1,700 inhabitants in 2030. The estimated wastewater flow would then be 170 m^3/day instead of 220 m^3/day for a population of 2170 inhabitants. The wastewater characteristics would be the same, as the other parameters are identical.

Conclusion

It is very clear that the estimation of the current number of inhabitants, the population growth rate and the evolution of the water consumption are the crucial factors for the estimation of the wastewater quantity and characteristics in Al Gozayyera, now and in the future. Assuming that the water consumption increases to 100 L/cap/day in 2030, for a population of 2,150 inhabitants, we can observe that the wastewater consumption would triple and the concentrations divided by two. This must be taken into account in the planning of the treatment infrastructure. Besides, the high uncertainty regarding the key parameters advocates for a modular treatment system and a reduced planning horizon.

The quality of the water supply is very poor in Al Gozayyera (cf. field notes in Appendix 2). It is clear that its improvement is a priority for the village's population. If it happens, it will have a sudden and significant impact on the treatment system, and should be planned accordingly.

Al-Gozayyera - FACTSHEET (current situation)

Legend *Number of results in the surveys*

General characteristics

Latitude	*30.8386111*
Longitude	*32.2733333*
Team members	*Philippe Reymond, Kareem Khaled*
Number of houses interviewed	*27*
% of the population covered by the survey	*17%*

Number of non-domestic buildings

Health-centre	0
School	1
Mosque	1

Inhabitants

Number of inhabitants

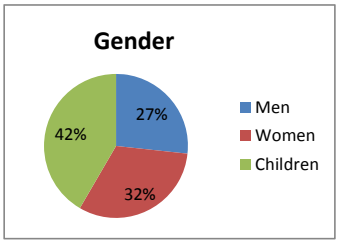
Personal estimation	1767
Official (based on census and growth rate)	0
Village authorities	1138

House and household

		n=
Nb. of houses (count on satellite image)	223	
Nb. of houses (Vil. auth.)	190	
Average household per house	1.7	27
People/house	7.9	27

Nb of Cattle

		n=
% of house with cattle	12%	26
% of house without cattle	88%	26
Nb. of cattle per cap (HH surveys)	0.02	26
Nb. of cattle per cap (Vil. auth.)	0.25	

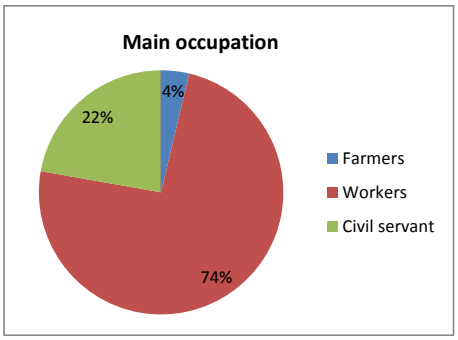


Main occupation

		n=
Farmers	4%	27
Workers	74%	27
Civil servant	22%	27
Shop owner	0%	27

Gender

		n=
Men	27%	27
Women	32%	27
Children	42%	27



Water Supply

Water consumption

		n=
Median (L/cap.d)	27	6
Average (L/cap.d)	33	6
Standard deviation (L/cap.d)	15	6

Water consumption vs sanitation syst.

		n=
Avg. building with bayara (L/cap.d)	33	6
Avg. building with sewer (L/cap.d)		0

Performance of the water supply system

		n=
Complaint about water supply	78%	27
House with water interruptions	96%	23
Frequency of interruptions (#/week)	5.7	22
Duration of interruptions (hours)	12.3	23
Complaint about low pressure	52%	27
Building with pump	81%	27

Sanitation system

Households sanitation system

		n=
Bayaras	100%	27
Sewer	0%	27
Pipe to drain	0%	27

Non-domestic buildings sanitation system

Bayaras	100%
Sewer	0%
Drain and canal	0%

Sewer network

	n=
Age (years)	0
House facing problems	0
Cloggage frequency (#/week)	0
Cost of maintenance (LE/house.month)	0
Cost of maintenance (LE/cap.month)	0

Bayaras

		n=
Sludge production (l/cap.day)	58	18
Complaint about the bayara	20%	25
Cost (LE/house.month)	69	21
Cost (LE/cap.month)	10	21

Discharge location of liquid manure from stable

		n=
Bayaras	0%	3
Sewer network	0%	3
Drain/Canal	0%	3
Field	100%	3
Street	0%	3

Emptying of liquid manure

		n=
Direct emptying (pipe)	0%	3
Manually emptying	100%	3
Nb. of emptying per day	1.0	3

APPENDIX 2: Notes from Al-Gozayyera field trip
Ismailia - June 2014

Team members: Philippe Reymond and Kareem Khaled Hassan
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Framework and objectives

This one-day field trip took place with the main objective to complete the dataset already collected in the village (cf. SWIM Report from Dr. Ghodeif), in order to be able to use the model developed within the ESRISS Project to estimate the future quantity and characteristics of wastewater to be treated in the village. Al Gozayyera will be used to test and validate the model.

Methodology

We proceeded as follows:

1. Discussion and interview with the Sheikh el Balad of Al Gozayyera, with the support of the ESRISS interview guidelines for village authorities and representatives.
2. Realisation of more than 20 household surveys, based on the ESRISS household survey questionnaire; survey of a representative sample of households randomly selected through the whole village.
3. Personal observation in the village.

Organisation and acknowledgements

This field trip has been organised with the support of:

- Dr. Moustafa Moussa, adviser in GIZ and the ESRISS Project
- Dr. Mohey and Aya, from the SWIM Project in GIZ.
- Dr. Rifaat Abdel Wahaab, SWIM Project coordinator in Egypt

Team's main observations

- In the village, about 15% fellaheen, 10% Saïdi and 75% so-called “Arabs”, from Bedouin origin.
- Most men are workers and few are farmers.
- The village is mainly divided into family house blocks with courtyard.
- The average number of cattle per capita is low, compared to villages in the Nile Delta, as most people are not farmers.

- The people use bayaras all over the village, even those near to the drain or the canal, which do not use a pipe to the drain.
- The soil is sandy, and the bayaras are built in a way to *exfiltrate* the wastewater; consequently, some bayaras remain untouched for years.
- Some villagers claim that wastewater pumping is not needed until the bayara is opened for the first time; after that, according to them, exfiltration does not take place as before and the bayara needs to be emptied regularly.
- The water quality in the village is relatively good; however the quantity is not sufficient and water supply interruptions are common in the village.
- The village can be divided in three different zones in terms of water supply quality, as shown in Figure 1:
    1. A lower part, where the supply can be qualified as "good";
    2. An intermediate part, lacking water during daytime for 2-3 days per week;
    3. A higher part, where water is not available during daytime 7 days a week. Most households have a pump and use storage tanks.

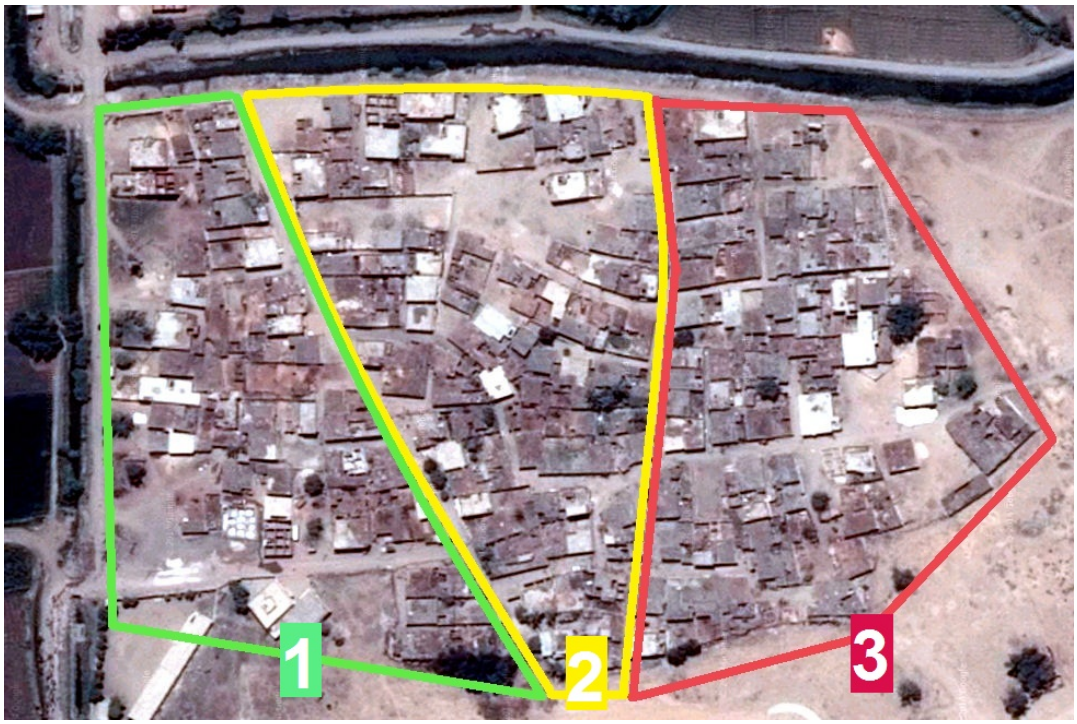

Figure 1: Approximate delimitation of three zones with different water supply quality.

- The water meters seem never to be checked; many of them are difficult to read or unreadable. What is more, it has been observed that some household partly short-circuit the water meter with a second piping system.
- A family reported that water is paid through one payment of 200-300 LE/year to the Village Council.

- Some villagers expressed that they expect the water supply to be improved through the project.
- Because many men in the village are workers and are working outside the village, it impacts on the overall water consumption calculated per inhabitant.
- There are electricity cuts 2-3 times per day.

Interview of the Sheikh El-Balad

Date: 24.06.2014

Team: Philippe Reymond and Kareem Hassan

Interviewee*:* Ahmed Allam (*Sheikh El-Balad*): 01091590417, 01279063332

General characteristics (according to the Sheikh El-Balad)

- Al-Gozayyera has 180-185 houses according to the Sheikh El-Balad. It belongs to the Village Council Al Rayyah.
- Half of the inhabitants are farmers and the rest are workers and merchants (we noticed that the majority are workers).
- Average number of cows per house is 2-3 (which was contradicted by our personal observation in the village).
- Power cuts happen every day for two hours, one in the afternoon and the other in the evening.
- The groundwater level is 8-9 meter deep under the land surface.

Sanitation

- The village is entirely using bayaras for wastewater collection, and suction tanks driven by tractors are used to collect the wastewater from the bayaras and bring it to the main drain.
- The suction tanks come about twice a month to collect the wastewater; it costs from 20 to 40 LE per trip.
- Bayaras are built from the white bricks manufactured in Al-Minia governorate; the bayara average volume is 6 m^3 (2m*2m*1.5m).
- Due to the deep groundwater table, the wastewater infiltrates into the ground, which is facilitated in this village by the sandy soil, unless the bottom of the bayara gets clogged with sludge.

Drinking water

- The drinking water is produced in El Qantara water treatment plant.
- There are frequent interruptions; however the water has a good quality.