Samir Mahgoub

- Ph. D. in Microbiology and Biotechnology from Agricultural University of Athens, Greece.
- Assistant prof. of Microbiology in Zagazig University, Egypt.

- Postdoctoral at Laboratory of Water and Wastewater Technology, Department of Food Technology, School of Food Technology and Nutrition, Technological Educational Institute of Thessaloniki, P.O.Box 141,57400 Sindos, Thessaloniki, Greece

Microbiological and Physico-chemical Characteristics of Municipal Wastewater at Treatment Plants, province Sharkia, Egypt (Case study)

- Samir Mahgoub[1,2]*, Petros Samaras[2], H. Abdelbasit[1], H. Abdelfattah[1] and S. Hamed[1]
- [1]*Microbiology Department, Faculty of Agriculture, Zagazig University, Zagazig, Egypt*
- [2]*Technological Educational Institute of Thessaloniki*, *Greece*

The basic problem

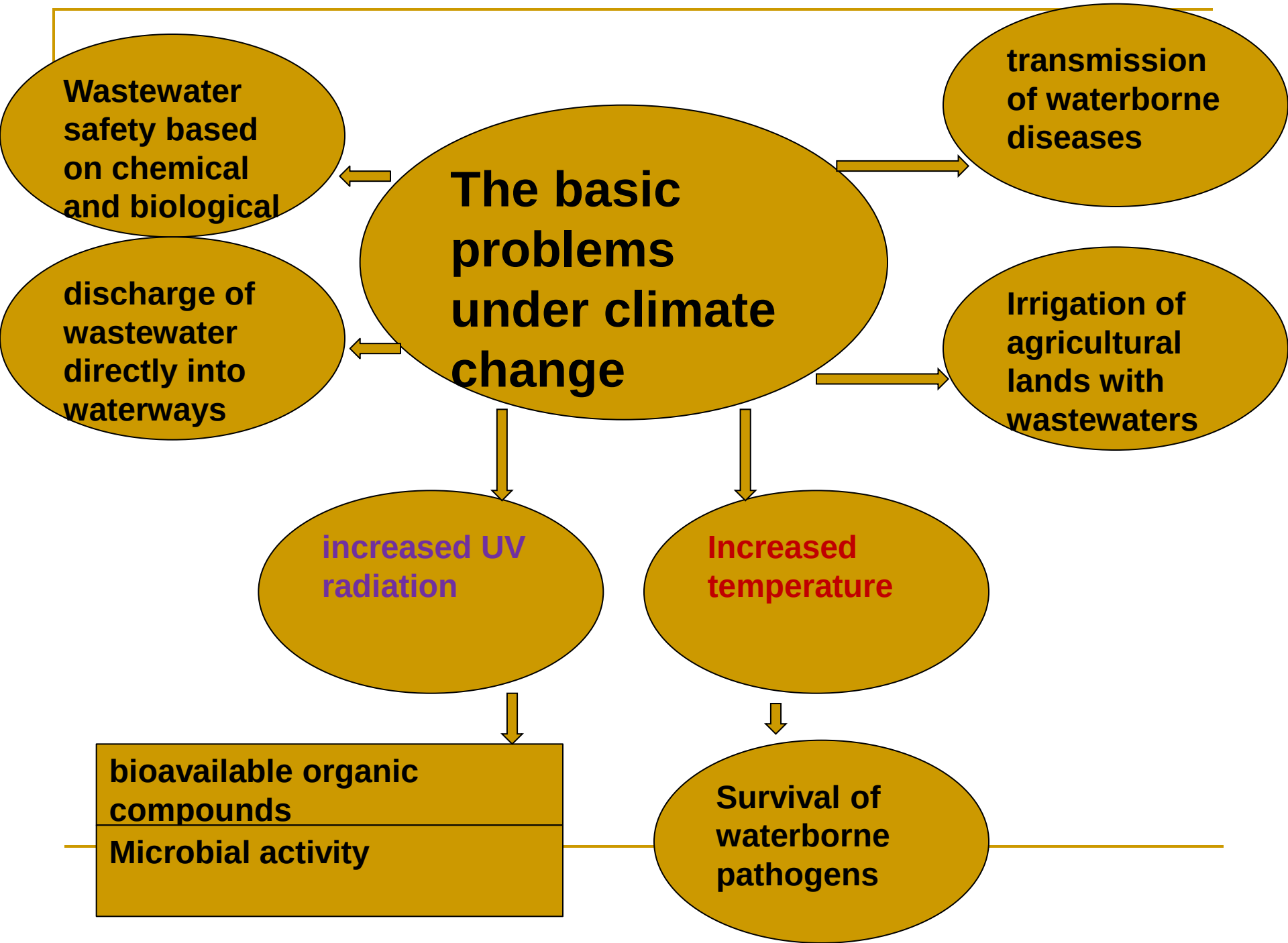
- poor infrastructure in the developing countries (Egypt case) and pools of wastewater in the open gutters .

- Effluents (wastewaters) if disposed untreated, add to the pollution problem e.g. outbreak diseases by waterborne pathogens.

- In view of the extensive contamination of the environment by persistent and toxic chemical pollutants originating from industrial wastewaters.

- The impact of climate change on the transmission of waterborne diseases from effluents if disposed untreated.

- The Mediterranean is a ‘hot spot’ for climate change, an increase in the average annual temperature between +3.5 ◦C and +3.9 ◦C (Giorgi, 2006).


Wastewater safety based on chemical and biological
transmission of waterborne diseases
The basic problems under climate change
discharge of wastewater directly into waterways
Irrigation of agricultural lands with wastewaters
increased UV radiation
Increased temperature
bioavailable organic compounds
Microbial activity
Survival of waterborne pathogens

The solution of these problems

- According to the EU Urban Waste Water Treatment Directive (91/271), the environment should be protected from municipal and agro-industrial wastewaters.
- So, we need to assess the performance of Wastewater Treatment Plants (WTPs) in cold and hot climate.
- Examine the changes in physical, chemical and microbiological quality in wastewater during treatment operations and waterways.
- The function of the systems evaluated in terms of their ability to remove nutrients, organic and microbial loads under climate changes.
- Evaluate the quality of wastewater in drainages that discharges from the WTPs then may be used in irrigation and agricultural uses.

- Enhancing the role of resident microbial under different treatment process under climate changing because microorganisms are playing a key role in the purification of water quality

Outline of this research

- Background and introduction
- Materials and methods.
- Results and discussion
- Conclusion

Background

- **Objective of wastewater treatment plants:**

{ **Wastewater is water that has been used and must be treated before it is released into another body of water**}

- **Reduce organic content (reduction of COD, BOD)**
- **Removal/reduction of nutrients i.e., N,P**
- **Removal toxic chemicals e.g. pharmaceuticals, personal care products, metalloids (As, Se), metals (Cd, Hg), benzene compounds, phenol compounds and chlorinated compounds**
- **Removal/inactivation of pathogenic microbes**

(So, it does not cause further pollution of water sources)

Levels of Treatment

- **Primary**
- removal by physical separation of grit and large objects (material to landfill for disposal)

- **Secondary**
- aerobic microbiological process (sludge)

$$\text{organic matter} + O_2 \rightarrow CO_2 + NH_3 + H_2O$$

$$NH_3 \rightarrow NO_3^-$$

- lowers suspended solids content (into sludge)

- **Tertiary (advanced)**
  - anaerobic microbiological process with a different microbe where O_2 is toxic (more sludge)

    $NO_3^- \rightarrow N_2$ (escapes to atmosphere)

  - PO_4^{-3} if not removed in sludge in secondary process

    $PO_4^{-3} + Al^{+3} \rightarrow AlPO_4$ (s) (into sludge)

    - aeration to strip N_2 and re-oxygenate (add DO)

When the treatment is done

- **Effluent back to stream after**
  - a final carbon filtration
  - chlorination/dechlorination

- **Sludge – very nutrient rich**
  - applied directly to land as fertilizer
  - incinerated (good fuel after drying)
  - composted

Impact of climate change on wastewater treatment

- **Temperature**

  1- Increase air temperature → transmission of waterborne diseases because raw untreated sewage are often discharged into the open and fresh-water sources such as the majority of villages and rural areas discharge their raw domestic wastewater directly into the waterways in the most of developing countries.

  2- Decrease land surface water availability and increase of extreme hydrological events

- **Rainstorms and storm water** The wastewater eventually percolates or is washed into the water bodies resulted in transmission of bacteria.

it was shown that with increased UV radiation due to ozone layer depletion, NOM trap higher levels of UV energy and breaks down to more bioavailable organic compounds, minerals and micronutrients. All these processes could stimulate bacterial activity in aquatic ecosystems.

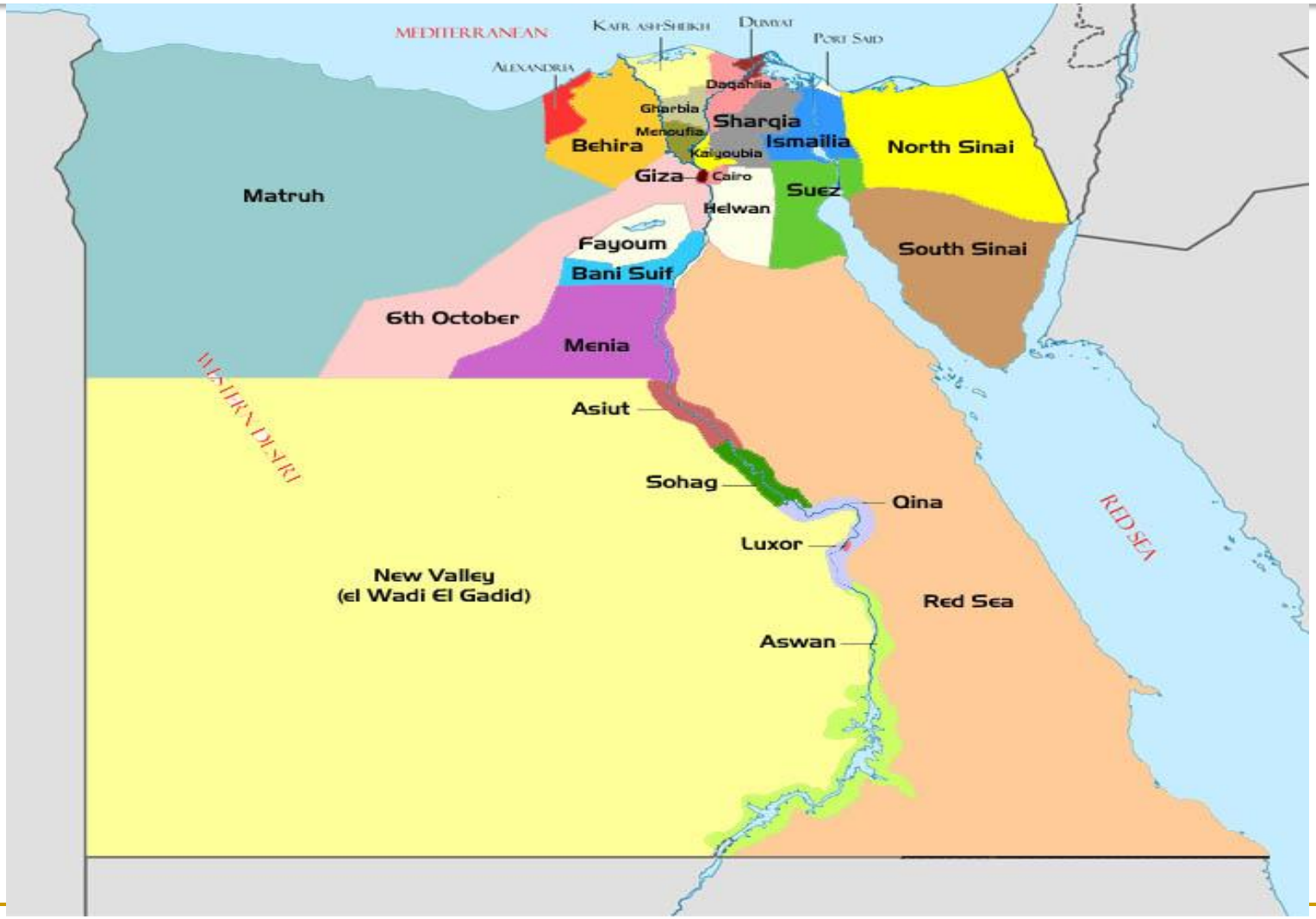
Objective of this research

- This study assessed the performance of 17 Wastewater Treatment Plants (WTPs) in cold and hot climate over a one-year period from April 2012 to March 2013 in province Sharkia, Egypt.
- The main purpose was to examine the changes in physical, chemical and microbiological quality in wastewater during treatment operations.
- The function of the systems evaluated in terms of their ability to remove nutrients, organic and microbial loads.
- The second aim was to evaluate the quality of wastewater in drainages that discharges from the WTPs.

Materials and Methods

- ***Study area***
- ***Water sampling***
- ***Microbiological analysis***
- ***Data collection***

Study area


MEDITERRANEAN
Kafr ash-Sheikh
Damyat
Port Said
Alexandria
Dagahlia
Gharbia
Sharqia
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Behira
Ismailia
Kalyoubia
North Sinai
Giza
Cairo
Suez
Matruh
Helwan
Fayoum
South Sinai
Bani Suif
6th October
Menia
WESTERN DESERT
Asiut
Sohag
Qina
RED SEA
Luxor
New Valley
(el Wadi El Gadid)
Red Sea
Aswan


Awlad Saqr
El Husseiniya
Kafr Saqr
Dirb Negm
Abu Kabir
Faqous
El Salhiya El Gedida
Hihya
El Zagazig
Sharkia
Abu Hammad
Belbeis
Mashtoul El Souq

Microbiological analysis

Indicator microbial for water quality

1- Total bacterial count
2- Total coliform count
3- *Escherichia coli*
4- Total *Candida* count
5- *Salmonella & Shigella*

Data collection

sewage water quality parameters

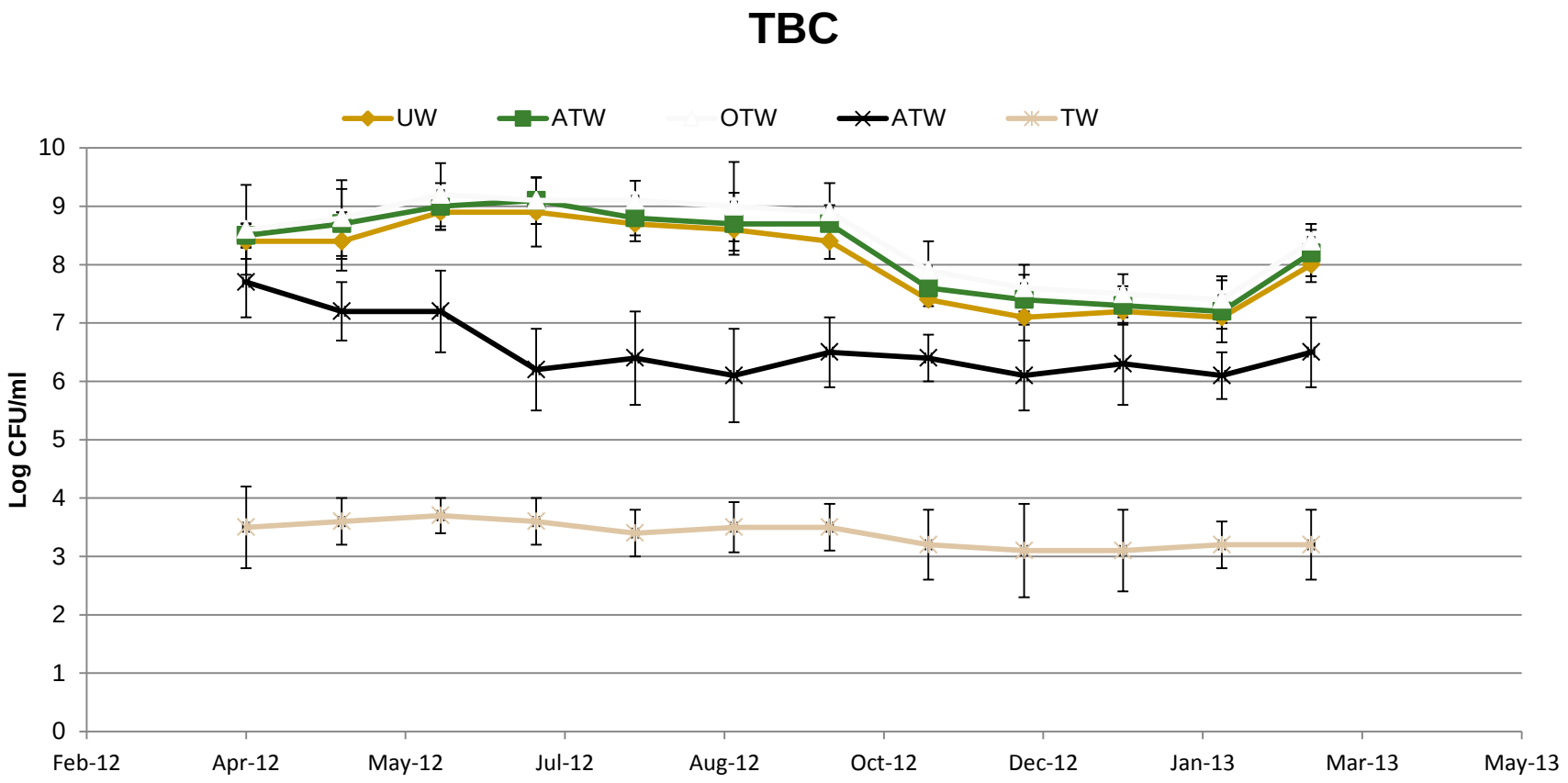
Temperature, pH, Total Suspended Solids (TSS), Turbidity, Total dissolved Solids (TDS), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Nitrate (NO_3-), sulphite (SO_4-) and oil

Correlation between coliforms and other microbial parameters

Equation Used

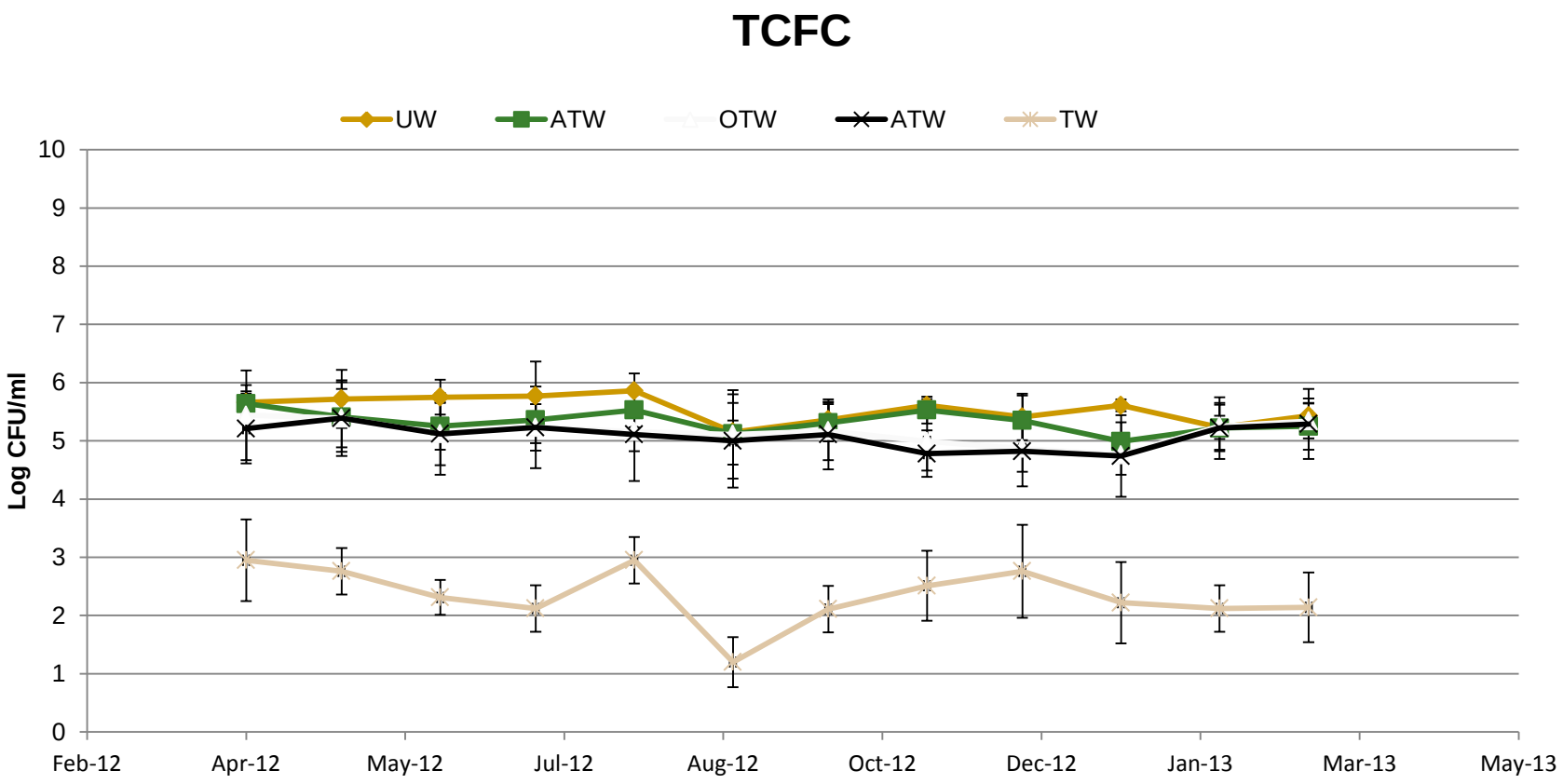
The removal efficiency of each treated wastewater sample in the wastewater treatment plants was calculated as [(influent- effluent)/influent x 100]

Microbial indicators (Total bacterial counts (TBC) in wastewater



UW: influent; ATW: influent to aerated; OTW: Effluent from aerated grit chamber; ATW: anaerobic effluent; TW: treated wastewater

Coliforms (TCFC) indicators in wastewater



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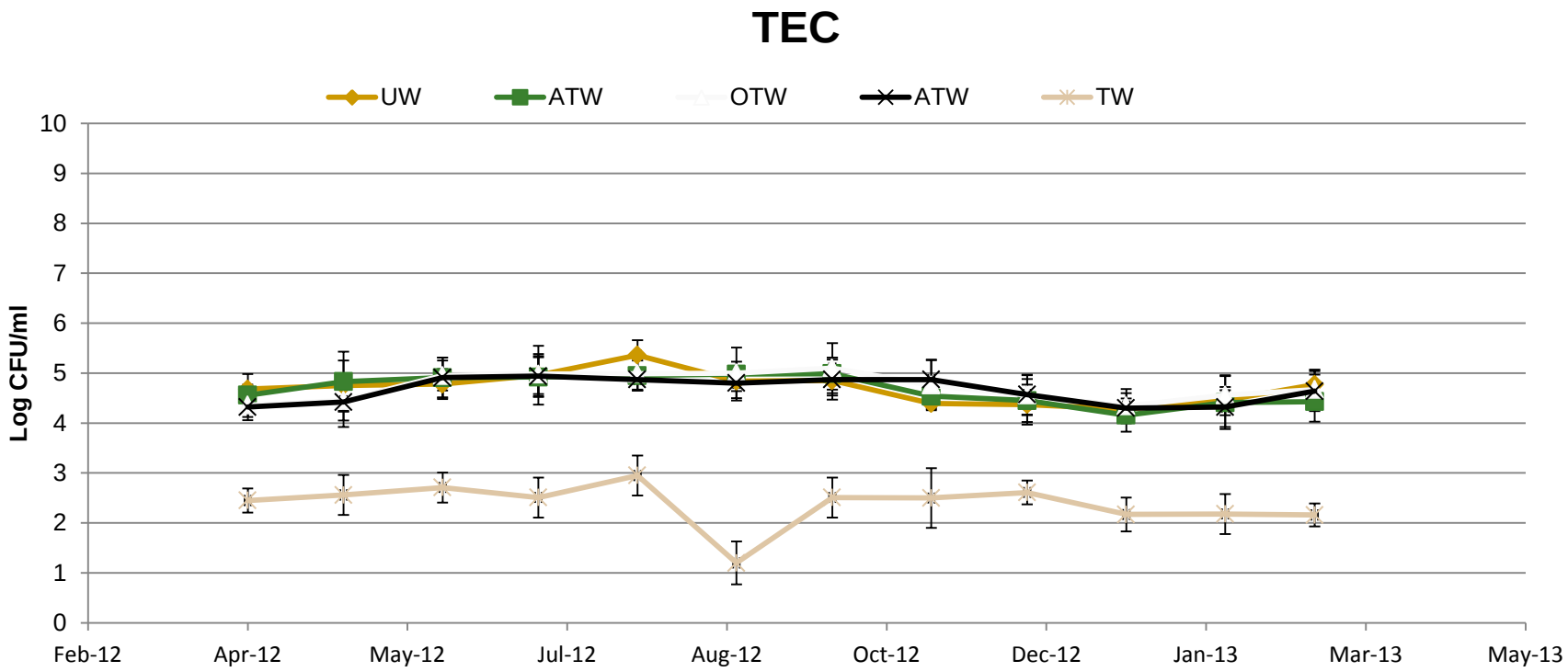
Escherichia coli(TEC)



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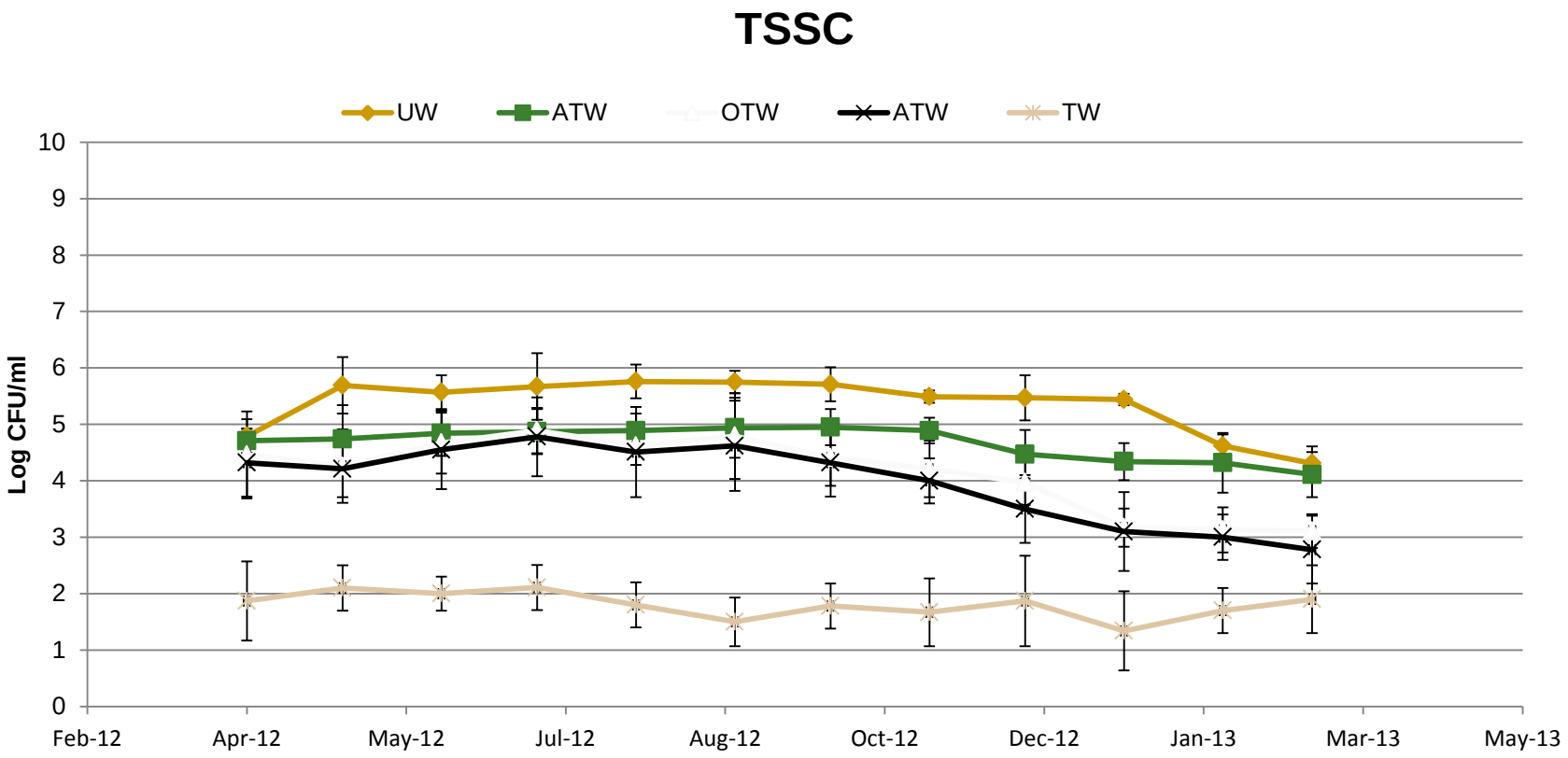
Total *Salmonella & Shigella* (TSSC)populations in wastewater and treated wastewater



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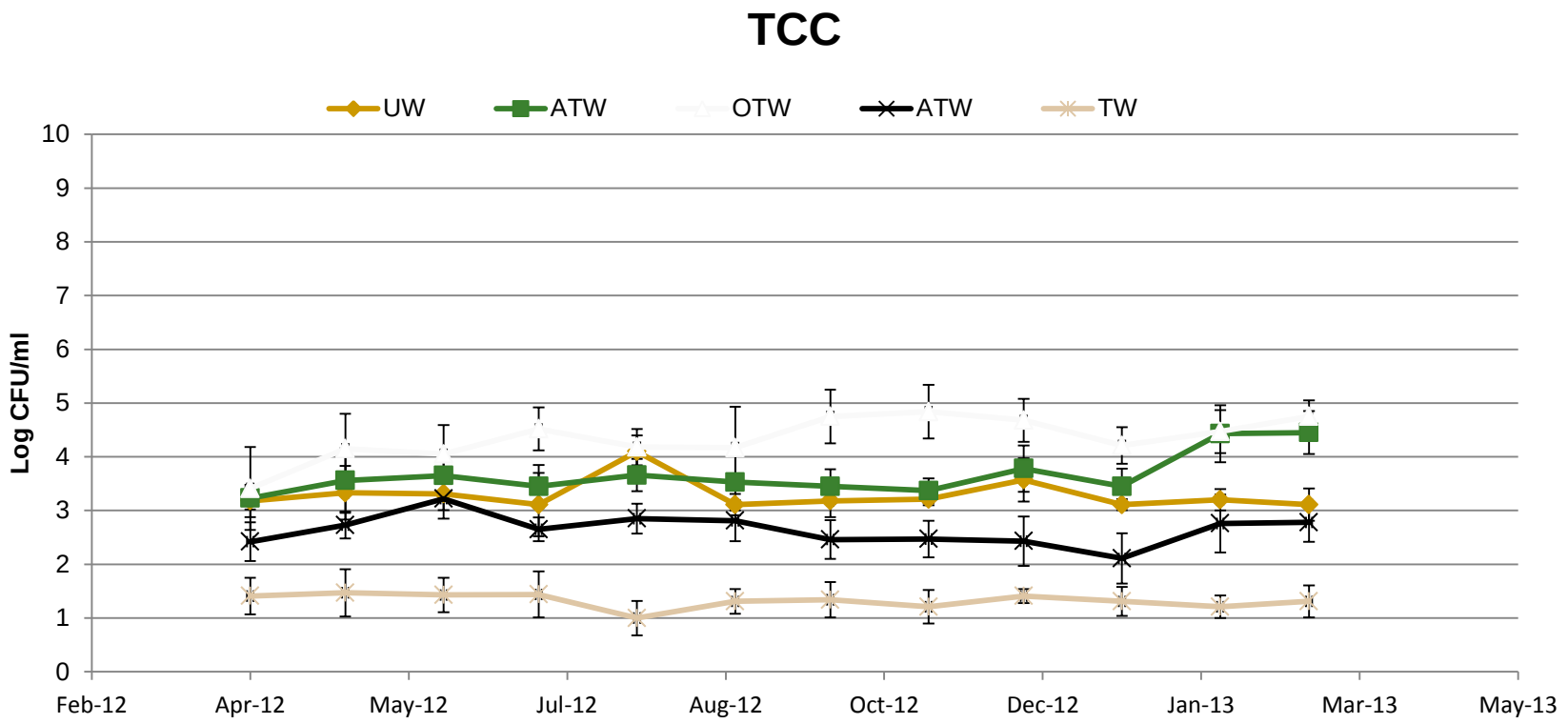
Total *Candida* counts (TCC



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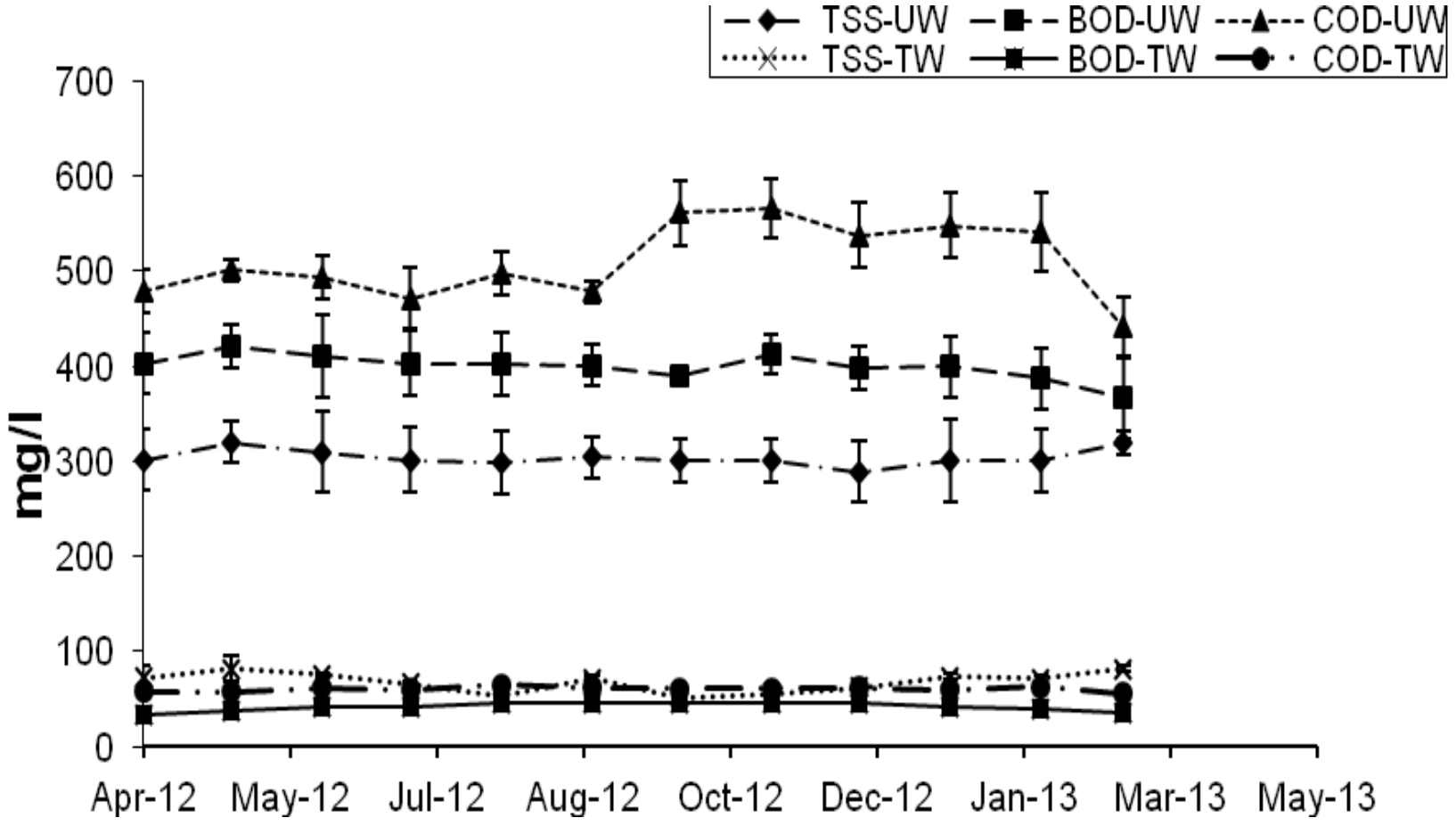
COD, BOD and TSS in wastewater and treated-wastewater



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Conclusion

- Treatments routinely used in 17 WTPs can effectively reduce 49-66% of microbial indicators in wastewater
- Treated wastewater produced did not have a quality to use in agriculture
- need more attention for monitoring the critical control points in the system of treatment sewage water

Acknowledgment

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The authors also greatly appreciate the personnel at the sewage treatment plants who contributed to this study

Thank you very much for your attention

Questions?