Watershed Management, A Tool for Sustainable Safe Reuse Practice, Case Study: El-Salam Canal

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Abstract
In Egypt, drainage and irrigation network receives a complex mixture of industrial and domestic effluent. Therefore, water quality was subjected to rapid deterioration over the past decades. A need for using marginal quality water in agriculture for new expansion projects is becoming a great necessity. Good quality water is no longer available for new irrigation projects. One strategy to increase available water resources is to reuse agriculture drainage water for irrigation. Surface water of low quality along with limitation of current water resources was found to be the largest current environmental threat to the drainage reuse practice in Egypt. The detrimental effects of drainage water reuse can be minimized by adopting appropriate pollution sources management. Although domestic diffuse sources represent very small portion of the total discharge in drains, they contribute to a high percentage of organic load to the water system. Lack of investment and time required to execute proper wastewater treatment plants (WWTPs), become a constrain impeding the improvement in surface water quality. The proper water quality management system along with good planning for constructing, upgrading and upscaling of WWTPs within a certain watershed can positively improve the water quality at the mixing point with fresh water for reuse. In this study, a practical management tool based on watershed as one of the primer water system unit has been introduced. The tool works under GIS environment to help water managers and planners concerned in irrigation system to incorporate the reuse of drainage water to set best prioritization scenario of WWTPs implementation, upgrading or upscaling within the sub-watershed of El-Serw and Bahr-Hadous drains that feed El-Salam canal. The study is based on analyzing the transport and decay of pollutants expressed as BOD load through network analysis of drains network within El-Salam canal watershed as a case study.
Keywords: Water quality management, Watershed, Drainage water reuse, GIS, Point source pollution (PSP), BOD.
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1. Introduction

Based on the measures towards water resources management, Egypt is facing serious challenges such as deterioration of water quality and the growing demand-supply gap (Mohamed 2013). In the 1980s, the reuse of agricultural drainage water became a policy in Egyptian water resources management practice (El Gammal et al. 2010). The amount of annually produced drainage water is 24.12 billion cubic meter (BCM/ year) extracted amount of 15 BCM/ year as surface water outflow (base year 2012) (MEWINA 2015). El-Salam canal is one of the most leading national water reuse projects in Egypt. The drainage water supplied to the project is essential for its sustainability. It is estimated to be 2 BCM/ year. This quantity is harvested from two main drains: El-Serw and Bahr-Hadous. This drainage water is mixed with another 2 BCM/year freshwater drawn from Damietta Branch, to produce a total discharge of 4 BCM/ year in order to supply enough water to irrigate 200,000 feddans in the western Suez canal region and 420,000 feddans in North Sinai.

Since the sub-watershed area of the two drains is located in a highly populated areas, the drainage system within the region is susceptible to pollution from legal and illegal dumping of domestic and industrial wastewater. Furthermore, the current proposed mixing ratio of 1:1 may be changed to a higher percentage of mixed drainage water, due to expected development in North Sinai and a limitation in fresh water. This might put more pressure on water managers and planners to go forward in improving the water quality of reused drainage water.

In 2005 a field study has done and was found that most of the water received by Bahr-Hadous drain (94.3%) is from agricultural diffuse sources. Although domestic diffuse sources contribute only 4% of the total discharge, this fraction contributes 94.7% of the organic load received by Bahr-Hadous, expressed as BOD load (EcoConServ 2005). This percentage of organic load resulting from domestic diffuse is almost the same for drains within El-Salam catchment area. Accordingly, the water quality of the canal has been negatively affected and the reuse plan of increasing the amount of mixing drainage water has been threatened. Therefore, and due to urgent need of irrigation water, important and immediate measures should be taken.

This study identifies watershed management as one of the premier water system unit for best water management. That occurring within the designated watershed rather than administration boundaries. The watershed of El-Salam canal can be classified into three main categories: 1- Fresh water source sub-watershed (Damietta Branch); 2-Mixing drainage water source sub-watershed (El-Serw & Bahr-Hadous drains) and finally 3- Irrigated sub-watershed of El-Salam canal (620,000 feddans). This study will focus on El-Serw and Bahr-Hadous sub-watershed which is located within five governorates (administration boundaries). The Watershed Approach is an ongoing cycle of tasks: setting standards for surface water quality; taking measurements of the conditions; assessing the data and identifying the impairments including establishing priorities; verifying the pollution sources and developing plans for restoring water quality and implementing pollution source controls (Texas Water 2018). Pollution source controls can be permits, rules, and source management practices. The plan should be set to better achievement of protecting watershed, which means clean water in the streams within watershed.

Watershed planning is a continuous process that requires:

- Collect and analyze of water resources data to identify issues and problems;
- Design a watershed plan on the basis of this data to protect and promote resource sustainability;
- Implement the plan;
- Monitor and evaluate the plan while continuously updating it to adapt to new information or technology;
- Enforcement and compliance efforts.

1.1 Problem statement

Since the dawn of time, nature has known how to preserve the internal balance that contributes to a healthy and clean environment (ElKhazragy 2016). The continuous release of wastewater to the water network reaches the level that exceeded capabilities of a natural system to process the pollution resulting to a serious impact on the water quality, which affects the sustainability of reuse projects in Egypt. The low level of sanitation service especially in rural areas makes nearby streams (either canals or drains) the perfect places for inhabitants to dispose of their sewage (Shaban et al 2010). Most water policies adopted conventional strategies and continuing dumping in water streams without serious consideration to its environmental effects on downstream, and when considered, they were superficially touched within isolated administration boundaries and there is a lack of consistent analytical studies on the quantity of pollution load and the reduction target. This raises important questions:

- Does water managers need to consider watershed, rather than isolated administrative boundaries in management and planning?
- What water managers can achieve with limited funds in the near term to improve water quality of surface water?
- What is the appropriate management approach for best implementation of WWTPs, taking into consideration the limited funds and fast impact to downstream water quality?
- How much pollution load - expressed in BOD Total Maximum Daily Loads (BOD TMDLs) - is produced from mixing drains sub-watershed of El-Salam canal?

1.2 Research objectives

- The wide goal of this study is to contribute for solving the problem of water shortage in Egypt, by presenting the most proper management tool for better understanding the problem of pollution sources and plan for reducing pollution.
- Production of environmentally safe drainage water suitable for disposal and/or reuse.
- Put best management tool for water quality management starting by considering point source of pollution (PSP) and ending up by considering all sources of pollutions including nonpoint source of Pollution (NPS).

2. Materials and Methods

The methodology is based on setting a practically distributed and physically based watershed-scale water quality model for estimating the movement of point sources BOD load through in surface water (case study: El-Serw and Bahr-Hadous drains sub-watershed). A pollution load assessment has been carried out by estimating BOD load at both source (upstream) and at mixing point (downstream) of the sub-watershed through the comparison analysis of transport and decay of pollutant (BOD Load) for best management within the study watershed in order to get safe water reuse practice (irrigation and fish farming). The study considers domestic diffuse sources (point source) as initial stage. The system has been designed under a Geographic Information System (GIS) environment, to support development of a comprehensive watershed simple model, for use as a tool for watershed planning, resource assessment and ultimately, water quality management purposes of El-Salam watershed (Appendix 1, shows a sample of the analysis result). The study considers only domestic sewage point source within the study watershed by knowing how much pollution load is going to El-Salam canal, where it comes from, who is producing it, how it is being contaminated and where it is ends up.

Watershed are important because all point and non-point sources of pollution within the study area ultimately drain to other water bodies. It is essential to consider these downstream impacts when developing and implementing water quality protection and restoration actions. Whatever is dumped in upstream ends up downstream within the watershed. In this case, management and planning in a holistic approach (watershed approach) is much more effective rather than individual management within isolated administrative areas (Figure 1).

2.2 Collecting data and building the network

The major steps in system application process consist of:

1. Collection and development of data;
2. Characterization and segmentation of watershed; and
3. Scenario analyses.

The following detailed steps has been done:

1. A drains network of the study area has been built in a geographical database, as preparation to assist a network analyses based on watershed approach (Figure 2).
2. Digitizing of drains network within the watershed and specify the served area for each WWTP, population data, villages location and clusters planning;
3. The villages, WWTPs and area served by each treatment plant were located, a networking analysis was conducted as well as the determination of the flow of network paths.
4. Evaluate the efficiency of WWTPs within studied watershed: 67.5 % for El-Serw catchment, 68 % for Bahr-Hadous catchment area.

Many of WWTPs in developing countries which were constructed outside of urban regions, have become surrounded by residential buildings. This has prevented the horizontal expansion of these WWTPs (Safwat 2018), accordingly, nearby unserved villages can be served by those WWTPs that have upscaling ability either horizontally or vertically within the same cluster according to land availability. The computational analysis of the network was made to calculate the decay rate of the organic load (BOD) for the distance from production at source to the mixing point with El-Salam Canal, considering villages and clusters as segment units using the decay equation:

$$BOD(x) = BOD_0 \, exp\left(-\frac{k_d x}{\bar{u}}\right) \tag{1}$$

Where BOD_o is the amount of the biochemical oxygen demand at $x = 0$;

$\bar{u}$ is the mean velocity in drains = 1 m/s, with a decay coefficient: k = 0.5, at average temperature=20^o C.

3. Urgent pollution treatment strategy:

This is can be achieved by two scenarios: 1- either by implementing new WWTPs within un-served areas; 2- Upscaling neighboring existing WWTPs to accommodate surrounding un-served areas; and/or; 3- upgrading unqualified existing WWTPs within served areas. The decision support system is designed to support analysis at a variety of scales using tools that range from simple to sophisticated.

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Administration division (five governorates)

Watershed division (two catchment)

Figure 1: Two types of management divisions (administration and watershed boundaries)

The methodology is based on pollution treatment strategy. Watershed management traditional approach typically involves many separate steps: collecting data, summarizing information, developing maps and tables, applying and interpreting models. The data can be classified into two categories: 1- Spatial wise data: geographic data; 2- Measurable wise: Quantity and quality data.

For initial quick decision, those interpretations do not require other information on hydrology, agriculture and land, which is not included in this study and can be considered in future studies.

The analysis conceived as a system for supporting the development of BOD Total Maximum Daily Loads (BOD TMDLs). Developing BOD TMDLs requires a watershed-based point source analysis for a point source of pollution. A geographic information system (GIS) provides the integrating framework for network analysis. GIS organizes spatial information so it can be displayed as maps, tables, or graphics. GIS provides techniques for analyzing compined information and displaying relationships.

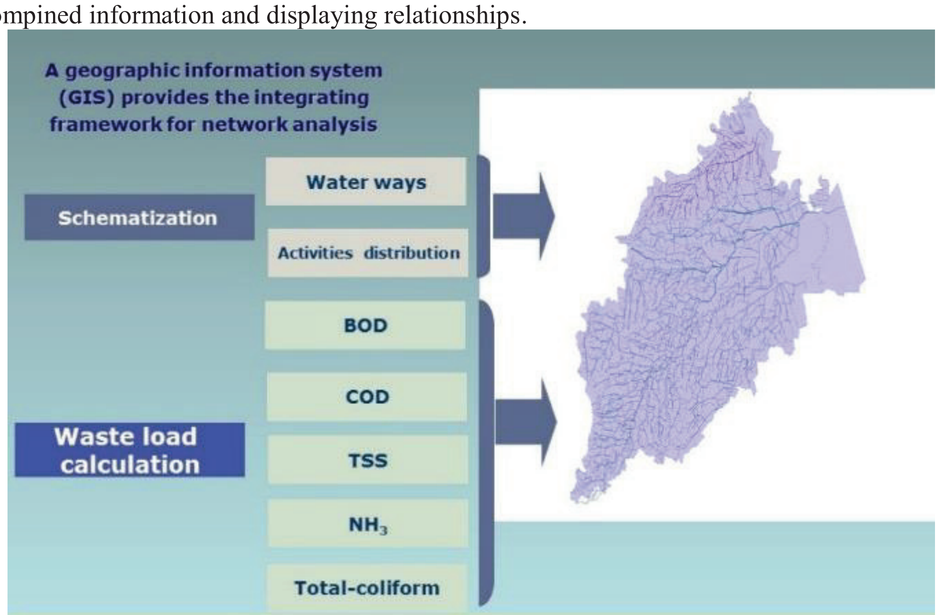

Figure 2: Integrated water quality framework for watershed management

3.1 Scenario 1: Implementation of new WWTPs for un-served areas

This is achieved by putting prioritization for constructing new WWTPs in phases within the study watershed using network analysis based on updated construction cost/m^3 (NOPWASD 2017) as follows:

- Capital cost for new WWTP less than 10,000 m^3/day = 8000 LE/m^3;
- Capital cost for new WWTP more than 10,000 m^3/day = 10,000 LE/m^3;
- Running cost for existing (treatment only) = 40~65 piasters/m^3;
- Running cost (collection, pumping and treatment) = 1.5 LE/m^3.

The sub-watershed of the study area has been divided into villages and clusters (Figure 3) and has been classified as:

- Served villages: those villages that have wastewater treatment facilities;
- Un-served villages: those villages that have no wastewater treatment facilities;
- Cluster: a geographical area that has more than one villages and can be served by one WWTPs;

3.1.1 Prioritization of building a new WWTPs within El-Salam watershed area

Prioritization of the constructing new WWTPs has been identified within the sub-watershed of El-Serw and Bahr-Hadous drains. The analysis has been done through a GIS network to calculate the maximum organic load resulting from each village at the mixing point with El-Salam Canal (BOD Total maximum daily load). The GIS model has been built within the framework of the available information from Ministry of Housing, Utilities and Urban Development (MoHUUD) to determine the priorities from the perspective of water managers, where the geographic data of the villages, main and secondary drains of the study area has been adopted, along with the population data from the Holding Company for Water Supply and Sanitation (HCWSS 2016).This section aims to determine the priorities of the implementation of WWTPs in successive phases in order to reach the accepted quality of mixed drainage water on the El-Salam canal to the degree that commensurate with the importance of this project from both environmental and national prospective.

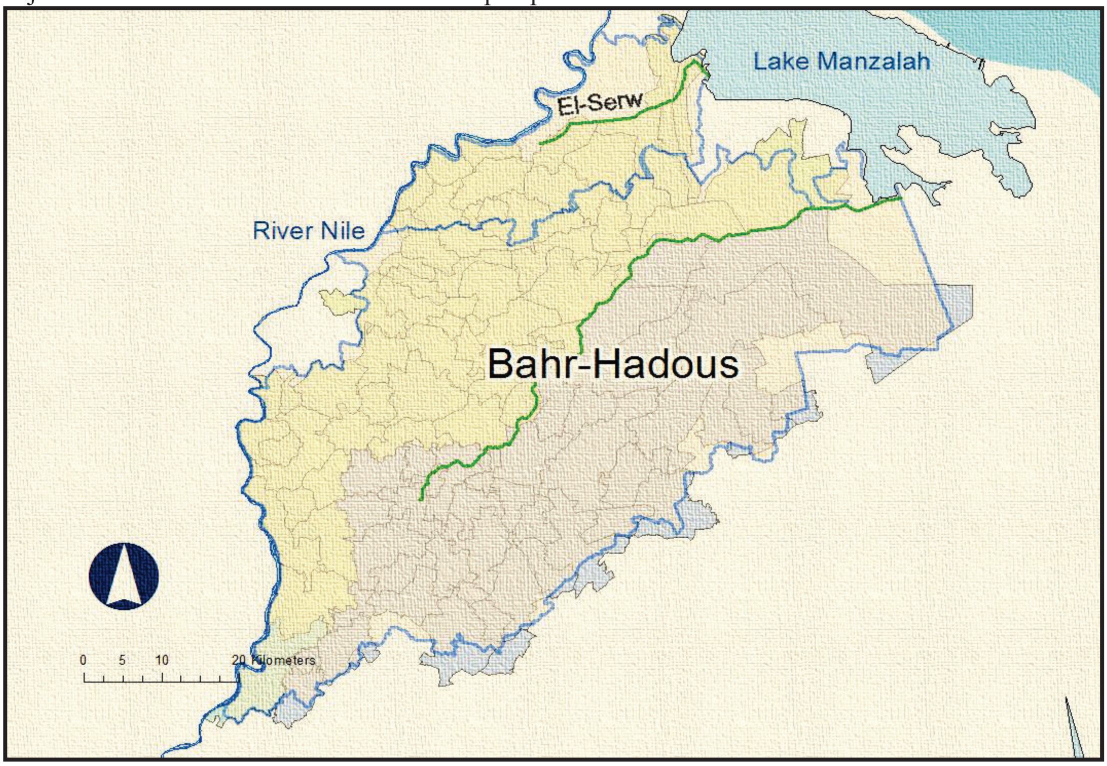

Figure 3: Watershed divided to clusters

3.1.2 Network analysis for WWTPs prioritization

Assumption:

Pollution load:

BOD: 15-80 gm/capita/day, this study considers the figure 54 gm/capita/day (Egyptian Code for Sewage Treatment 2007), and/or 230-560 gm/m^3, (the figure 423.5 gm/m^3will be considered in this study) (Henze et al. 2018)

BOD load calculation (Egyptian Code for Sewage Treatment 2007)

Residential wastewater flow: $\boldsymbol{Q_{av(Sewage)}}$

$$\boldsymbol{Q_{av(sewage)}/Capita = (0.85) \times Q_{av(Water\ consumbtion)}} \quad (2)$$

$$Q_{av(Water\ consumbtion)} = 150\ Liter/capita/day.$$

By considering the assumptions and applying the network analysis according to flow direction as in figure 4, for the villages within the sub-catchment of ElSerw and Bahr-Hadous, a list of the priorities for the most affective un-served villages in producing BOD. A map analysis has been done for villages within El-Serw drain, verified with field investigation and the results were as follows:

3.1.3 Un-served villages (discharge directly to El-Serw drain network)

- Served number of villages 51 Villages;
- Number of villages within sub-watershed 88 Villages;
- With a total population 881,786 Capita;
- Number of existing WWTPs 21 WWTP;
- With population of 217,546 capita;
- Within Number of clusters 24 clusters;
- Number of un-served villages and discharge their effluent to drains without treatment (Figure 5) 36 villages;
- With a total population 277,646 capita;
- Producing raw sewage of 35,400 m^3/day;

Resulting 11,078 kg/day BOD at source (drains) and ending to 9,952 kg/day at the mixing point with El-Salam canal.

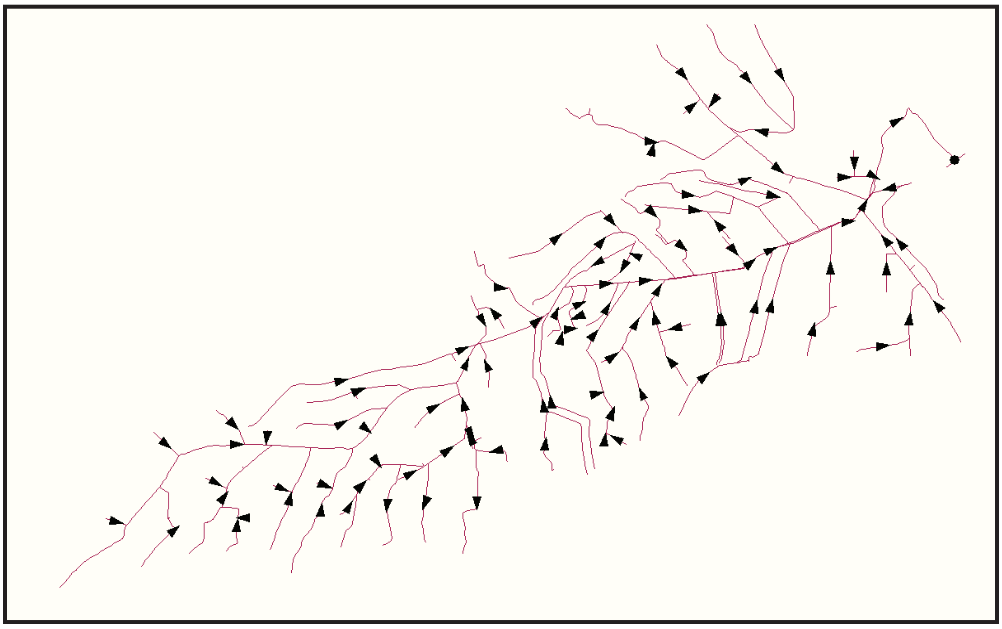

Figure 4: Flow network diagram for El-Serw drain

3.1.3.1 Proposed new WWTPs

By starting the 1st phase with building the most effective 10 new WWTPs, that impacting high reduction in BOD load at the mixing point with El-Slam canal (Figure 6) as follows:

- 1st phase new WWTPs (Figure 6) 10 plants;
- Serving a population of 142,167capita;
- With a capacity of 18,126 m^3/day;
- To remediate a total of BOD 7,677 kg/day;

This end up to a reduction in the total BOD load of 7,677 kg/day at source and 6,597 kg/day at mixing point, by applying the treatment process for the 1st 10 new WWTPs, the BOD will drop down from 11,078 to 3,401 kg/day at source and from 9,952 kg/ day to 3,355 kg/ day of BOD at the mixing point.

3.1.4 Un-served villages (discharge directly to Bahr-Hadous drain's network)

A map analysis has been done for villages within Bahr-Hadous sub-watershed, verified with field investigation and the results were as follows:

- Number of villages within sub-watershed 641 Villages;
- With a total population 6,221,024 capita;
- Number of existing WWTPs 82 WWTP;
- Served number of villages 262 Villages;
- Within Number of clusters 75 clusters;
- Number of un-served villages and discharge their effluent to drains without treatment (Figure 7) 379 villages;
- With a total population 2,882,123 capita;
- Producing raw sewage of 367,000 m^3/day;

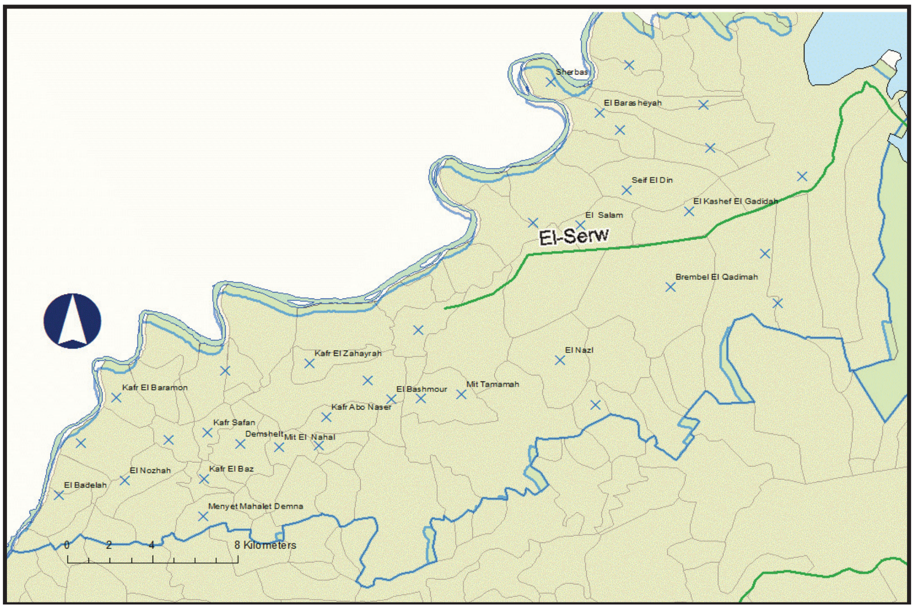

Figure 5: Un-served villages within El-Serw catchment area

Resulting 155.6 tons/day BOD at source (drains) and ending to 123.2 tons/day at the mixing point with El-Salam canal.

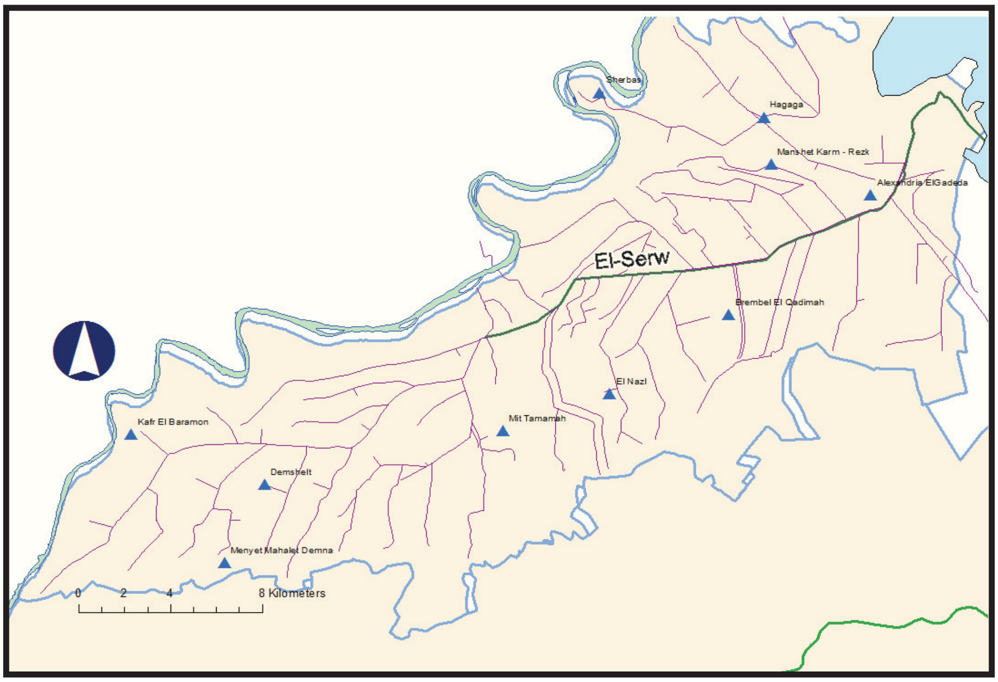

Figure 6: Scenario 1: First 10 new establish new WWTPs within El-Serw catchment area

3.1.4.1 Proposed Treatment solution

By starting the 1st phase with building the most effective 126 new WWTPs, that producing high reduction in BOD load at the mixing point with El-Salam canal as follows:

- 1st phase WWTPs (Figure 8) 126 plants;
- Serving a population of 1,810,846 capita;
- With a capacity of 230,882 m^3/day;
- To remediate a total of BOD 97,779 kg/day;

This is resulting a reduction of total BOD by 97,779 kg/day at source and at mixing point ending to 62,194 kg/day. By applying the treatment process for the 1st 126 new WWTPs, the BOD will drop down from 155,600 to 57,821 kg/ day at source and from 123,200 kg/ day to 61,006 kg/ day of BOD at the mixing point.

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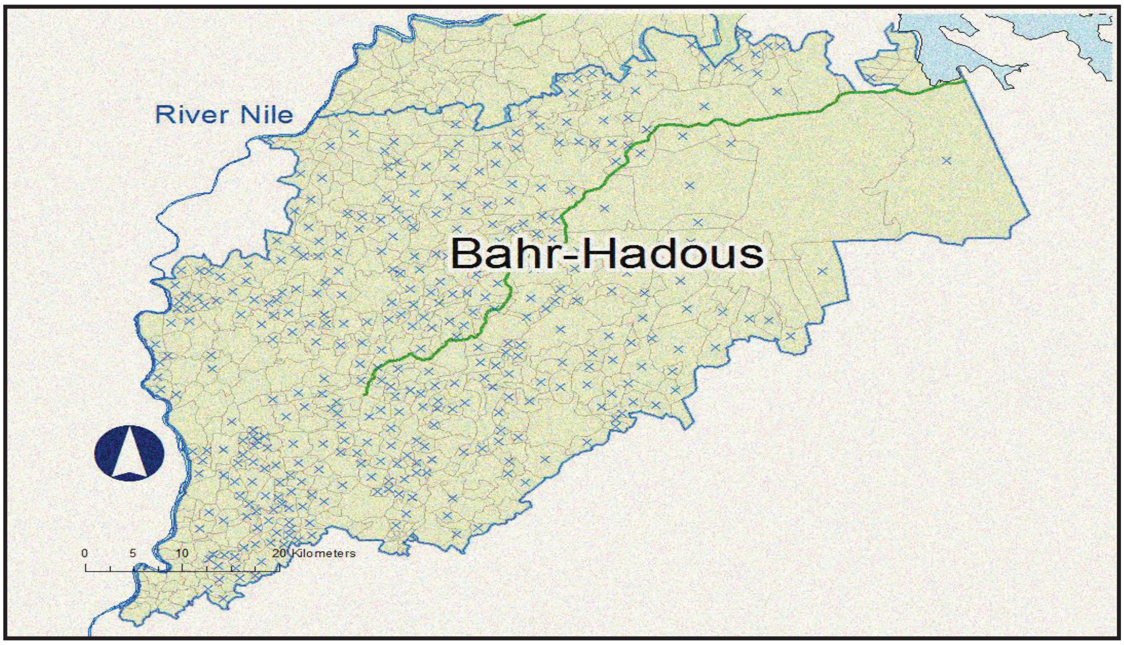

Figure 7: Un-served villages within Bahr-Hadous catchment area

3.1.5 Cost analysis for treatment and pollution control

3.1.5.1 Treatment (Building new WWTPs)

The assumption: Capital cost for less than 10,000 m^3/day = 8000 LE/m^3 (All treatment plants within the study area are of capacity less than 10,000 m^3/day).

a- El-Serw catchment area

b- The 10 first priority of new WWTPs of a discharge 18,126 m^3/ day (8000 LE/m^3) as initial stage cost: 145,010 thousands L.E.;

c- The whole 36 unserved villages of a 35,400 m3/ day as final stage cost: 283,200 thousands L.E.

d- Bahr-Hadous catchment area

- The 126 first priority new WWTPs of a discharge 230,882 m^3/day as initial stage cost: 1,847 thousands L.E.
- The whole 379 unserved villages of a 367 thousands m^3/day as final stage cost: 2,939,000 thousands L.E

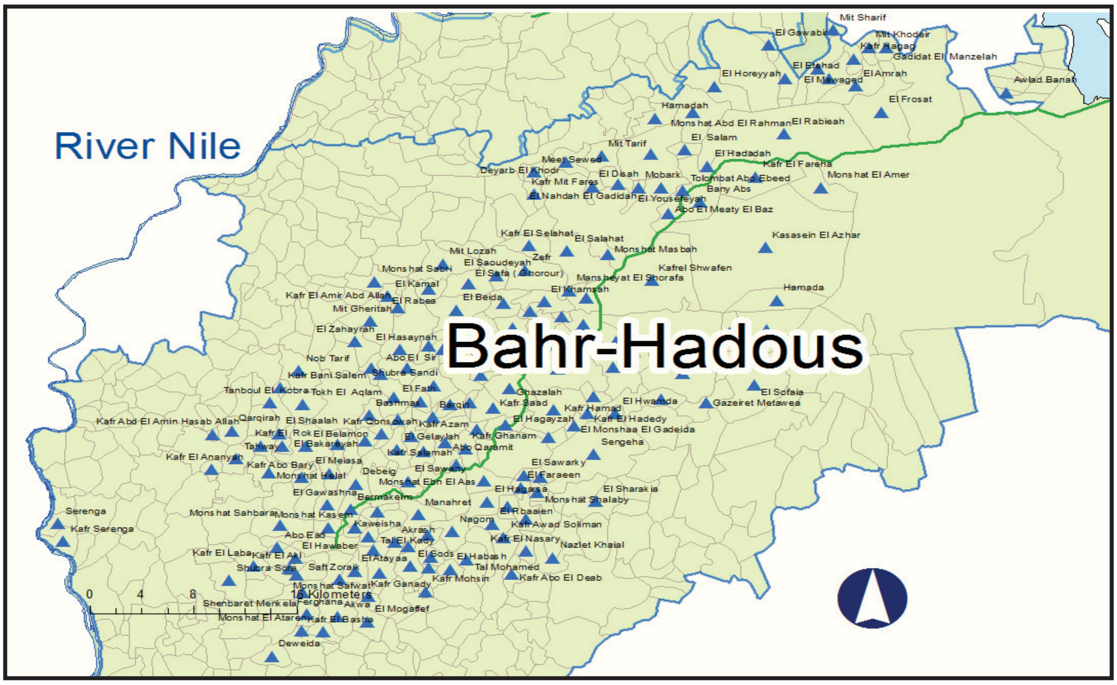

Figure 8: Scenario 1: first 126 new establish WWTPs within Bahr-Hadous catchment area

3.2 Scenario 2: Upgrading existing WWTPs for served areas

3.2.1 Served villages (Existing WWTP)

a- WWTPs (discharge directly to El-Serw drain network)

- Number of existing WWTPs 21;
- Serving population of 217,546 capita;
- With a treatment capacity of raw sewage 29,840 m^3/day (actual capacity);
- With an average efficiency of 67.5 %
- That result to 9,698 m^3/day untreated sewage;

Resulting 4,107 kg/day BOD at source (drains) and ending to 2,854 kg/day at the mixing point with El-Salam canal (taking the assumption 423.5 gm/m^3 BOD)

Proposed upgrading and upscaling existing WWTPs:

By applying upgrading for the most effective existing WWTPs, starting the 1st phase with 12 WWTPs, by raising up the efficiency from 67.5 to 95% and producing high reduction in BOD load at the mixing point with El-Slam canal as listed:

- 1st phase upgrade/ upscale WWTP 12 plants;
- Serving a population of 166,090 capita;
- With a capacity of 22,890 m^3/day (actual capacity);
- Untreated amount of sewage 7,439 m^3/day (67.5 % efficiency);
- To remediate a total of BOD of 3,150 kg/day;
- This end up to a total BOD at mixing point 2,548 kg/day;

By executing the upgrading and upscaling for the 1st 12 existing WWTP, the BOD will drop down from 4,107 to 957 kg/ day at source and from 2,854 kg/ day to 306 kg/ day of BOD at the mixing point.

b- WWTPs (discharge directly to Bahr-Hadous drain network):

- Number of existing WWTPs 62;
- Served villages of 213;
- With a population 3,337,898 capita;
- With a capacity of 425,582 m^3/day;
- With an average WWTPs efficiency of 68 %;
- That result to 136,186 m^3/day untreated sewage;

Resulting 57,675 kg/day BOD at source (drains) and ending to 38,854 kg/day at the mixing point with El-Salam canal (taking the assumption 425 gm/m^3 BOD).

Proposed Treatment solution

By starting the 1st phase upgrading and upscaling the most effective 40 existing WWTP, that producing high reduction in BOD load at the mixing point with El-Slam canal as listed:

- 1st phase upgrade/ upscale WWTP 40 plants;
- Serving a population of 2754,625 capita;
- With a capacity of 351,215 m^3/day (actual design);
- Untreated amount of sewage 133,462 m^3/day (68% efficiency);
- To remediate a total of BOD 56,521 kg/day;
- This end up to a total BOD at mixing point 38,115 kg/day;

By executing the upgrading and upscaling for the 1st 40 WWTP, the BOD due to unqualified treatment will drop down from 57,675 to 1,154 kg/ day at source and from 38,854 kg/ day to 0.739 kg/ day at the mixing point with El-Salam canal.

4- Results summary

- The total sewage produced within watershed area is **882,963** m^3/day ; Treated amount is 402,400 m^3/day, representing a percentage of 45.6 % of a total sewage with an efficiency of around 68%;
- **Scenario 1**: Building the most effective new WWTPs for un-served villages (10 new WWTPs out of 36 unserved villages within El-Serw and 126 out of 379 unserved within Bahr-Hadous sub-watershed);
- **Scenario 2**: Upgrading the most effective existing, unqualified WWTPs for served villages (12 WWTPs out of 21 WWTPs within El-Serw and 40 WWTPs out of 62 within Bahr-Hadous sub-watershed;

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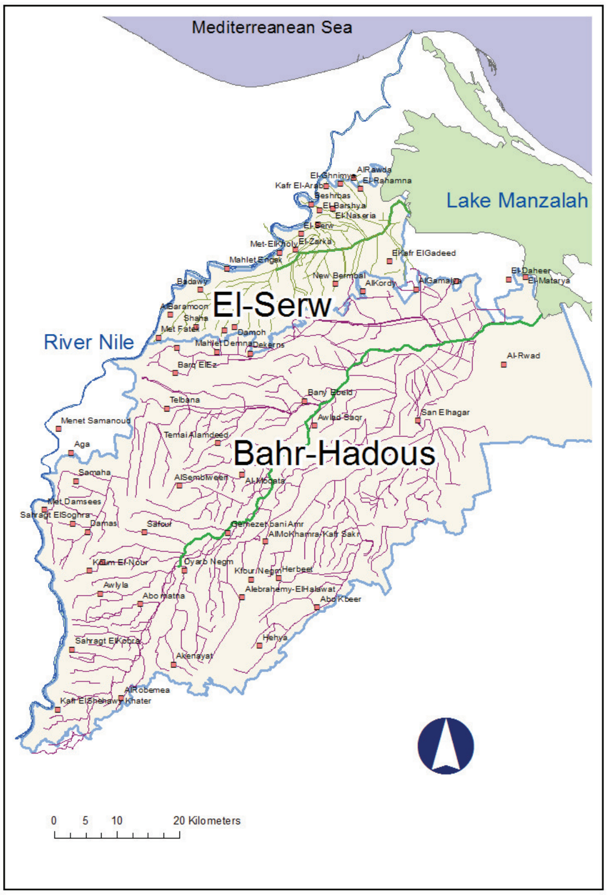

Figure 9: Integrated framework for watershed management

- The sum of treated sewage out of both scenarios= **394,892** m^3/day representing 44.7 % of total production wastewater;
- The reduction of the BOD load from 228,460 kg/ day to 63,333 kg/ day with a reduction percentage of 72.3 % at source;
- Along with a reduction in BOD load from 174,860 kg/ day to 65,406 kg/day with a reduction of 62.6 % at mixing point with El-Salam canal.
- Scenario 1: was to build 136 new WWTPs out of expected 454 WWTPs.
- Scenario 2: was to upgrade 62 Existing WWTPs out of 83 WWTPs.

5- Conclusions

Using watershed management approach with a proper tool of analysis resulted in the best scenarios for mitigation of the problem of bad quality of mixing water within El-Salam watershed as follows:

- Building of 30% of required new WWTPs along with upgrading 75% of existing WWTPs results in treating 44.7 % of total sewage water, 98 % of untreated sewage water, reducing BOD load with 72.3 % at source and 62.6 % at mixing point.

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Appendix 1: Example of network analysis output

Table

Cent_Vil_3

SHI_NAME	areaa	X	Y	OBJECTID	REMOVAL_PO	master_dra	Shape_Leng	Shape_Le_1	Latitude	Longitude	BOD	Enabled	Ancil
Gozor Bohayrat El Manzelah	0	408289.890091	3448534.28085	123	ترعة السلام	حادوس	446296.596436	12068.049321	3448534.28085	408289.890091	300	True	
Mit Sharif	0	391815.289602	3449137.96996	123	ترعة السلام	حادوس	446296.596436	5918.119878	3449137.96996	391815.289602	600	True	
Izbet El Tawabrah	0	400796.842079	3448692.8997	123	ترعة السلام	حادوس	446296.596436	3821.181671	3448692.8997	400796.842079	500	True	
Madinat El Manzalah	0	399147.041637	3443813.23271	123	ترعة السلام	حادوس	446296.596436	30069.897858	3443813.23271	399147.041637	200	True	
Mit Khodeir	0	394552.951315	3447597.99248	123	ترعة السلام	حادوس	446296.596436	8569.489245	3447597.99248	394552.951315	400	True	
Gadidat El Manzelah	0	395888.879477	3447555.27284	123	ترعة السلام	حادوس	446296.596436	7795.553197	3447555.27284	395888.879477	300	True	
El Mawaged	0	390590.911308	3445673.59152	123	ترعة السلام	حادوس	446296.596436	16901.852623	3445673.59152	390590.911308	200	True	
Kafr Hagag	0	393361.167843	3446535.89148	123	ترعة السلام	حادوس	446296.596436	7904.890828	3446535.89148	393361.167843	<Null>	True	
El Gamamlah	0	408949.76207	3446478.36023	123	ترعة السلام	حادوس	446296.596436	7611.444391	3446478.36023	408949.76207	<Null>	True	
El Sataytah	0	391466.940894	3444785.29629	123	ترعة السلام	حادوس	446296.596436	15846.123284	3444785.29629	391466.940894	<Null>	True	
Awlad Nour	0	406991.180875	3446516.76577	123	ترعة السلام	حادوس	446296.596436	6558.146307	3446516.76577	406991.180875	<Null>	True	
El Amrah	0	393564.100025	3444121.78782	123	ترعة السلام	حادوس	446296.596436	15625.838296	3444121.78782	393564.100025	<Null>	True	
El Qazaqzah	0	406795.551251	3445535.4028	123	ترعة السلام	حادوس	446296.596436	7006.507038	3445535.4028	406795.551251	<Null>	True	
El Frosat	0	395548.866792	3441788.86038	123	ترعة السلام	حادوس	446296.596436	24739.261534	3441788.86038	395548.866792	<Null>	True	
El Daqanwah	0	405114.554312	3445279.97778	123	ترعة السلام	حادوس	446296.596436	8197.536489	3445279.97778	405114.554312	<Null>	True	
El Horeyyah	0	382585.116352	3444068.7214	123	ترعة السلام	حادوس	446296.596436	18042.328498	3444068.7214	382585.116352	<Null>	True	
El Qatshah	0	408652.911071	3445061.03358	123	ترعة السلام	حادوس	446296.596436	7282.415936	3445061.03358	408652.911071	<Null>	True	
El Hanaydah	0	405367.813834	3444312.73255	123	ترعة السلام	حادوس	446296.596436	8026.280507	3444312.73255	405367.813834	<Null>	True	
El Qatili	0	407915.890805	3444003.91535	123	ترعة السلام	حادوس	446296.596436	6923.414681	3444003.91535	407915.890805	<Null>	True	
Awlad Banah	0	405185.671797	3443546.79236	123	ترعة السلام	حادوس	446296.596436	5388.801589	3443546.79236	405185.671797	<Null>	True	
Monshat Abd El Rahman	0	380911.586932	3441803.25854	123	ترعة السلام	حادوس	446296.596436	22372.852625	3441803.25854	380911.586932	<Null>	True	
Awlad Hanah	0	406734.22358	3443053.0241	123	ترعة السلام	حادوس	446296.596436	9025.462157	3443053.0241	406734.22358	<Null>	True	
El Rabieah	0	388015.442587	3439831.89533	123	ترعة السلام	حادوس	446296.596436	36759.103276	3439831.89533	388015.442587	<Null>	True	
El Koramaa	0	370361.987105	3438815.72953	123	ترعة السلام	حادوس	446296.596436	32715.098607	3438815.72953	370361.987105	<Null>	True	
El Mahmoudeyah	0	377636.761599	3438047.98728	123	ترعة السلام	حادوس	446296.596436	19719.906696	3438047.98728	377636.761599	<Null>	True	
Mit Tarif	0	373839.086123	3437846.68288	123	ترعة السلام	حادوس	446296.596436	13174.086719	3437846.68288	373839.086123	<Null>	True	
Mahalet Demna	0	357659.523227	3437144.21625	123	ترعة السلام	حادوس	446296.596436	18780.642918	3437144.21625	357659.523227	<Null>	True	
El Salam	0	380237.499607	3438397.76468	123	ترعة السلام	حادوس	446296.596436	7186.000855	3438397.76468	380237.499607	<Null>	True	
Deyarb El Khodr	0	371087.184052	3437339.07776	123	ترعة السلام	حادوس	446296.596436	14790.90582	3437339.07776	371087.184052	<Null>	True	
Salamon	0	353893.600015	3437673.97947	123	ترعة السلام	حادوس	446296.596436	13950.414689	3437673.97947	353893.600015	<Null>	True	
El Hadadah	0	382058.694003	3436922.37151	123	ترعة السلام	حادوس	446296.596436	18570.49567	3436922.37151	382058.694003	<Null>	True	
Meet Sewed	0	368634.594869	3436430.64973	123	ترعة السلام	حادوس	446296.596436	9304.724989	3436430.64973	368634.594869	<Null>	True	
El Danabiq	0	351898.202136	3436342.50503	123	ترعة السلام	حادوس	446296.596436	10146.639676	3436342.50503	351898.202136	<Null>	True	
El Nahdah El Gadidah	0	375089.456941	3435309.72209	123	ترعة السلام	حادوس	446296.596436	13256.909407	3435309.72209	375089.456941	<Null>	True	
Bani Ebeid	0	373701.492973	3432678.35399	123	ترعة السلام	حادوس	446296.596436	38185.571047	3432678.35399	373701.492973	<Null>	True	
El Disah	0	373107.052593	3435130.47169	123	ترعة السلام	حادوس	446296.596436	7981.573071	3435130.47169	373107.052593	<Null>	True	
Mit Fares Wa Kafraha	0	366629.055065	3434813.51818	123	ترعة السلام	حادوس	446296.596436	14388.487367	3434813.51818	366629.055065	<Null>	True	
Badin	0	356007.118301	3435239.53314	123	ترعة السلام	حادوس	446296.596436	12516.932131	3435239.53314	356007.118301	<Null>	True	