Water Quality Assessment in the Nile River, Damietta Branch, Egypt

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The Nile River, Egypt

- The Nile is the main source of fresh water in Egypt (1352 km length, 55.5 BCM); with various uses:- drinking/domestic, irrigation, industry, fisheries, navigation, recreation, etc.
- Water needs in Egypt are continuously increasing as a result of population growth and various developments (agricultural “80%”, urbanization, industriazation).
- Increasing Nile water pollution (down-stream) is considered one of the main environmental problems facing Egypt.
- Anthropogenic activities have varieties of potential impacts upon water ranging from changes in water quantity (abstraction), to deterioration of water quality and aquatic life.
- Nile water management along with monitoring of water quality have been considered as a national responsibility for achieving sustainable development in Egypt.

The Nile River, Damietta Branch

- The Nile travels 940 km behind the Aswan High Dam, and divides at El-qnater into two branches, Rosette branch and Damietta branch (220 km), enclosing in-between the Nile Delta (holds ecological and economic values).
- The Damietta Branch receives polluted water from agricultural drains, industrial effluents, domestic sewage, urban runoff and extensive fish cages.

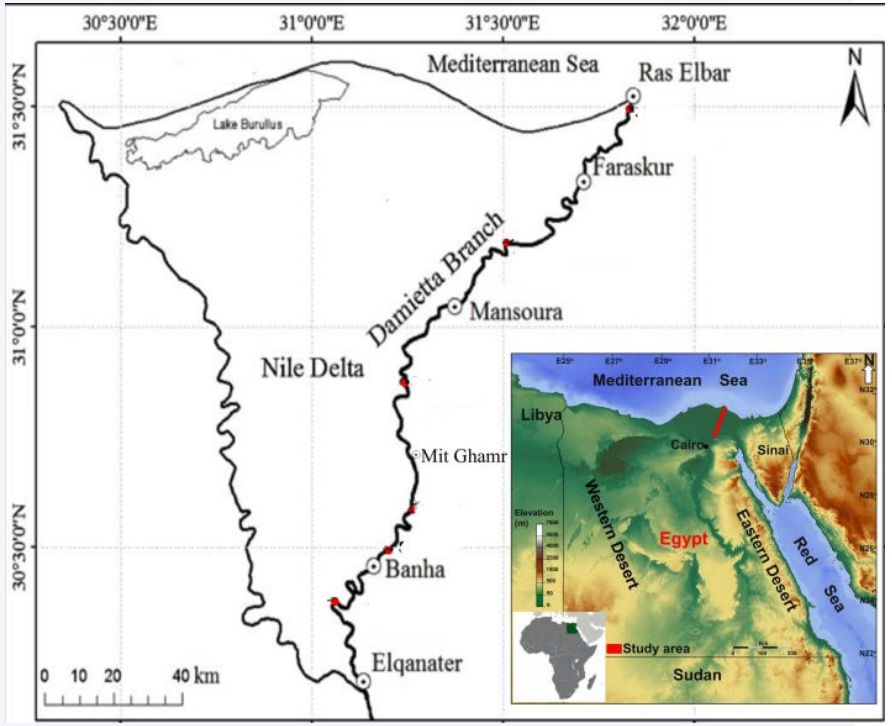


Figure 1: Geographic Map of the Nile River, Delta region.

Water Quality Assessment

- Changes in water quality include depletion of DO, enhanced concentration of DOM and nutrients (N, P), elevated levels of heavy metals, detergents and pesticides.
- Understanding of C, N and P biogeochemical cycles (sources, sinks, transformation) enable us assess water resources quality.
- Organic pollution indicators include DO, BOD, COD, DOC, DON, DOP; nutrients pollution (N, P, Si).
- N species (DON, ammonia, nitrite, nitrate), P (DOP, PO_4).
- C (DOC, carbonate, bicarbonate and CO_2).

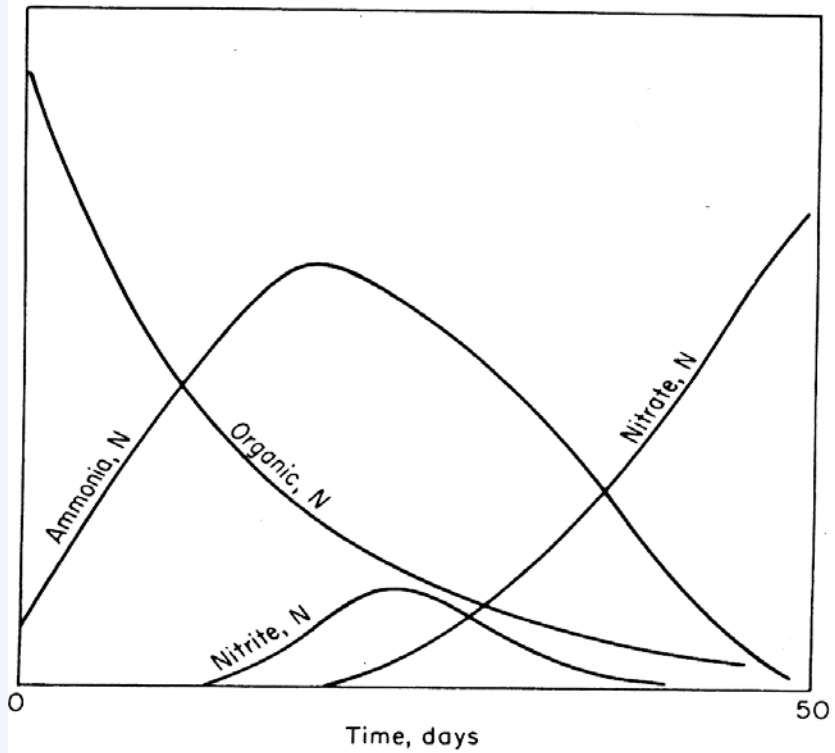


Figure 2: Changes in N species in recently polluted aquatic env with organic matter under aerobic conditions.

Nile WQA

- This study was designed to assess water quality of the Nile - Damietta branch at two different districts Dakahlia and Damietta.
- Twenty-four water sites have been chosen for sample collection and analysis of physio-chemical characteristics of water, some heavy metals, and calculating WQI.
- Sampling started from upstream near Banha to downstream Ras El-Bar

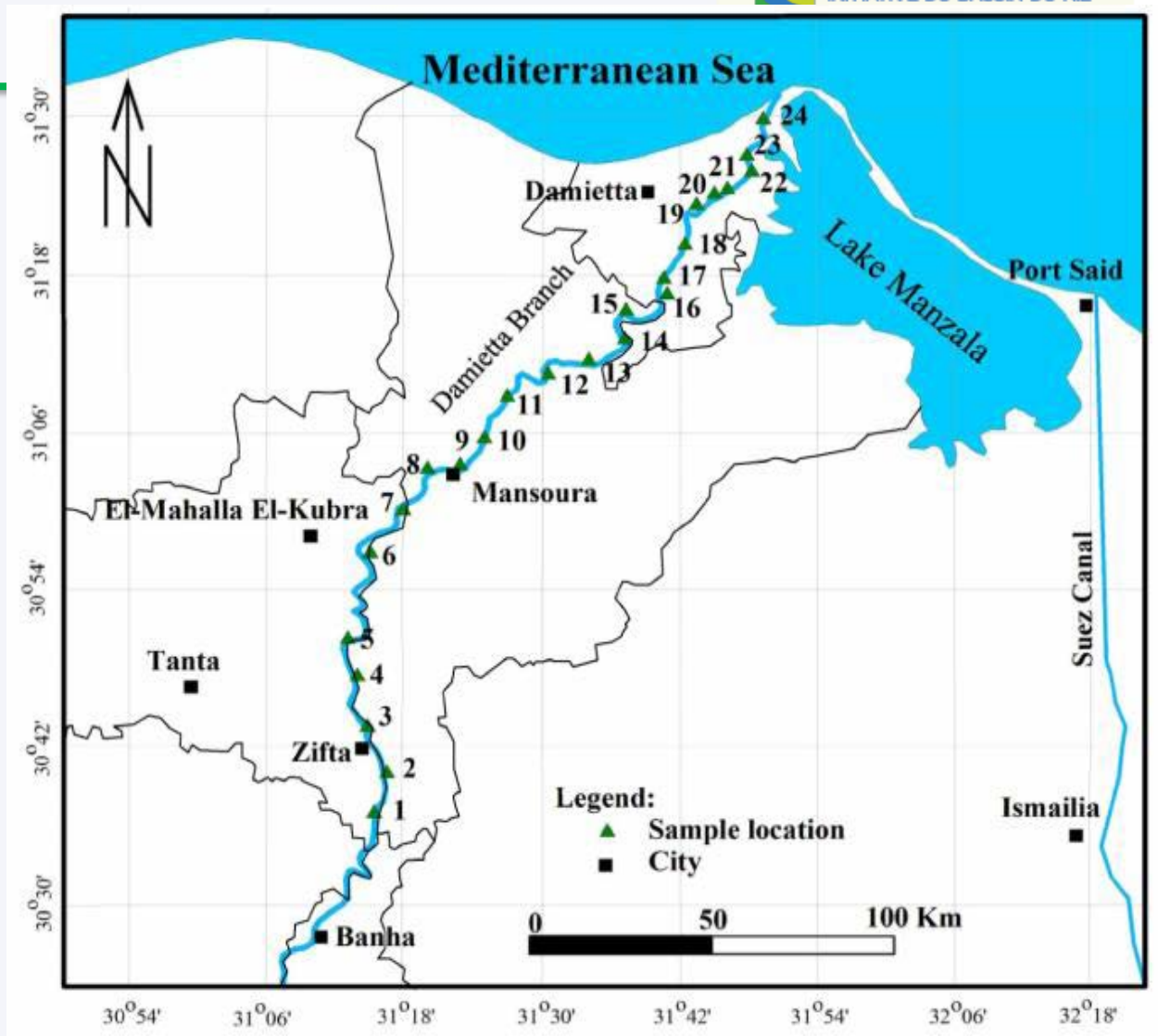


Figure 3: Geographic Map of the Nile River, Damietta Branch.

Nile WQA

- Measured water quality parameters include pH, TDS, EC, Turbidity, pollution indicators (DO, BOD, COD), organic matter (DOC, DON, DOP), nutrients (N,P) including NH_4, NO_2, NO_3, PO_4, heavy metals (Fe, Mn, Cu, Zn, Pb, Cd); along with calculating WQI.
- WQI was calculated for each sampling point using the following empirical equation

$$WQI = k \frac{\sum_i C_i w_i}{\sum_i w_i}$$

- Where, Ci is the value assigned to each measured parameter after normalization, Wi is the relative weight assigned to each parameter, k is a subjective constant.
- WQI is usually ranges from <25 (highly polluted water), 26-50 (bad), 51-70 (medium),71-90 (good), 91-100 (excellent water quality).

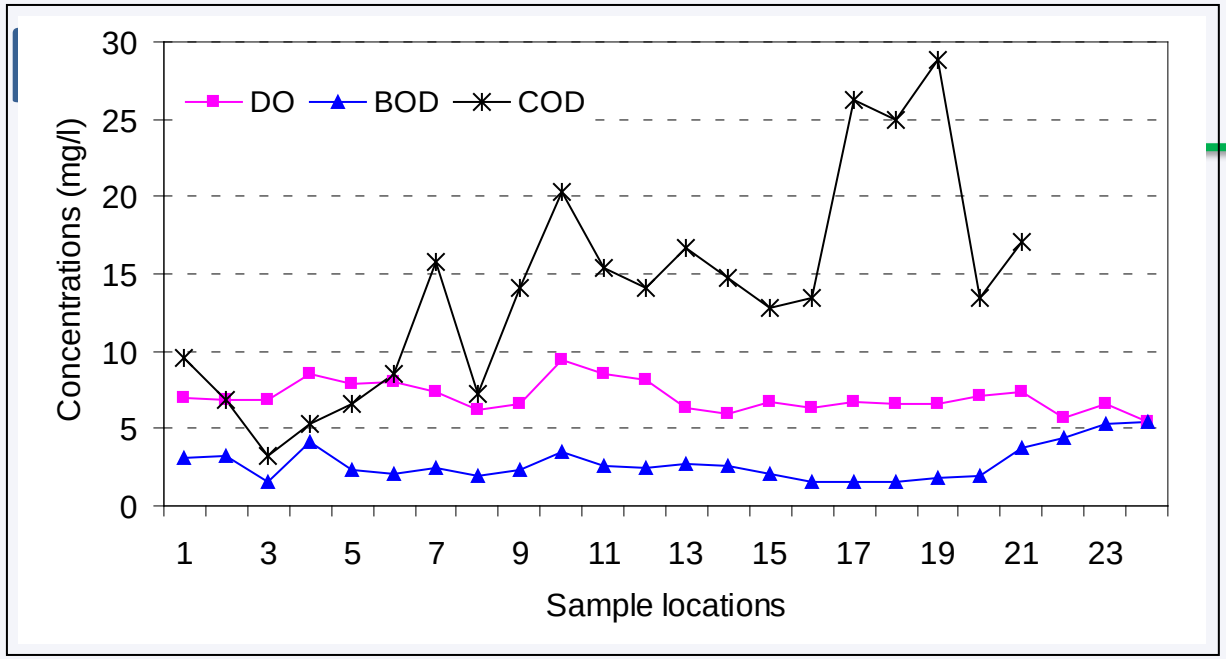
Nile WQA Findings 1

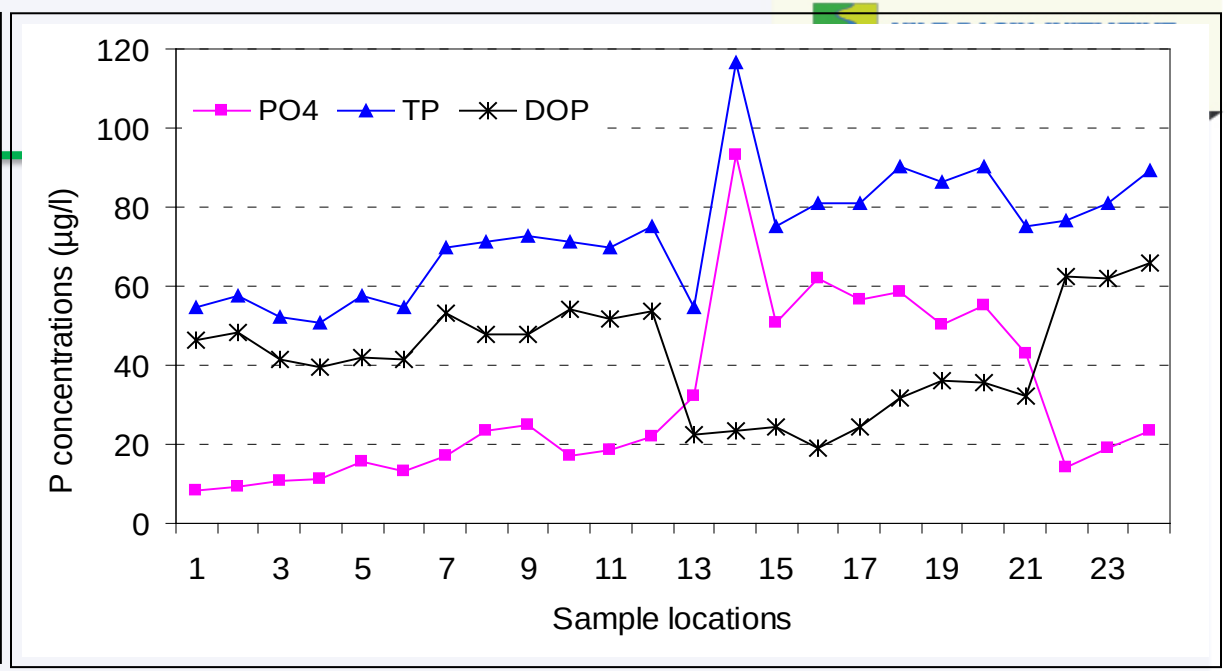
- TDS values for freshwater samples were in the range of 170 – 248 mg/l. Turbidity values ranged from 0.74 to 6.6 NTU.
- Values of DO, BOD and COD ranged 5.46 - 9.5 mg/l, 1.54 to 5.40 mg/l, and 3.78 - 28.9 mg/l; respectively. Relatively higher DO values were reported for water samples collected from Dakahlia district; reflecting a better water quality of this region compared to downstream.
- Average concentrations ammonia, nitrite, nitrate, phosphate were 174±131, 33.6±30.8, 239±156, and 47.8±33.8 µg/l; respectively
- Average concentrations DOC and DON were 5.15±2.36 mg/l, and 251±115 µg/l; while DOP ranged 18.8-65.8 µg/l.
- The amount of DON as a percentage of TDN pool ranged 23.9 - 71.5 %; whereas percentages of DOP/TP of were in the range 20.1 – 84.6 %

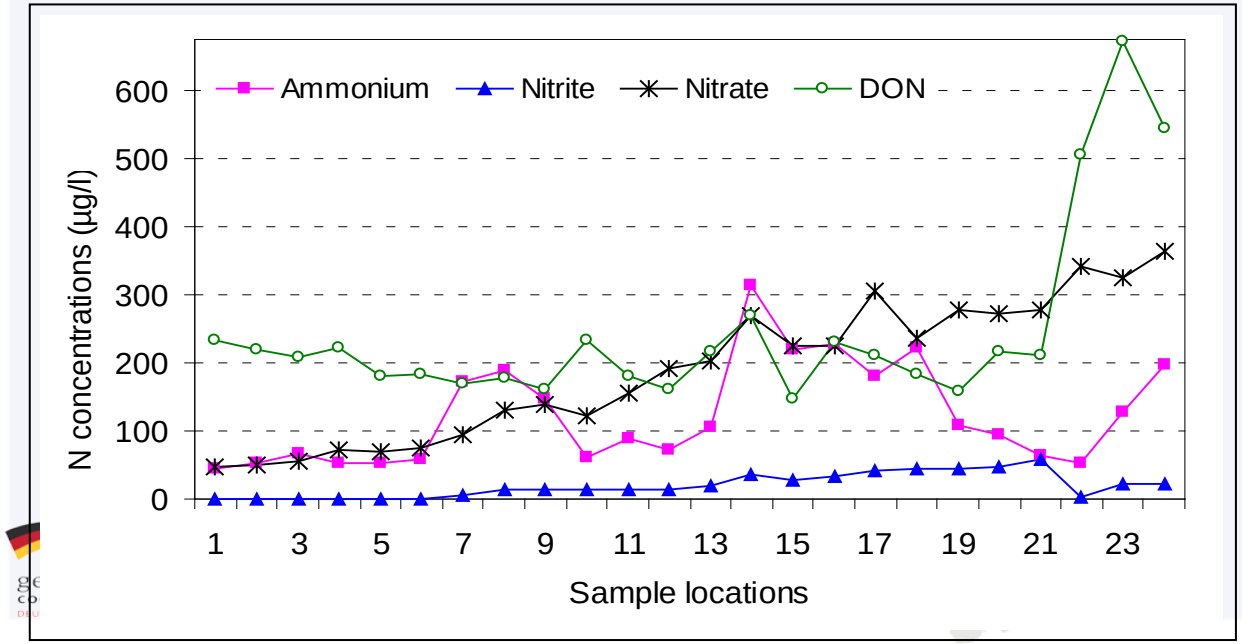
Nile WQA Findings 2

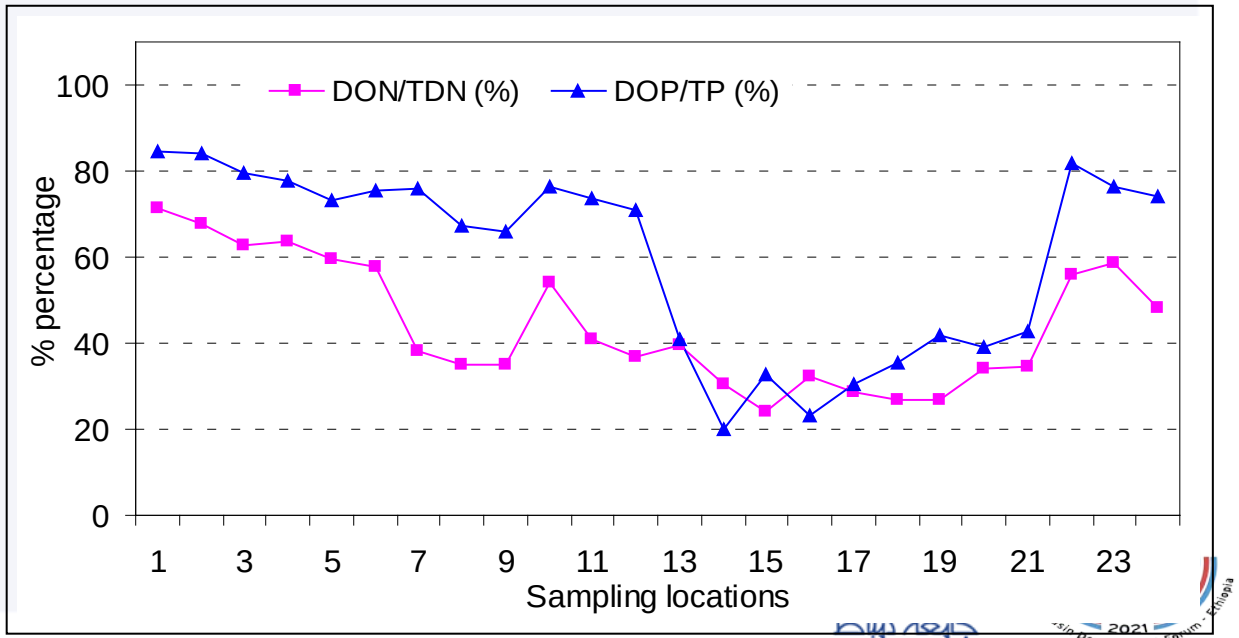
- Relatively higher concentrations of BOD, COD, nutrients (ammonium, nitrite, nitrate, and phosphate), dissolved organic matter (DOC, DON) and some heavy metals (iron, manganese, and lead) were measured in the Nile at Damietta district, compared to Dakahlia district.
- The obtained results indicate relatively better water quality of the Nile up stream at Dakahlia Governorate. Whereas the Nile at Damietta Governorate is subjected to various sources of pollution such as domestic wastewater, industrial discharge, agricultural drains and the undesirable habits of the local people.
- Thus, the Nile River in the vicinity of Damietta City is under pollution stress from various anthropogenic activities.

Figure 4: Concentrations of some of the measured water characteristics in the Nile, Damietta Branch.









Nile WQA Findings 3

- WQI indicates better water quality of the Nile at Dakahlia district (WQI ranges 85 – 92) compared to Damietta district (WQI ranges 73 – 85).
- Current values of WQI (73 – 92) are higher than WQI values (62 – 76.5) reported by El-Ezaby et al (2010); indicating improvement of water quality after removal of fish cages
- A bacterial incubation experiment indicated that 52.1–95.0 % of DON was utilized by bacteria within 21 days. Decrease in DON value was accompanied by an increase in nitrate concentration of 54.8–87.3 %, presumably through DON mineralization.
- Concentrations of major chemical elements in the Nile water were correlated with the distance downstream from the source of the river, with water in the upstream reaches of good quality, but were relatively polluted at the estuary.

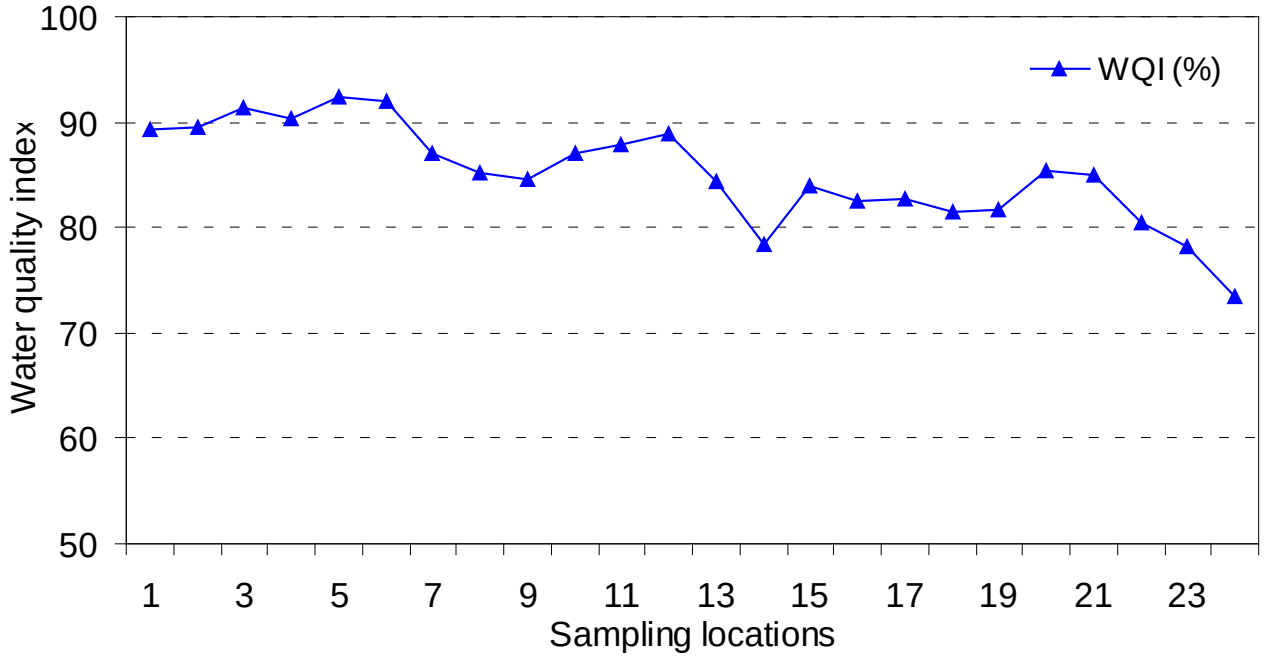


Figure 5: Values of water quality index (WQI) in the Nile, Damietta Branch.

- Better water quality of the Nile at Dakahlia district (WQI 85 – 92) compared to Damietta (WQI 73 – 85).

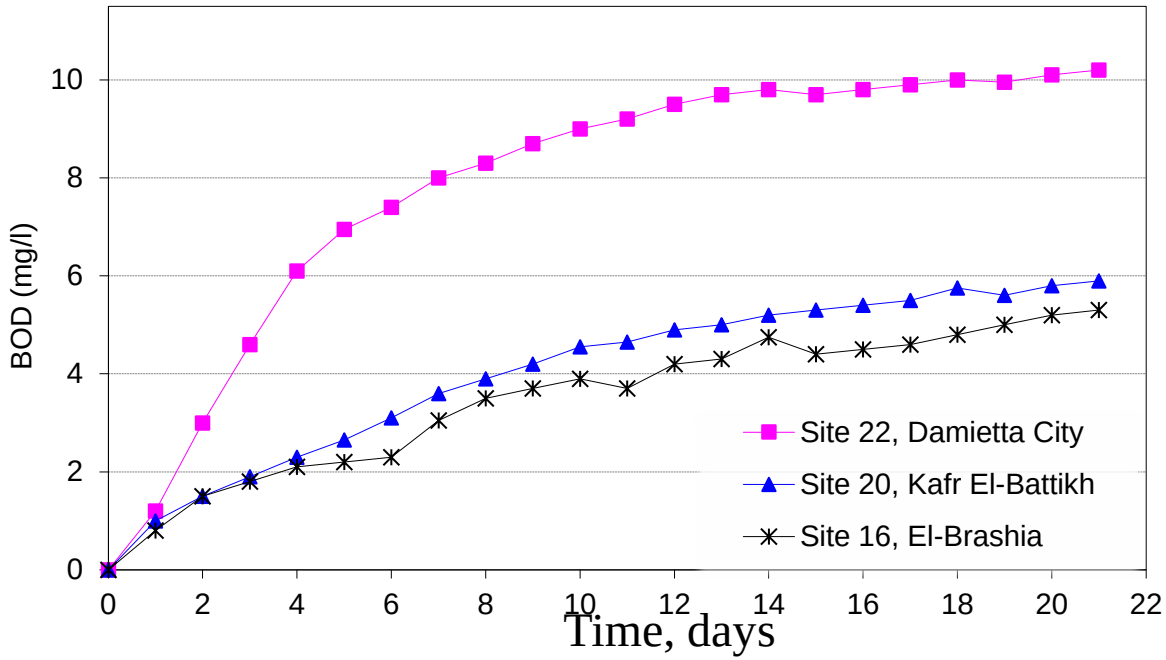
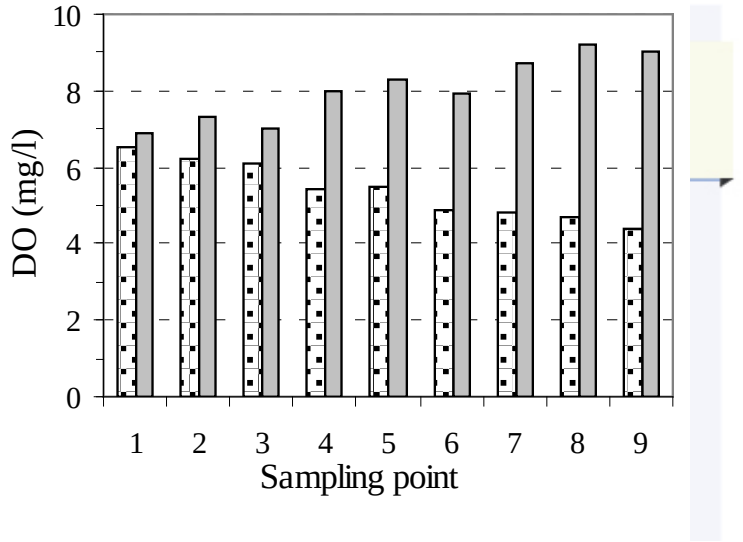


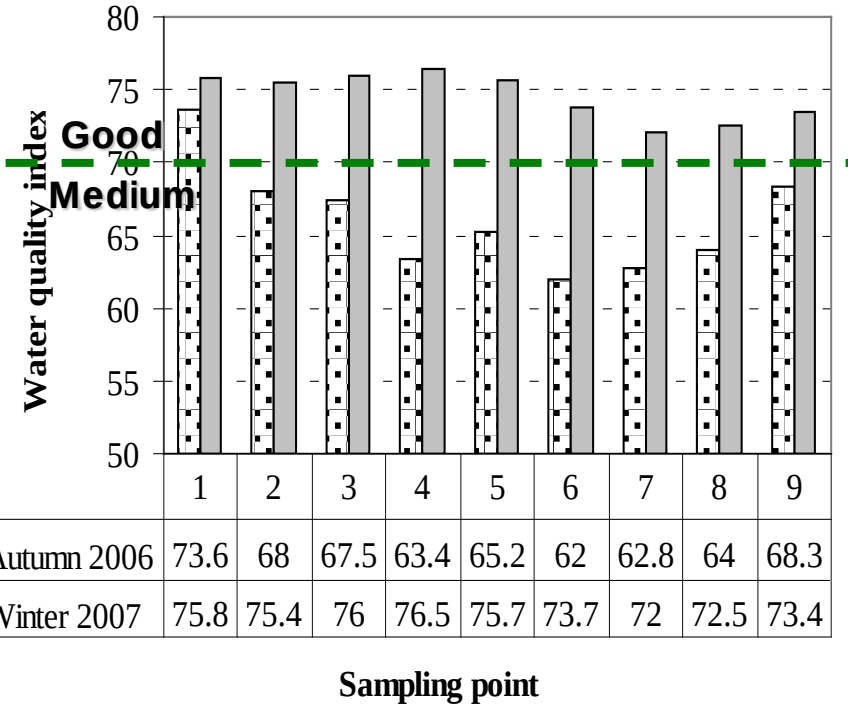
Figure 6: Bacterial growth curve (BOD) as function of time.

- High bacterial growth rate (site 22) reflect high organic matter load.

Nile WQA – Fish cages

- Fish cages developed since 1984, with increasing levels of pollution.
- Aimed to investigate the impact of fish cages removal (government decision, 2006) on the Nile water quality at Damietta region
- The result proved that fish cages removal from Damietta branch improved its water quality.
- DO values improved from 4.4 – 6.5 mg/l of 1st field trip to 6.9 – 9.2 mg/l of 2nd field trip.
- Calculated WQI indicate more biodegradations conditions (medium water quality) after removal of fish cages and improving of the aquatic system into good water quality in winter 2007.





	1	2	3	4	5	6	7	8	9
Autumn 2006	73.6	68	67.5	63.4	65.2	62	62.8	64	68.3
Winter 2007	75.8	75.4	76	76.5	75.7	73.7	72	72.5	73.4

Figure 7: Values of WQI in the Nile, Damietta Branch, after fish cages removal.

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Recommendations

- *Certain water management strategies should be implemented to reduce anthropogenic inputs into the Nile, including*
- *(i) prohibition of discharge of wastewater (agricultural, domestic or industrial) through enforcement of legislations such as Environmental Law No. 4 of 1994 and law No. 48 of 1982;*
- *(ii) use of efficient treatment techniques to effectively treat wastewater;*
- *(iii) re-use of agricultural drainage waters along with treated wastewater in irrigation especially for new land reclamation projects;*
- *(iv) continuous monitoring and evaluation of anthropogenic inputs and their env impacts*
- *(v) strengthening of the integrated coordination between relevant sectoral authorities and academic institutes for the Nile water quality monitoring and data exchange; and*

NILE BASIN INITIATIVE
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THANK YOU!