

# Assessment of the impacts of phyto-remediation on water quality of the Litani River by means of two wetland plants (*Sparganium erectum* and *Phragmites australis*)

Évaluation des impacts de la phyto-assainissement sur la qualité de l'eau du Litani au moyen de deux plantes des zones humides (*Sparganium erectum* et *Phragmites australis*)

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### Problem

**Conventional wastewater treatment** is a series challenge for many development country



### Solution

#### **Constructed wetlands :**

- Green
- Cost-effective
- Mimic the treatment processes of natural wetlands



**To address the deteriorated water quality of the Litani River the LRBMS constructed a wetland system between 2012 and 2013**



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- Located in a publicly owned site by the LRA center in Kherbet Qanafar in the western plains of the Bekaa Valley
- Free Water Surface (FWS) Wetland
- Oval-shaped basin

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- Average N-S length: 240 m
- Average W-E width: 125 m
- Average perimeter: 730 m

- Average area: 30,000 m<sup>2</sup>
- Average depth: 1.5 m
- Average storage capacity: 45000 m<sup>3</sup>

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## A few hydraulic considerations – Conceptual Reservoir Model

A catchment surface is conceptualized as a 'Reservoir' with inflows (upstream contributions) & outflows (evaporation, infiltration & surface runoff).

The storage is conceptualized as the difference between inflows & outflows:

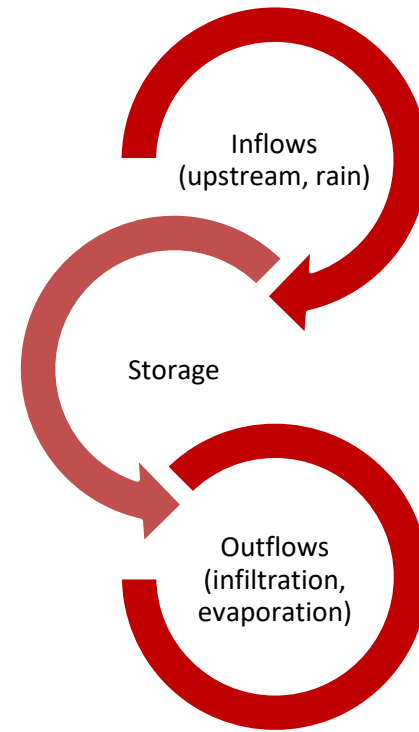
$$Q_{in} - Q_{out} = \frac{dV}{dt}$$

$Q_{in}$  = inflow (m<sup>3</sup>/s)

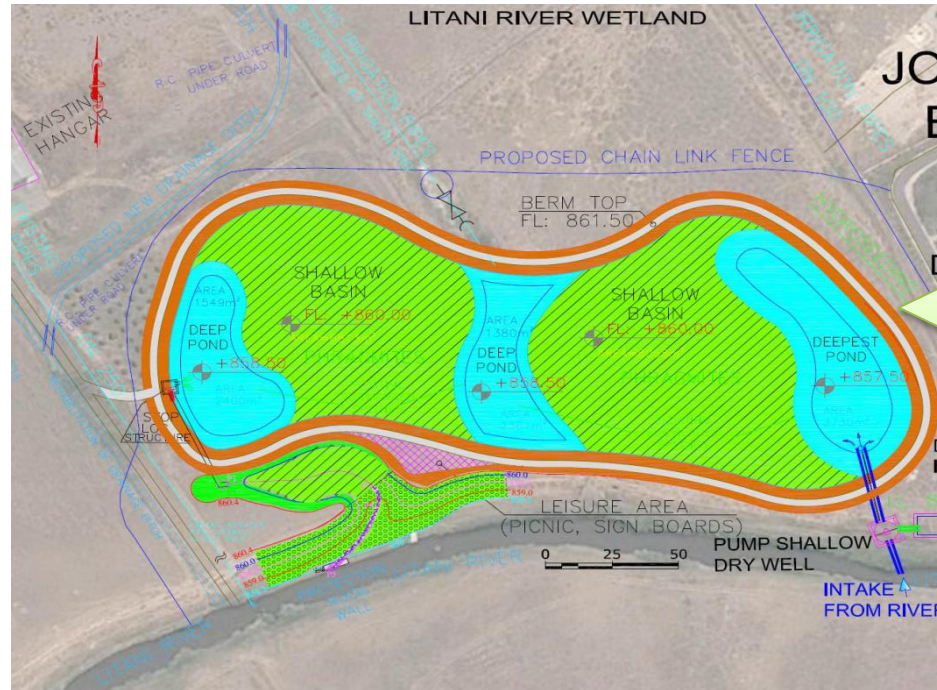
$Q_{out}$  = outflow (m<sup>3</sup>/s)

$V$  = storage (m<sup>3</sup>)

$T$  = time (s)



## Vegetation types

*Phragmites australis**Sparganium erectum*

Water flow:  
**30 L/s** dry season  
**60 L/s** during the  
 rest of the year

From the inlet to the outlet, water will spend 5 days in the wetland site for treatment purposes



Time residency corresponds to BOD<sub>5</sub>-days

## Évaluation des avantages environnementaux d'une zone humide construite le long du fleuve Litani dans le Bekaa occidentale

- Water samples were collected weekly during the period of **15 June 2020** through **15 September 2020**



Inlet



Outlet

- Samples were collected in **glass labeled bottles** and placed at **4°C** during transport to laboratory



- Physical, chemical** and **biological** parameter analysis were performed on water samples



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The following parameters were measured directly on site:



EC ( $\mu\text{S}/\text{cm}$ )  
TDS (mg/L)

pH

T ( $^{\circ}\text{C}$ )

DO (mg/L)

Nitrate - Nitrite- Phosphate – Sulfate

Reagent Powder Pillow + Water sample cell



Analysis takes place by using a spectrophotometer



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## COD

Dichromate solution + 2mL water sample



150 °C for 2 hr.



Analyse in a spectrophotometer



## BOD

250 mL of water sample

+

Nitrification inhibitor

+

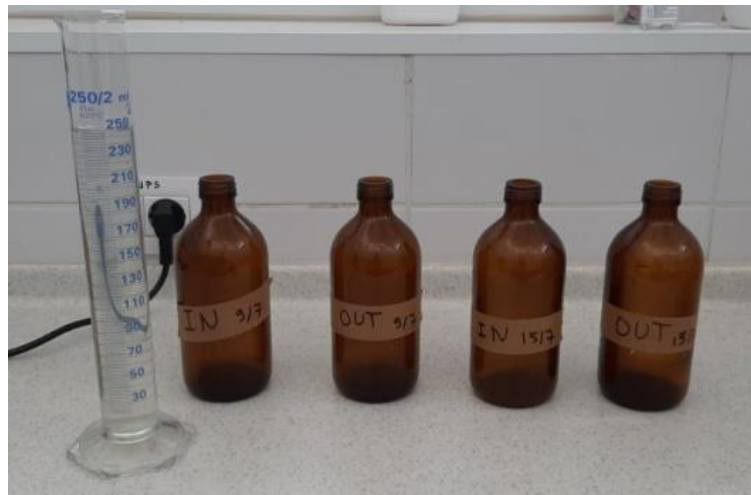
Sodium hydroxide

+

Stirring bar

+

VELP BOD Sensor

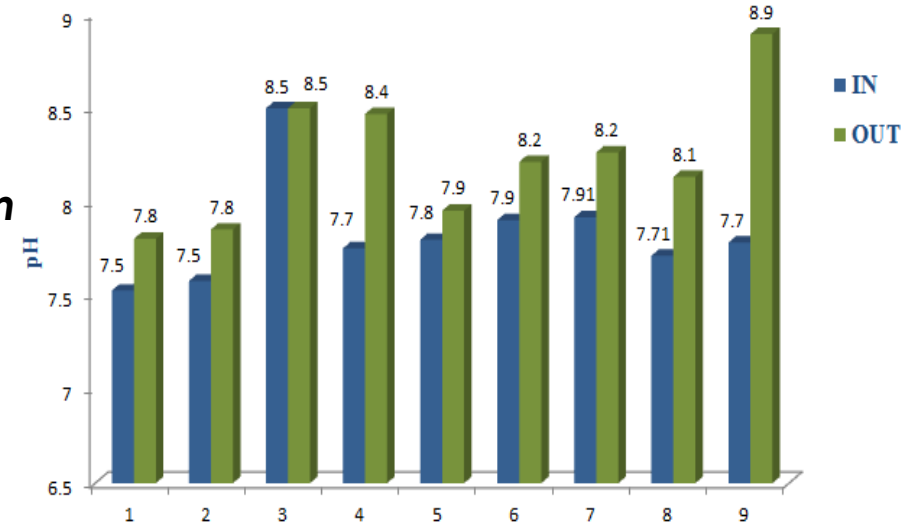


Refrigerated thermostat at  
20 °C for 5 days

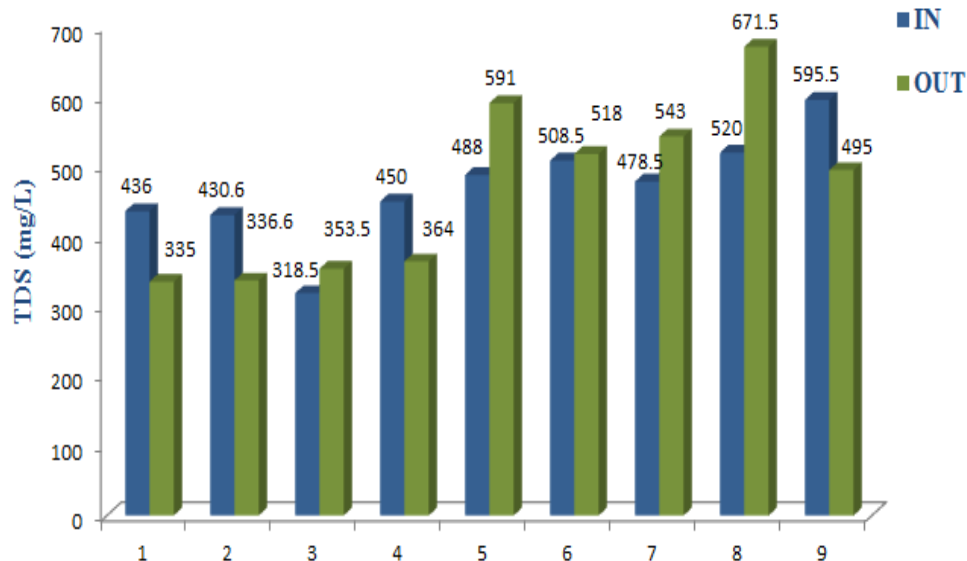


### Results of physical analyses of the constructed wetland influents and effluents

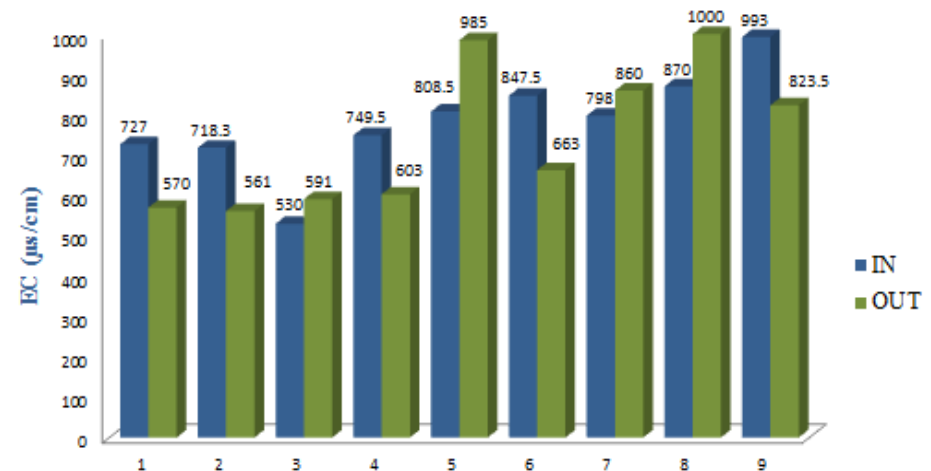
- Conductivity is ranging from **10** to **1000  $\mu\text{s}/\text{cm}$**
- Ideal pH range of **6** to **9** in surface water
- TDS concentration less than **1000 mg/L**



Time line evolution of pH



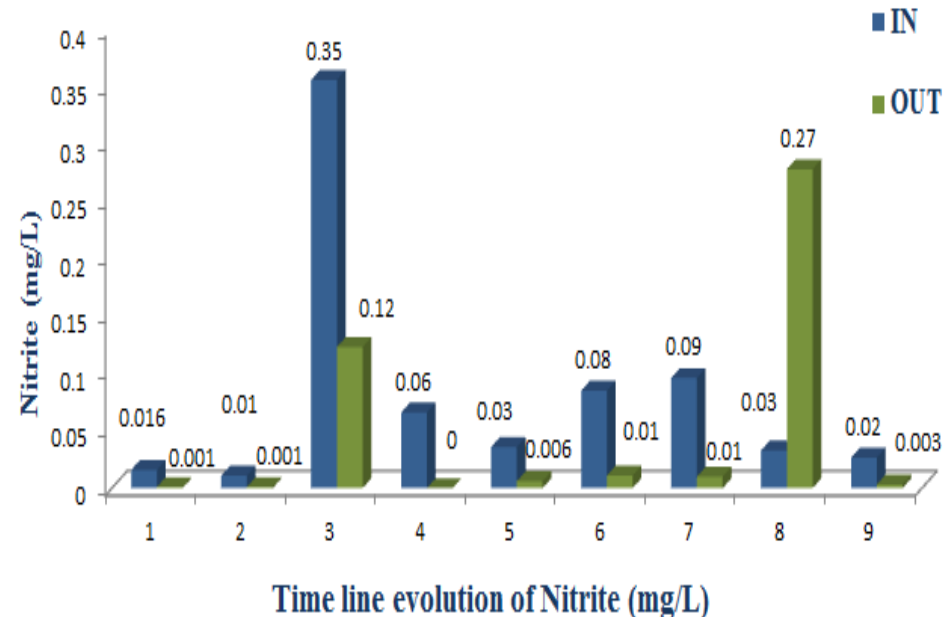
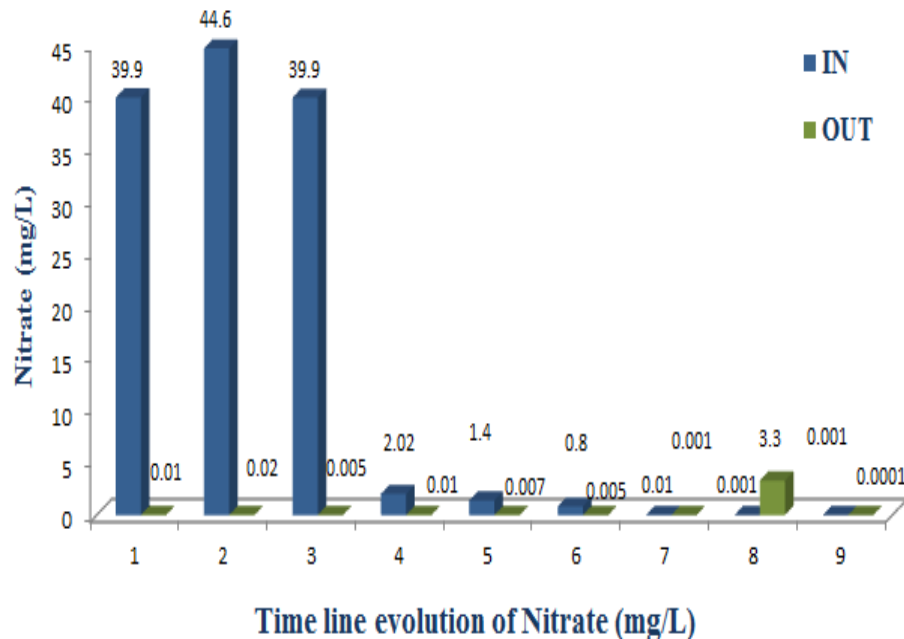
Time line evolution of TDS (mg/L)

Time line evolution of EC ( $\mu\text{s}/\text{cm}$ )

### Results of chemical analyses of the constructed wetland influents and effluents

- $[\text{NO}_3^-] < 90 \text{ mg/L}$
- Removal Rate
  - $\text{NO}_3^-$ : **97.39 %**
  - $\text{NO}_2^-$ : **40.27%**

- Growth of the late-in-season potato & The wake of COVID19 pandemic



## Introduction

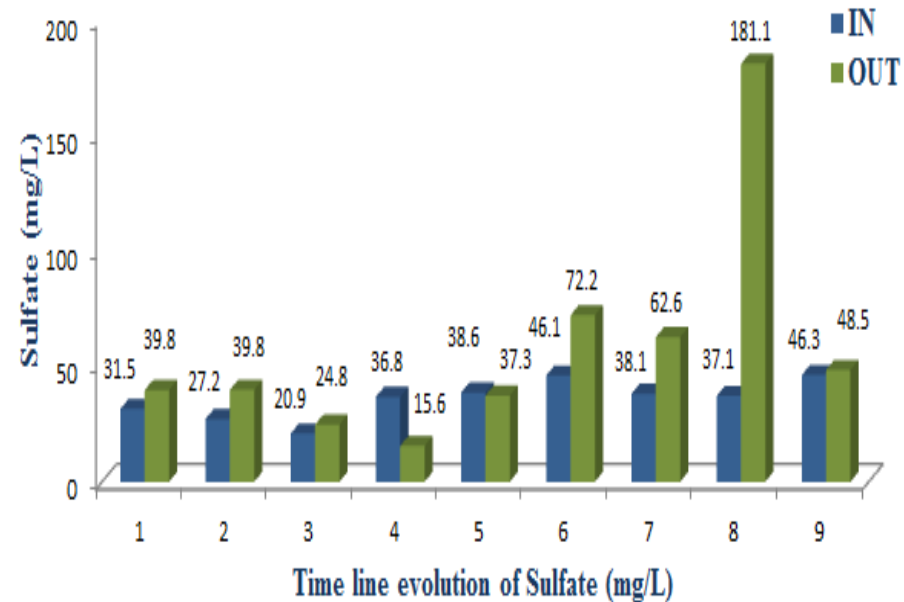
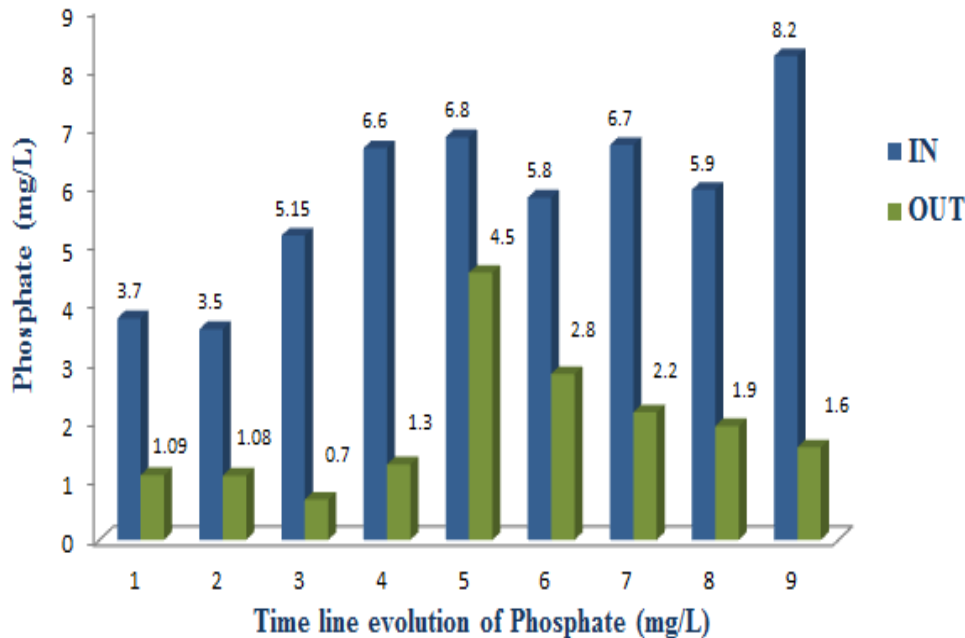
## Material & Methods

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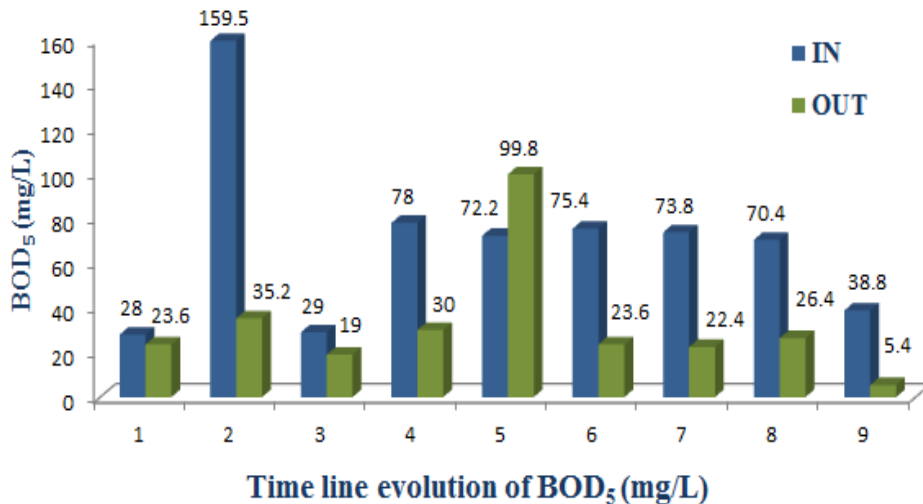
- $[\text{PO}_4^{3-}] < 5 \text{ mg/L}$
- Removal Rate of **66.9%**

- $[\text{SO}_4^{2-}] < 1000 \text{ mg/L}$
- Removal Rate -**61.67 %**
- Sulfide can be oxidized to  $\text{SO}_4^{2-}$  during denitrification by nitrate-reducing and S-oxidizing bacteria

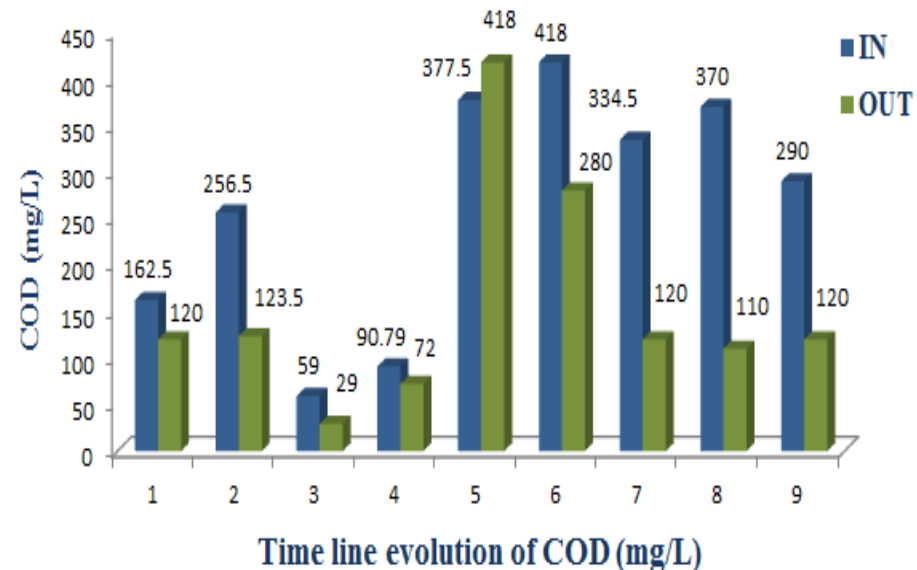


## Results of biological analyses of the constructed wetland influents and effluents

- BOD<sub>5</sub> is the amount of O required by bacteria to degrade the organic matter components in water
- [BOD<sub>5</sub>] < **25mg/L**
- Removal Rate of **54.3 %**

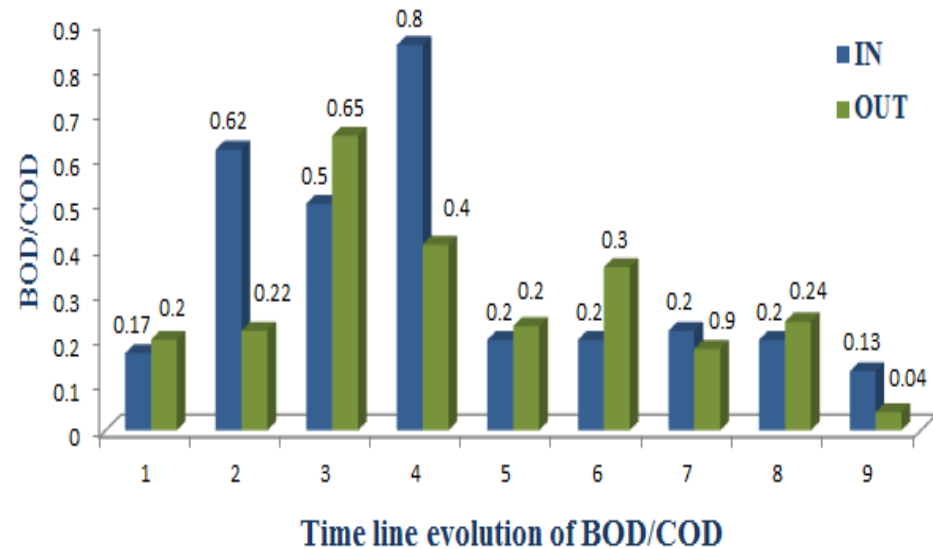
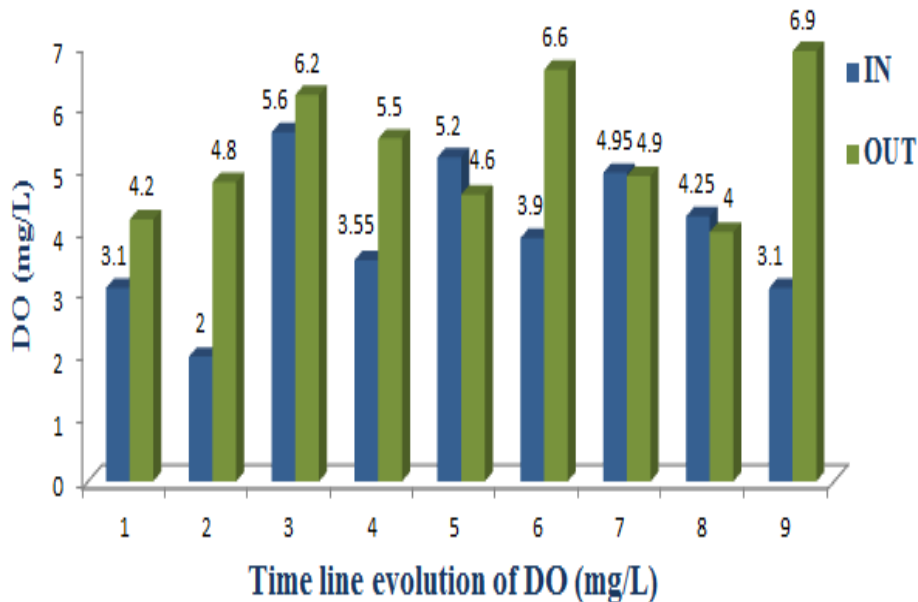


- COD is the amount of O required to chemically oxidize organic compounds
- [COD] < **125mg/L**
- Removal Rate of **42 %**



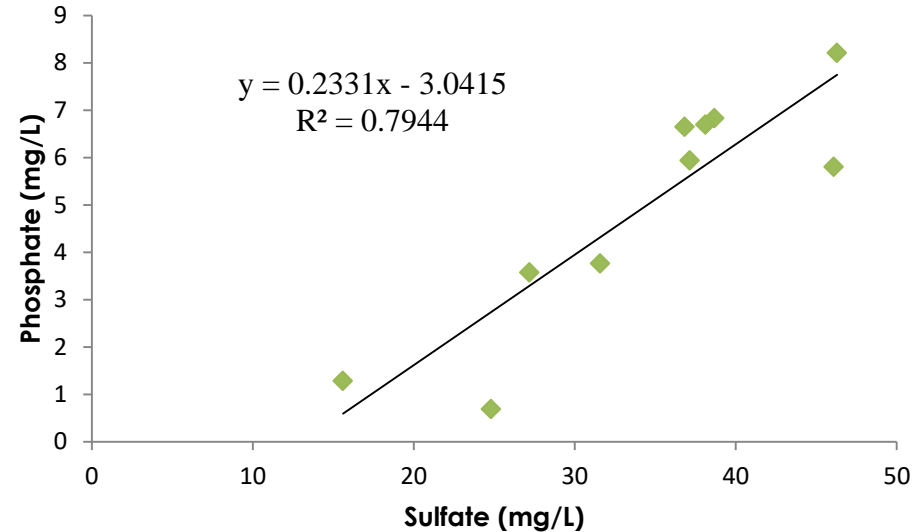
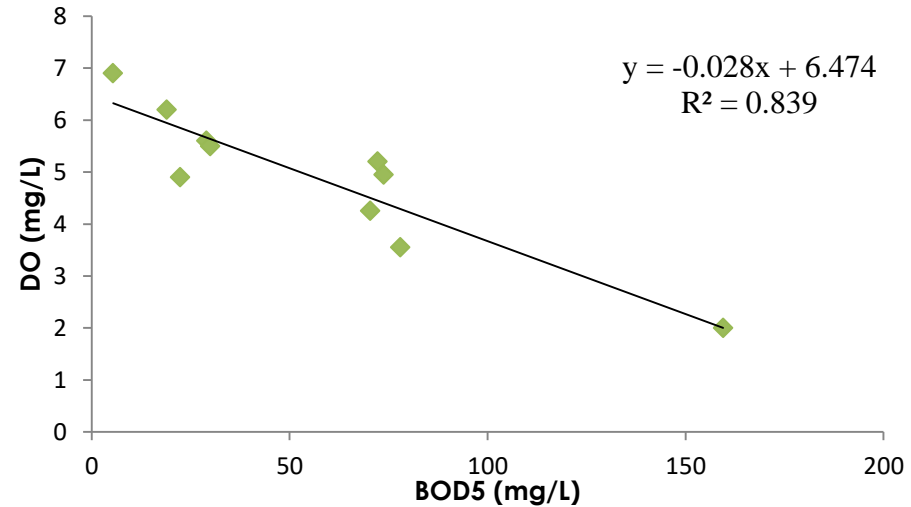
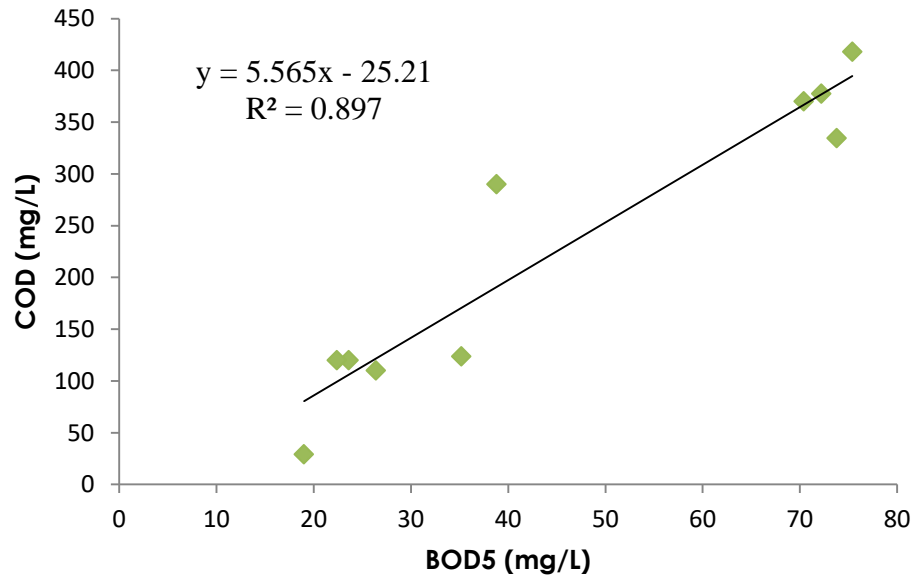
- DO Less than **2 mg/l** poor, greater than **9 mg/L** excellent

- BOD/COD ratio can be categorized into toxic, biodegradable and acceptable or stable zones



## Results of chemical analyses of the constructed wetland influents and effluents

- **COD versus BOD:** significant positive correlation
- **DO versus BOD5 :** significant negative correlation
- **Sulfate versus Phosphate:** significant positive correlation





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- Obtained results clearly demonstrate that the constructed wetland along the Litani River has a **high removal capacity of nutrients**, especially for **nitrate**.
- Implementation of an artificial aerated system :  
→ increase **[DO]** → increase **BOD** and **COD** removal efficiency
- Further comprehensive studies to better illustrate the role **of aquatic plants** in the remediation process are needed.



**Merci de votre écoute, et à la prochaine réunion le mois de mai 2021 en Algérie, inshallah!!!**