Ministry of Water Resources and Irrigation

National Water Research Center

Drainage Research Institute

USING REAL -TIME TELEMETRY SYSTEM FOR ASSESSING WATER QUALITY AND IMPROVING ROUTINE MONITORING

BY

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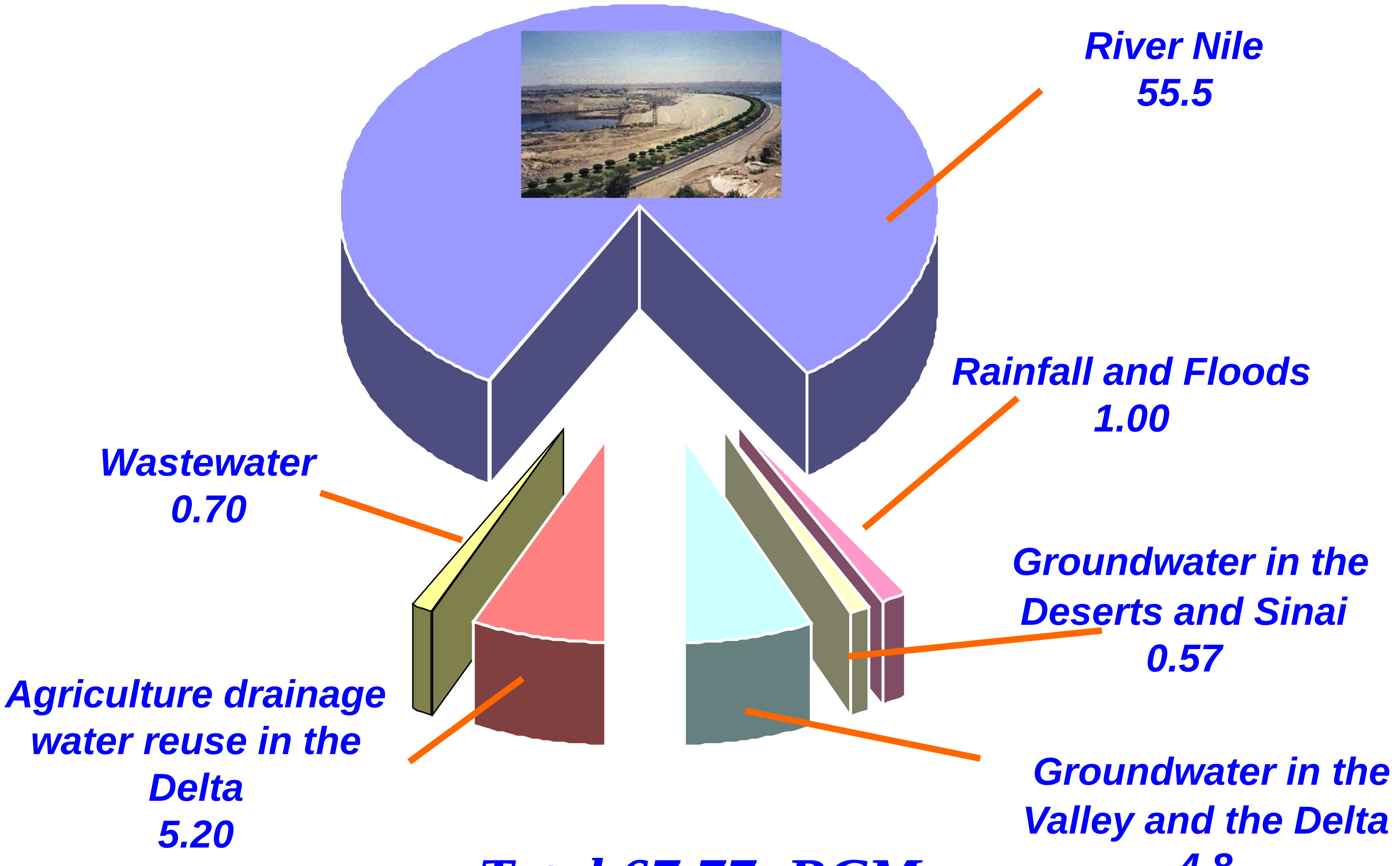
Introduction and Problems Definition.

Water Resources in Egypt



Total 67.77 BCM

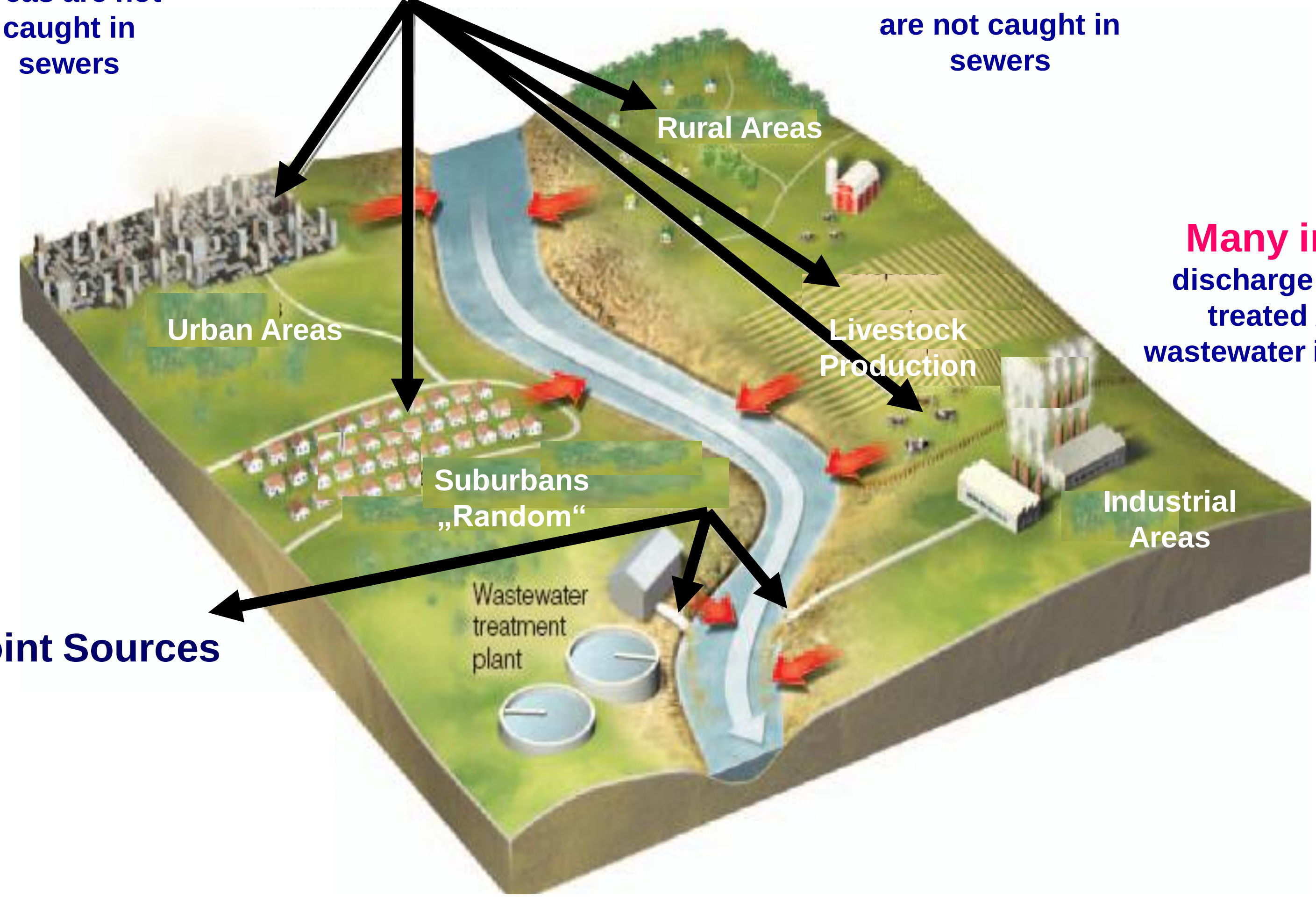
CHALLENGES

20% of urban areas are not caught in sewers

Non-Point Sources

92% of rural areas are not caught in sewers

Many industries discharge inadequately treated / untreated wastewater into the system



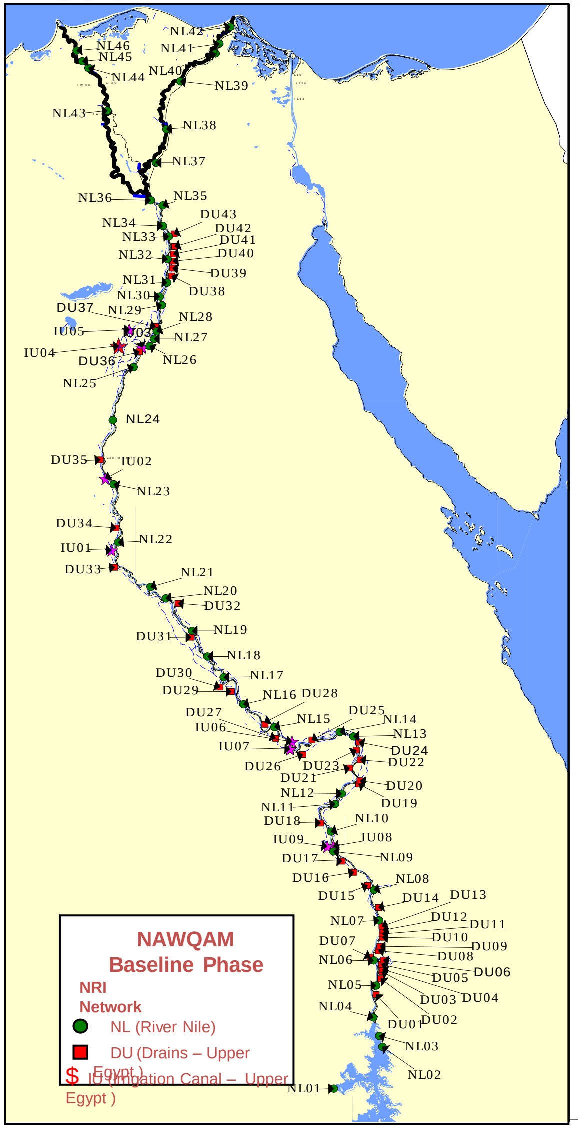
Point Sources

NEEDS FOR MONITORING

In General, water quality data are needed to

- ***Assess compliance with standards;***
- ***Facilitate impact assessment studies;***
- **Validate & calibrate models and establish a databases;**
- **Conduct research;**
- **Define WQ problem;**

Monitoring Sites in Upper Egypt and Nile Branches



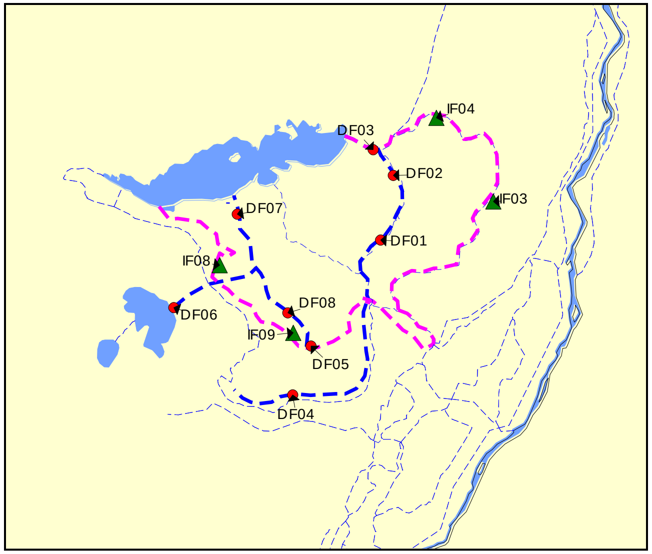
Outfalls to Northern Lakes
15 sites

Nile Delta
Irrigation Canals 50 sites
Drains 116 sites

Nile River
Nile Water 48 sites
Irrigation Canals 9 sites
Drains 43 sites

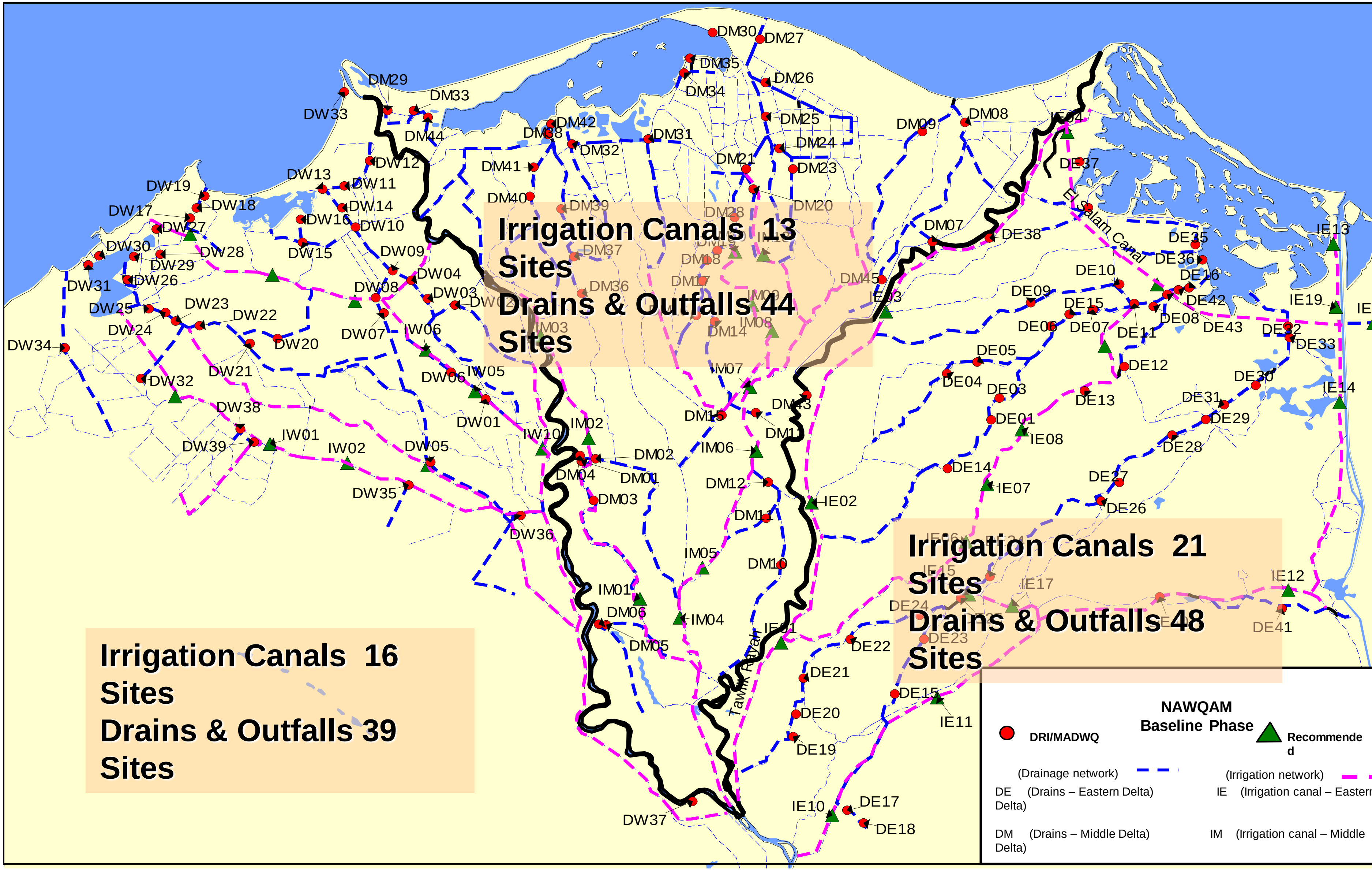
Lake Naser
4 sites

Monitoring Sites in Fayoum



Irrigation Canals 4 sites
Drains 8 sites

NATIONAL WATER QUALITY MONITORING PROGRAM



MONITORED PARAMETERS

Chemical

- EC , TDS, pH
- Na , K, Ca, Mg
- Cl,SO_4,HCO_3,CO_3

Physical Parameters

- Temperature
- Odor, Color
- Turbidity

Microbiology

- Total Coliform

MONITORED PARAMETERS

Nutrients

- **N - (NH4,NO3)**
- **P - (P_2O_5)**

Heavy Metals

- **Fe**
- **Mn**
- **Pb**
- **Cu**
- **Zn**

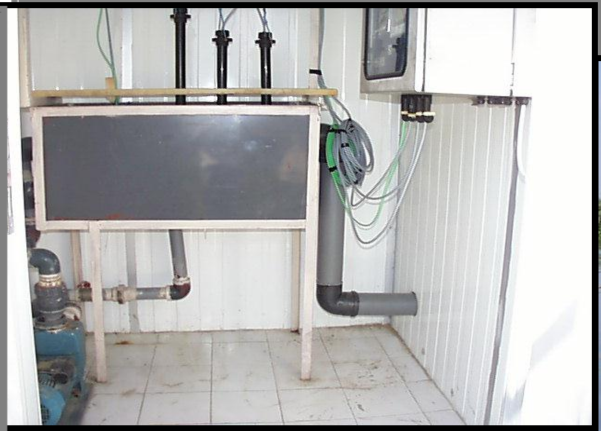
Oxygen budget

- **O2**
- **BOD**
- **COD**

Sampling Frequency

- *Sampling frequency is a function of the statistical objective of the monitoring program.*
- *More measurements will increase the precision, reduce the bias, and increase the power of the statistical component of the program but will increase the overall monitoring cost.*
- *The MWRI take 12 samples per year.*

Routine Monitoring Program



Discharge measurement using current meter

Automatic water quality monitoring station`

Sampling and in-situ water quality measurements

LABORATORY ANALYSIS

CLEQM

Disadvantage of Routine Water Quality Monitoring

- ***In routine WQM, water samples are typically collected and stored for shipment to a laboratory, where they are analyzed.***
- ***The time interval between data records is long too much.***
- ***The system can not detect the pollutions in the same time.***
- ***The decision maker has not enough knowledge to take the fast solution to solve any sudden problems in the water quality .***

Research Objectives

Objectives

The objectives of this study are to:

- Introduce the RWQM technology for Egypt.
- Assess the water quality changes in selected strategic points that represent the River Nile water system using Real Time monitoring.
- Using (WQI) to evaluate the suitability of water bodies for various uses such as drinking, irrigation, livestock, etc.
- *Evaluate different sampling frequencies for selected water quality parameters and propose the most efficient (economic) sampling frequency that may be used for routine monitoring within the NWQMN.*

Real Time Water Quality Monitoring System

➢ Advantages of Real Time Data:

1) *Increasing data-collection frequency provides an improved understanding of cause-and-effect relations that result in observed water-quality characteristics.*
2) *Notifying water resource managers in real time, eliminating delay between sample collection and lab analysis may be critical for warning the public.*
4) Decreasing time and costs associated with routine sampling.
5) Measuring water quality changes at night and during storms when samples are seldom collected and when storm events can have major effects on concentrations and loads.

Methodology

RTWQM System Set up

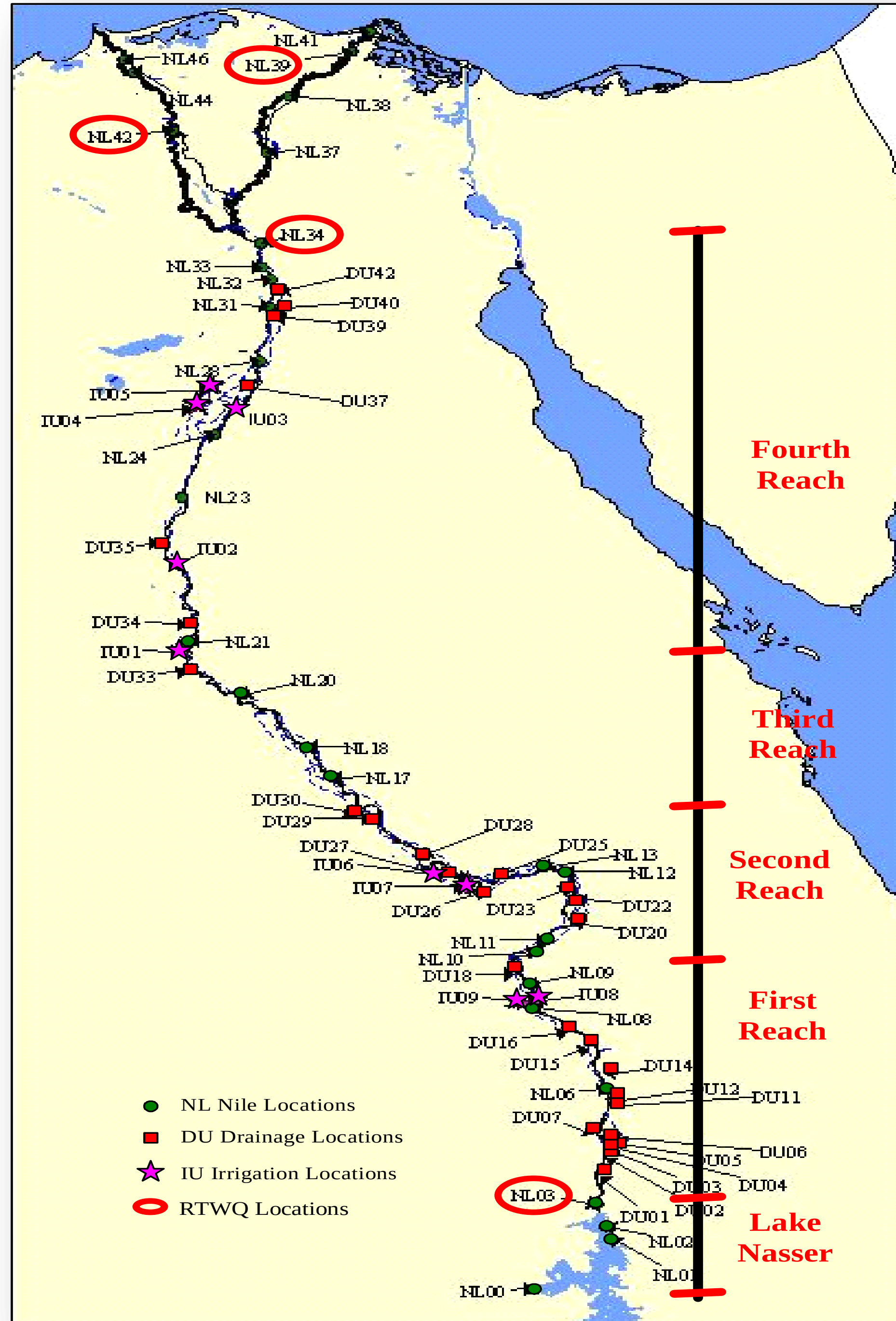
Assessing water quality on the Nile River

Sampling frequency

RTWQM System Set up

Real Time Water Quality Monitoring Sites

1. ***NL03A:* Aswan**
2. ***NL34 :* Ismailia Intake**
3. ***NL39 :* El Salam Intake (Damietta Branch)**
4. ***NL42 :* Benowvar (Rosetta Branch)**



Monitoring Location NL03A in Aswan

Monitoring Location NL34 at Ismailia Intake in Cairo.

Monitoring Location NL39 on the Damietta branch.

Monitoring Location NL42 on the Rosetta branch

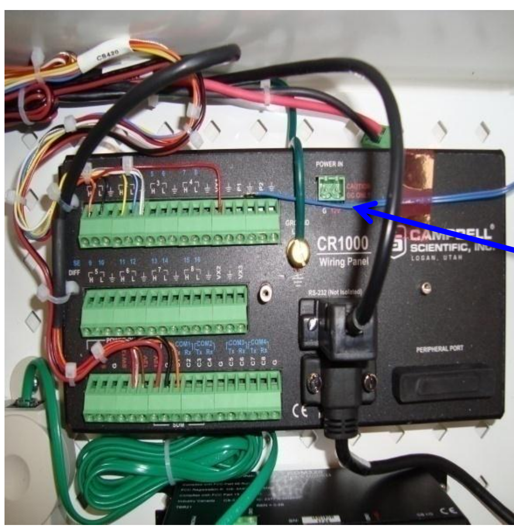
RTWQ System Description:

1.Station Design

The station contains two main parts :

- *Hydrolab sonde*
- *Data logger to record data*

Hydrolab sonde



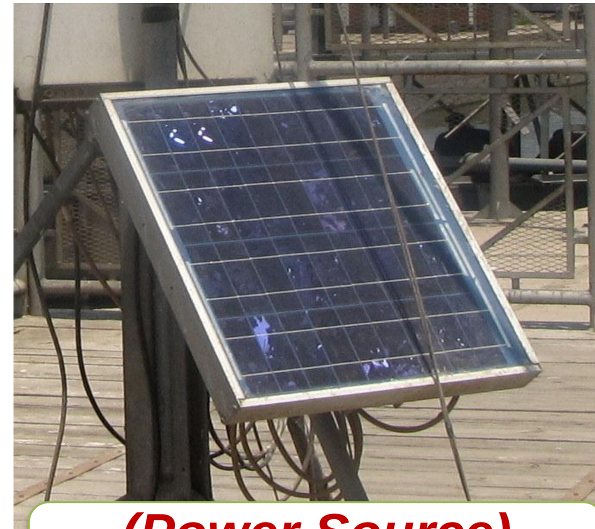
Data logger

2.Sampling Equipment

The equipments can be categorized

in three parts:

- *Sensors.*
- *Power Source.*
- *Data retrieval system.*

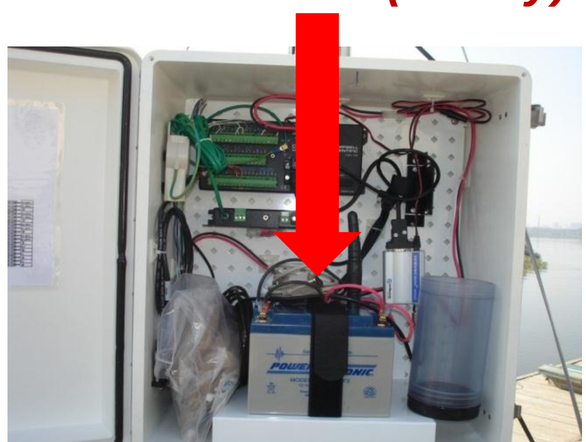


(Power Source)
Solar Cell

Sensors

Data retrieval system
(Laptop and Modem)

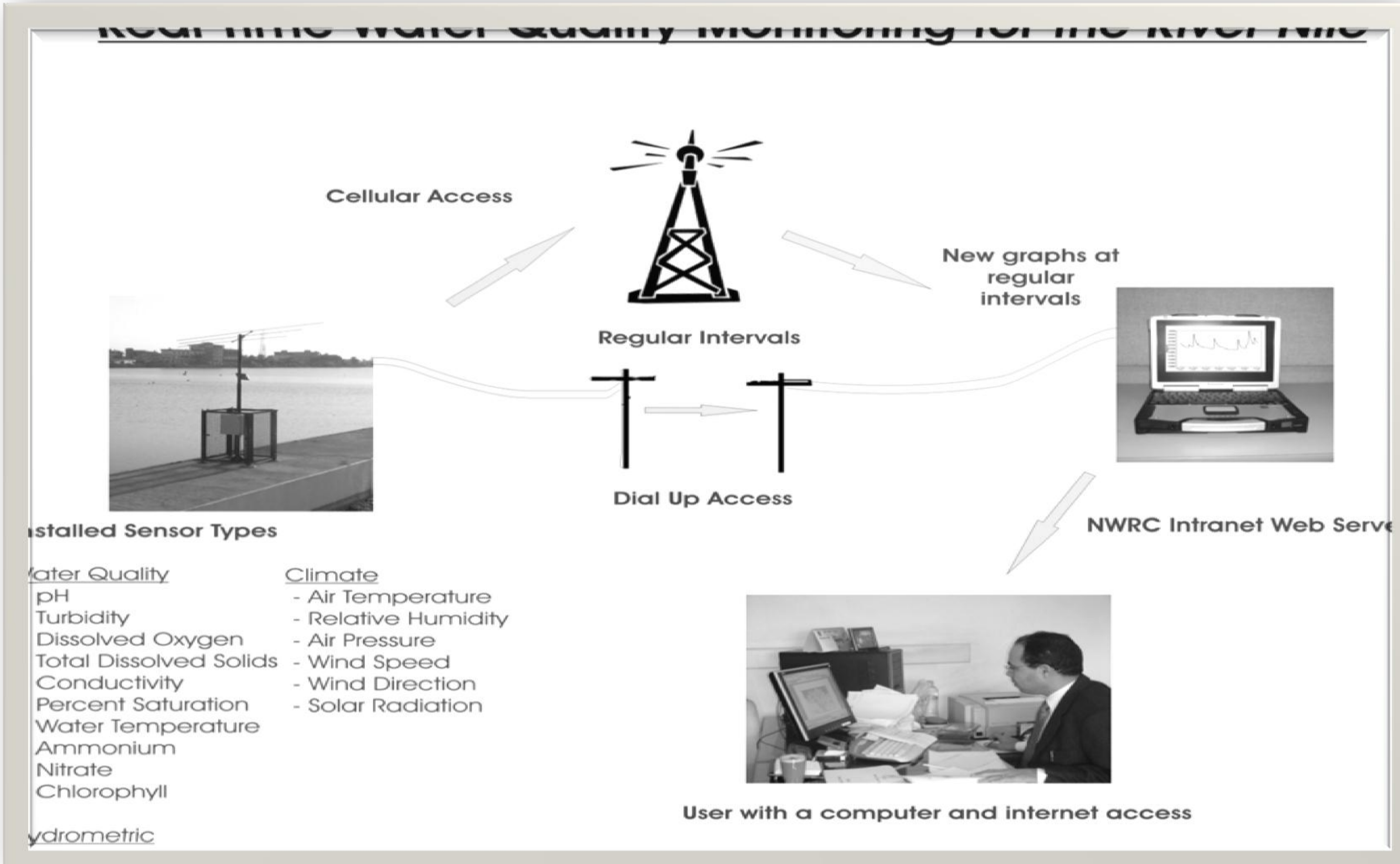
Power Source (Betray)



3. Sensor Deployment

The water quality instrument is placed in the downstream end of a 3 to 6 m length and 7 to10 cm diameter of PVC pipe that has the lower 1.5 m slotted Sensors.

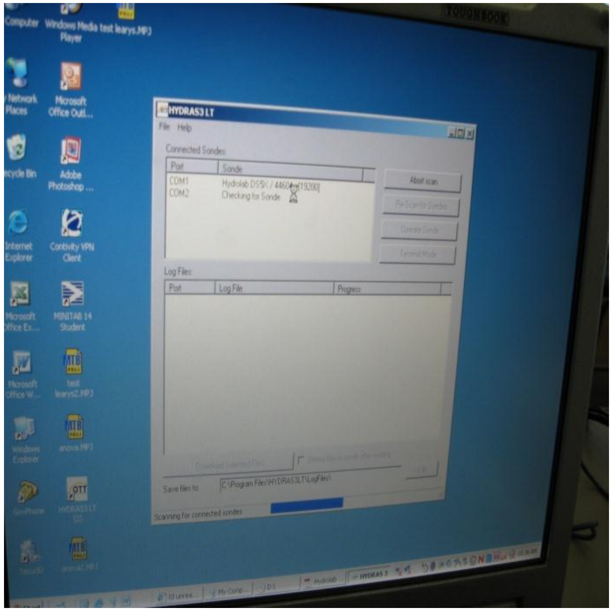
4.Communication System

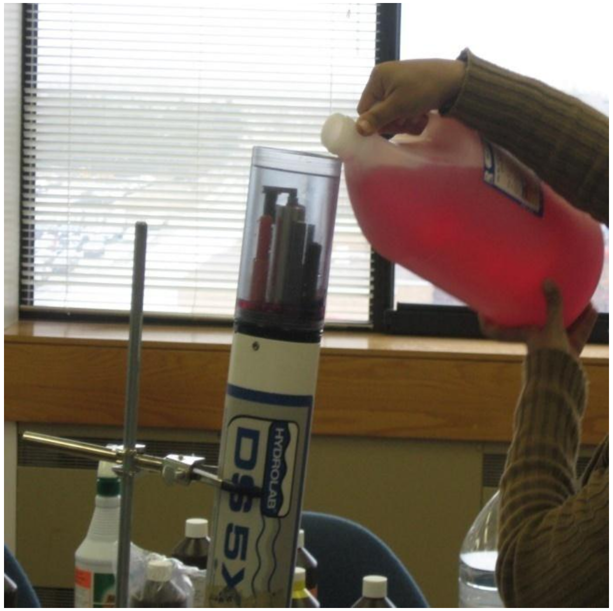


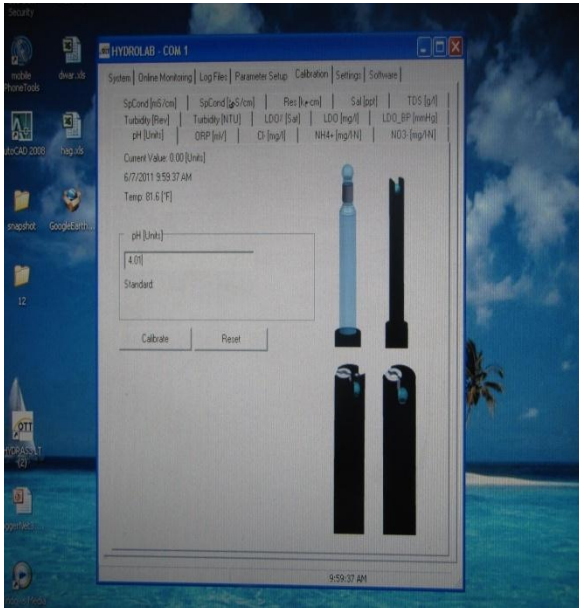
5.Monitored Parameters

- ***Temperature.***
- ***Specific Conductivity (SC).***
- ***Dissolved Oxygen (DO).***
- ***pH .***
- ***Total Dissolved Solids (TDS).***
- ***Turbidity (Tur).***
- ***Ammonium.***
- ***Nitrates.***

Calibration Work







WATER QUALITY INDEX

Water Quality Index

$$WQl = 100 - \left(\frac{\sqrt{f_1{}^2 + f_2{}^2 + f_3{}^2}}{1.732} \right)$$

- ***Scope (F1)*** **- number of variables not meeting water quality objectives**
- ***Frequency (F2)*** **- the number of times the objectives are not met**
- ***Amplitude (F3)*** ***- the extent to which objectives exceeded.***

WQI Categorization

RANKING	WATER QUALITY VALUE
Excellent	95 - 100
Good	80 - 94
Fair	65 - 79
Marginal	45 - 64
Poor	0 - 44

Water Quality Index Results During Low Flow

WQI Scores and Rankings for Nile River Site NL39

Data Summary	Drinking	Irrigation	Livestock
WQI	73	69	72
Category	Fair	Fair	Fair
F1(Scope)	33	40	33
F2(Frequency)	19	21	16
F3(Amplitude)	28	29	30

Water Quality Index Results During High Flow

WQI Scores and Rankings for Nile River Site NL39

Data Summary	Drinking	Irrigation	Livestock
WQI	79	66	77
Category	Fair	Fair	Fair
F1(Scope)	27	33	31
F2(Frequency)	14	16	14
F3(Amplitude)	21	47	21

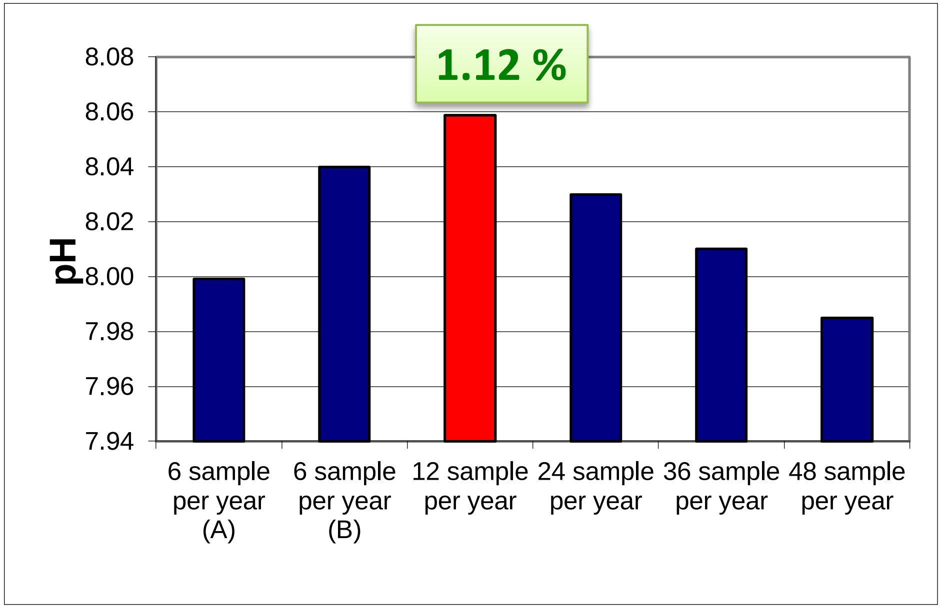
Sampling frequency

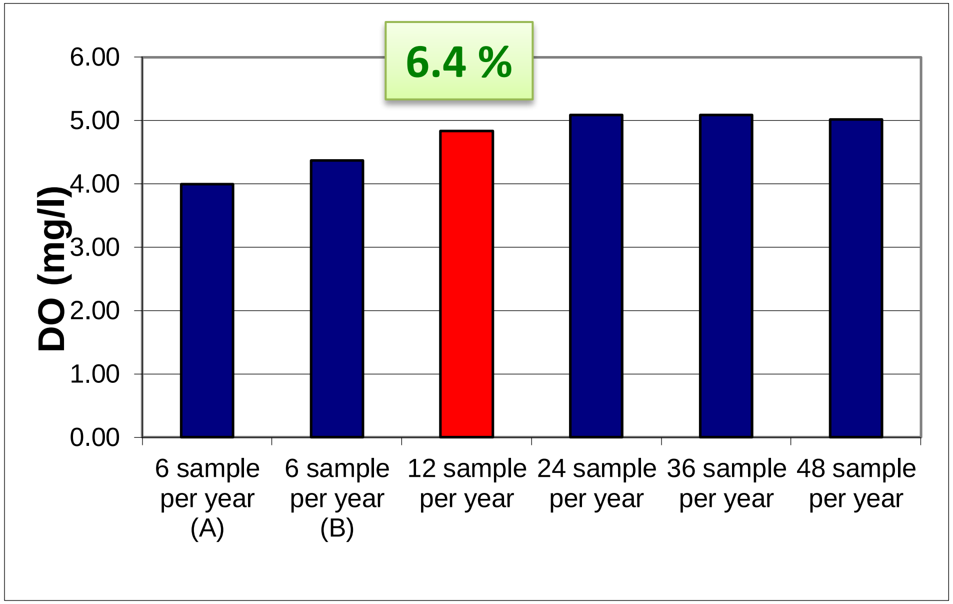
Data sets combinations

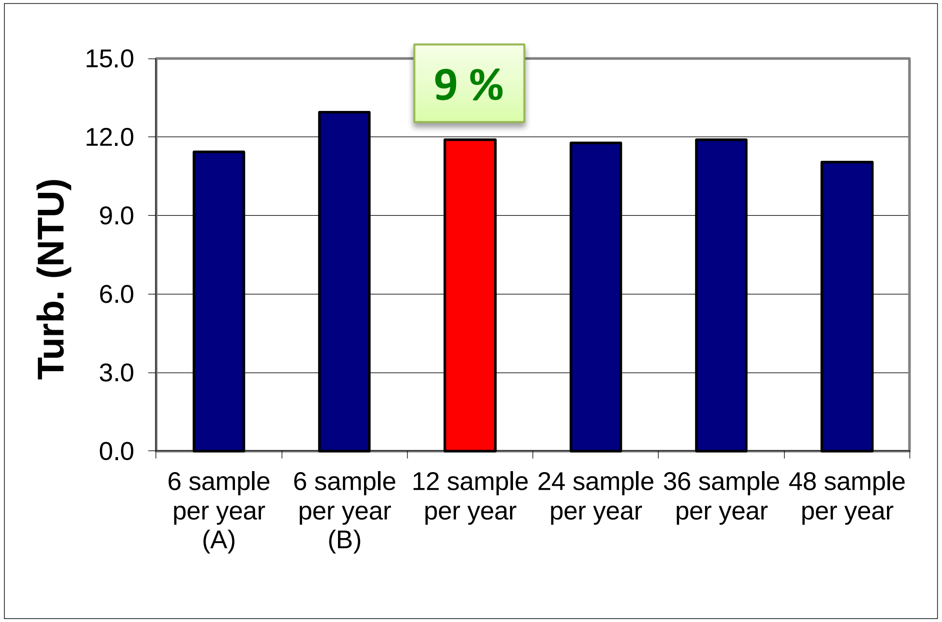
Six (6) data subset were developed as following:

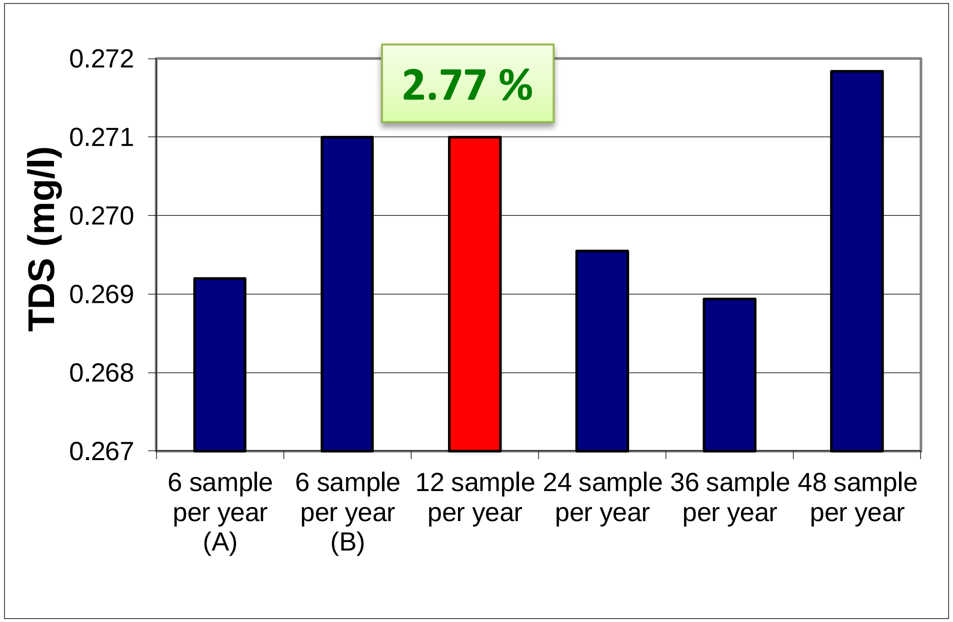
- ***Subset A (n= 6 samples/year) measurements started at 20 February 2009.***
- ***Subset B (n = 6 samples / year) measurements started at 20 January 2009.***
- ***Subset C (n = 12 samples / year) measurements started at 20February 2009.***
- ***Subset D (n = 24 samples / year) measurements started at 20 February 2009.***
- ***Subset E (n = 36 samples / year) measurements started at 20 February 2009.***
- ***Subset F (n = 48 samples / year) measurements started at 20 February 2009.***

Median Changes at different sampling frequencies for WQPs at NL39

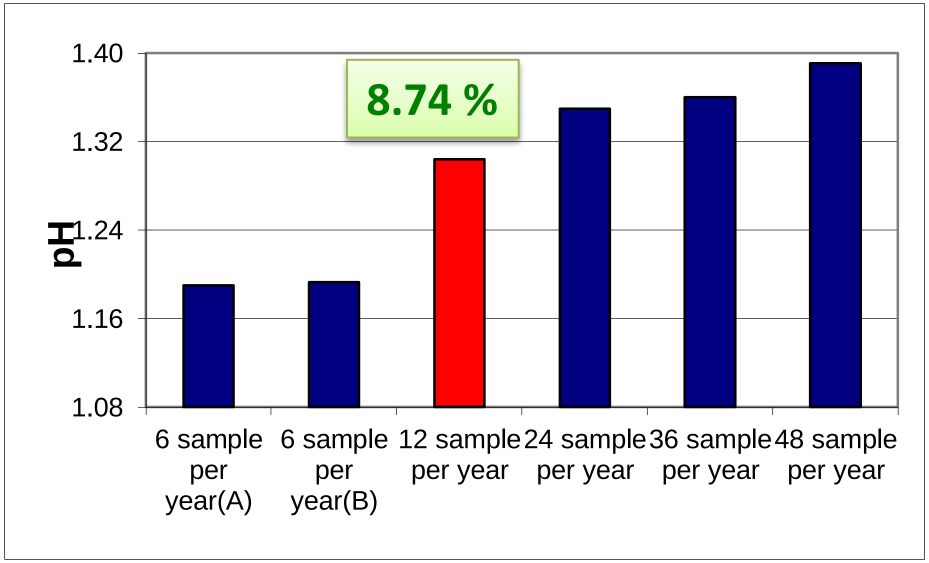


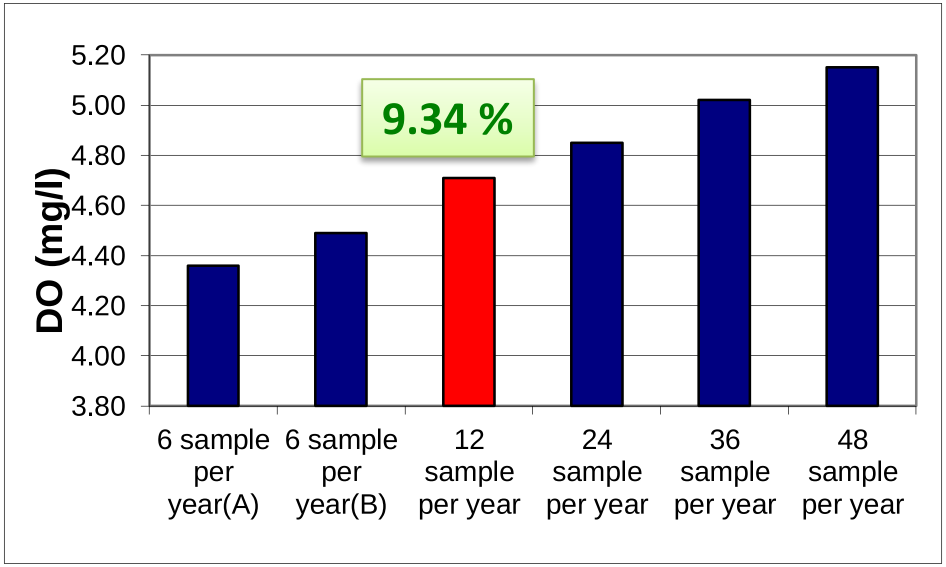


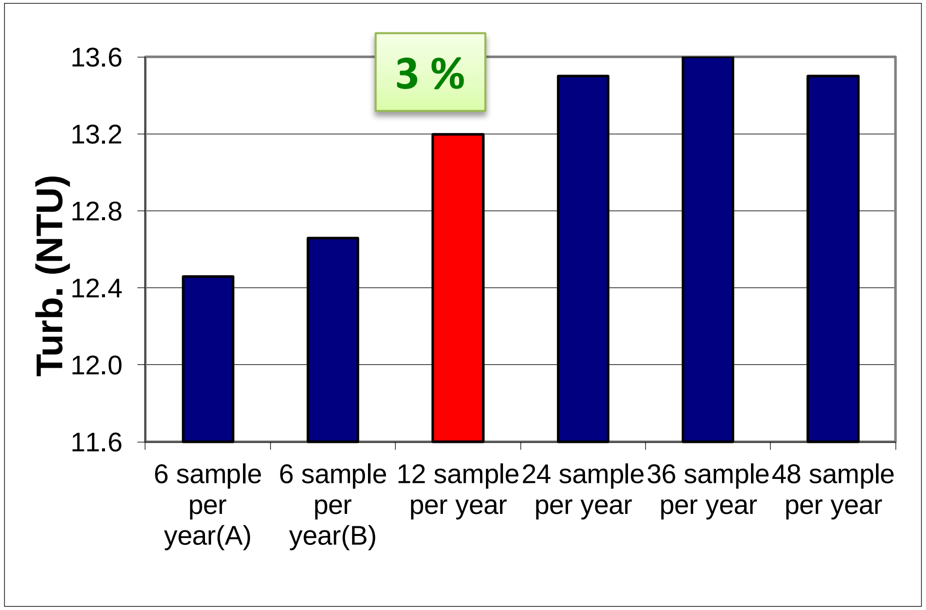


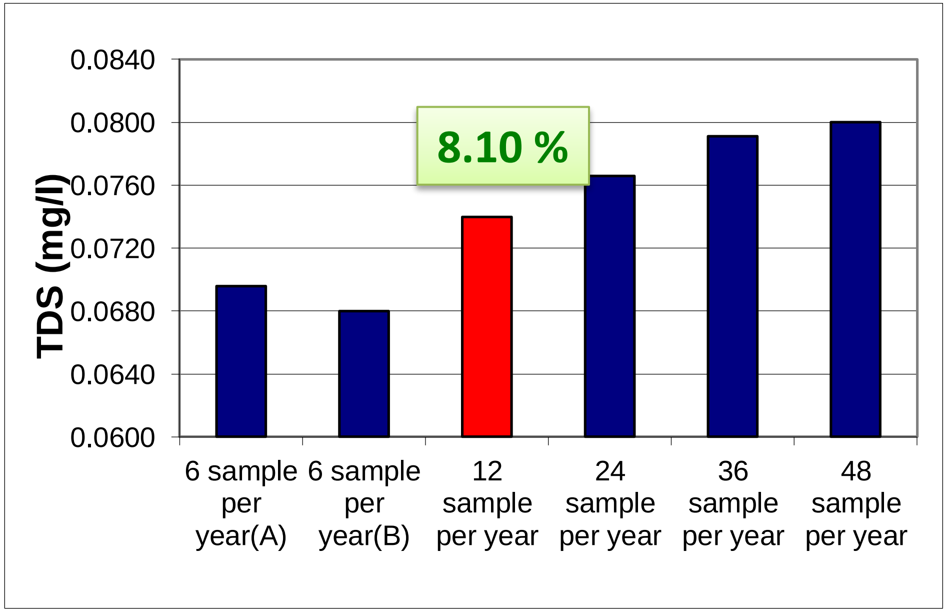


Range values at different sampling frequencies for WQPs at NL39









Conclusion

- ***The final output obtained proved that the RTWQ water quality monitoring <u>system is a powerful tool</u> in tracking the water quality status in near real time conditions.***
- ***<u>The system allows detecting any sudden changes</u> in the quality and permits to have fast reactions based on accurate information.***
- ***<u>The optimal sampling frequency</u> for the measured water quality parameters <u>is six (6) samples per year</u>. This will significantly reduce the overall cost of the monitoring program facilitating financial resources for better network management.***

Conclusion (cont.)

- ***The drinking water quality category for the River Nile site (NL39) was fair for low and high flow rates, respectively.***

- ***The irrigation and livestock water quality category was fair in both cases (low and high flow rates).***

Recommendations

- ***The system is strongly recommended to be expanded to cover other strategic water quality monitoring locations.***
- ***It is recommended to follow the QC/QA that describes the life time for each sonde. This may be achieved by finding more funds, this will also ensure system sustainability.***
- ***The performance of the already existed real time water quality stations can be improved through adding more sensors to detect more physical and chemical parameters.***

Thanks