Towards Selection of Wastewater Treatment Techniques for Rural Areas of Egypt

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Objective

The presented study aims in developing criteria that act as road map in selecting the clusters to be provided with decentralized sanitation facilities. The guided figures abstracted from the modeling exercise using QUAL2K are limited by two studied cases in the Nile Delta Regions. The water quality variables included in the model and assessment processes are Biochemical Oxygen Demand, Dissolved Oxygen and Coliform Bacteria. Criteria for success probability of self-purification of receiving water bodies to have decentralized system, would include having free zone of pollution point source along the drain, predominantly of diffuse source, minimal or non upstream pollution load.

Table (1): Typical water quality characteristics for main load contributors

Sources	Parameters			
	DO (mg/l)	BOD (mg/l)	TSS (mg/l)	Fecal Bacteria MPN/100 ml
Agriculture[1]	4.0	10	30	0
Week Raw Sewage[2]	0.0	400	400	10^6
Medium Raw Sewage[3]	0.0	600	600	$0.5 * 10^7$
Strong Raw Sewage[4]	0.0	800	800	10^7
Treated Centralized	2.0	90% reduction	90% reduction	5000
Treated Decentralized (average)	0.0	60% reduction	60% reduction	50% Reduction
Treated Decentralized (Maximum)	0.0	70% reduction	70% reduction	65% Reduction

1. The figure is based in average values for drains serving mostly agriculture area
2. The figure is based on 40 gm BOD generated for a capita/day and 100 l/capita/ day generated waste.
3. The figure is based on 60 gm BOD generated for a capita/day and 100 l/capita/ day generated waste in addition to organic waste load generated from livestock.
4. The figure is based on 80 gm BOD generated for a capita/day and 100 l/capita/ day generated waste in addition to heavy organic waste load generated from livestock and other sources

Table (3): Sharaf drain water quality characteristics for the simulated cases

Case	DO (mg/l)	BOD (mg/l)	Coliform bacteria (MPN/100ml)
Do Nothing	3.27	21.4	35130
Centralized with Decentralized	4.50	11.8	6128
Centralized	5.10	9.40	3800

Table (4): Nishil drain quality water characteristics for simulated cases

Case	DO (mg/l)	BOD (mg/l)	Coliform bacteria (MPN/100ml)
Do Nothing	2.64	22.60	18087
Centralized with Decentralized	4.78	10.91	8350
Centralized	5.70	7.50	3200

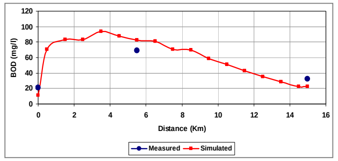

Figure (3): Simulated and measured BOD (June 2007) for Nishil drain

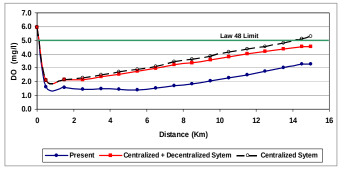

Figure (4): DO simulation result for Sharaf drain

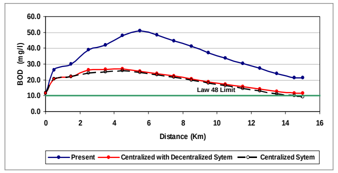

Figure (5): BOD simulation result for Sharaf drain

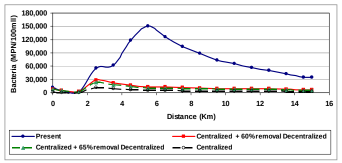

Figure (6): Coliform Bacteria simulation result for Sharaf drain

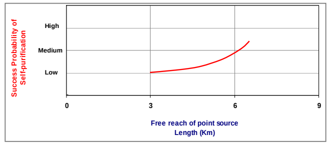

Figure (10): Impact of free zone of point source on success probability of self-purification of receiving water bodies

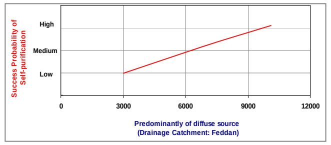

Figure (11): Impact of Predominantly of diffuse source on success probability of self-purification of receiving water bodies

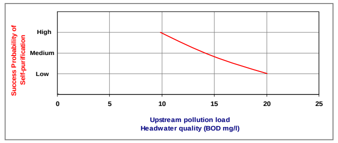

Figure (11): Impact of upstream pollution (Headwater quality) on success probability of self-purification of receiving water bodies

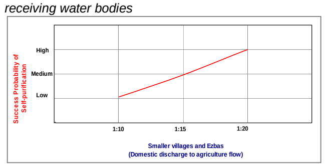

Figure (12): Impact of smaller villages and Ezbas on success probability

Methodology

The guided figures of the develop criteria in selecting the clusters to be provided with decentralized sanitation facilities will be abstracted from modeling exercise to quantify the impact on the drainage water quality. The tested clusters are limited by the four clusters where two will be presented as illustrative cases; Sharaf drain cluster of Mahmoudya Catchment and Nishil drain cluster of Mit Yazied Catchment. The approached methodology will follow the following procedures:

- Select the four clusters to be tested and appropriate water quality model
- Define hydraulic, physical and water quality characteristics of the relevant water bodies for the selected clusters
- Set up the Model and system schematization
- Calibrate the model and formulate the simulated scenarios
- Analyze the simulation modeling results
- Develop criteria for acceptability of decentralized system

The Enhanced Stream Water Quality Model QUAL2K (USEPA, 2003) is applied to test simulated scenarios for the selected clusters. It can simulate up to 15 water quality constituents in any combination desired by the user. QUAL2K (or Q2K) is a river and stream water quality model that is intended to represent a modernized version of the QUAL2E model (Brown and Barnwell 1987). For this study, schematic diagrams are constructed for the studied drains as illustrated in Figures (1) and (2).

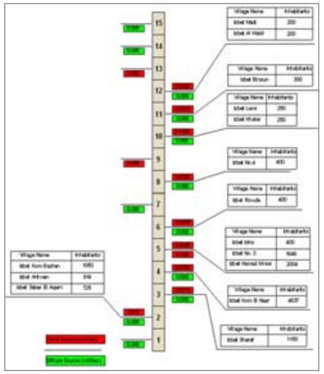

Figure (1): Schematic diagram of Sharaf drain cluster used in the Model Simulation (Mahmoudya Catchment)

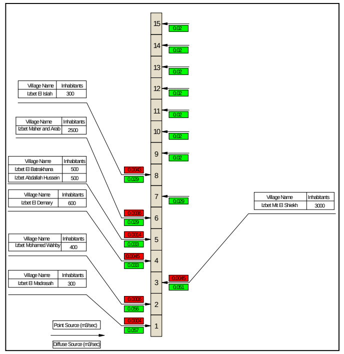

Figure (2): Schematic diagram used in the Model Simulation Mit Yazied Catchment

Major Findings and Conclusion

1. The water quality modeling for selected cases shows that:
2. Mit Yazied – Nishil drain and Mahoumdya – Sharaf drain cases show that the agriculture runoff from third order drain catchment enhances the purification capacity of the drain by dilution mechanism lead to significant improvement would meet the ambient water standard of law 48/1982.
3. Some cases show that heavy load from upstream activities diminishes the water quality improvement of the sanitation projects. The only solution to meet the ambient water standard is improving the water quality of the headwater by treating the towns and villages upstream the cluster.
4. Mahmoudya Catchment - Sharaf Drain and Mit Yazied – Nishil drain cases show that decentralized sanitation facilities could be an economic simple technical solution to many cases in the Nile Delta. Criteria for acceptability of decentralized system would include:
5. Having free zone of point source along the drain (Domestic wastewater)
6. Predominantly of diffuse source (agriculture drainage water)
7. Minimal or non upstream pollution load (Headwater quality)
8. Smaller villages and Ezbas

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