*Córdoba, June 30th. 2018*

# Survey Questionnaire
# Analysis of socio-economic impacts
# LIFE 13 ENV/ES/000800 - TL-BIOFER Project

## QUESTIONNAIRE INTRODUCTION:

The aim of this Questionnaire is to determine the socio-economic impacts of both: nutrients recovery from wastewater through the proposed microalgae innovative system and the application of the microalgae biomass as component for production of bio-based fertilizers.

The survey is divided in three sections:

a) **Section I:** General questions that must be answered by **All Participants.**

b) **Section II:** Specific questions regarding wastewater treatment and nutrients recovery (to be completed by **Participants related to wastewater treatment sector)**.

c) **Section III:** Specific questions regarding microalgae-based biofertilizers (to be completed by **Participants related to agricultural sector**).

Responses to the survey are anonymous and should take no more than 15 minutes to be completed.

Please, read carefully the following description of LIFE+ TL-BIOFER Project before starting:

## The LIFE+ TL-BIOFER Project:

The LIFE+ TL-BIOFER project aims to demonstrate the feasibility of an advanced nutrient removal technology by using microalgae immobilized culture in a Twin-Layer system, to address the environmental problem of point-source pollution from small and medium size urban agglomerations and simultaneously closing the global biogeochemical cycle of Nitrogen and Phosphorus, which is deeply affected by anthropogenic activities.

Key drivers of LIFE+ TL-BIOFER project:

- Protection of natural water from eutrophication by reducing N and P discharges from small and medium size wastewater treatment plants.

- To foster the compliance of the Directive 91/271/EEC on urban wastewater treatment for small and medium size wastewater treatment plants and for discharges on sensitive areas through advanced microalgae culture technology for tertiary treatment.

- To facilitate the recovery of nutrients through advanced microalgae based bio-fertilizers.

*The TL-BIOFER Project is co-funded by the European Union, LIFE+2013 Programme.*
*www.life-tlbiofer.eu*

## PRELIMINARY RESULTS:

### a) Nutrients removal from wastewater.

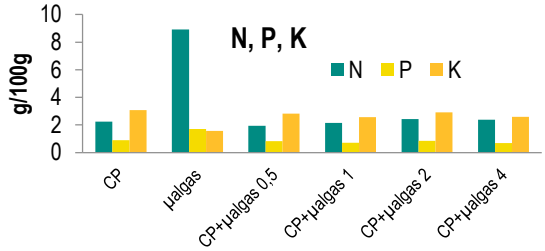
Here below are shown the nutrients removal rates at the *TL* prototype. There were significant differences among layers due to experimental conditions: total soluble Nitrogen and Ammonia nitrogen ranged between 45-68 % and 87-98 % respectively. In the case of Phosphorus, the removal rate ranged between 28-58 %. It is foreseen that removal rates could be over these results in stable operational conditions.

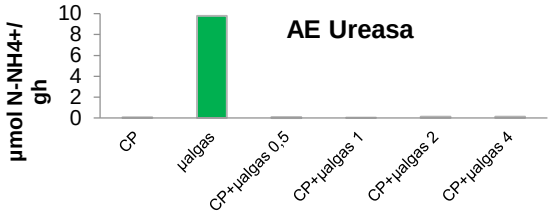
| Wastewater analysis | Input water | Output water from *TL* prototype | | | | |
|---|---|---|---|---|---|---|
| | | Layer 1* | Layer 2* | Layer 3** | Layer 5*** | Layer 6*** |
| **Ns (mg/L)** | 57 ± 1 | 31 ± 1 | 21 ± 1 | 23 ± 1 | 18 ± 1 | 23 ± 1 |
| **N-$NH_4^+$ (mg/L)** | 24,69 | 3,15 | 1,37 | 1,73 | 0,45 | 1,02 |
| **P-$PO_4^{-3}$ (mg/L)** | 5,42 ± 0,01 | 3,90 ± 0,01 | 3,39 ± 0,02 | 2,94 ± 0,01 | 2,30 ± 0,03 | 2,90 ± 0,02 |
| **TC (mg/L)** | 174 ± 1 | 121 ± 1 | 107 ± 1 | 114 ± 1 | 97 ± 1 | 102 ± 1 |
| **IC (mg/L)** | 124 ± 1 | 78 ± 1 | 67 ± 1 | 66 ± 1 | 51 ± 1 | 67 ± 1 |
| **TOC (mg/L)** | 50 ± 1 | 43 ± 1 | 40 ± 1 | 48 ± 1 | 46 ± 1 | 35 ± 1 |
| **Ns $_{removed}$ (%)** | | 45.6 | 63.2 | 59.7 | 68.4 | 59.7 |
| **N-$NH_4^+$ $_{removed}$ (%)** | | 87.2 | 94.5 | 93.0 | 98.2 | 95.9 |
| **P-$PO_4^{-3}$ $_{removed}$ (%)** | | 28.0 | 37.5 | 45.8 | 57.6 | 46.5 |

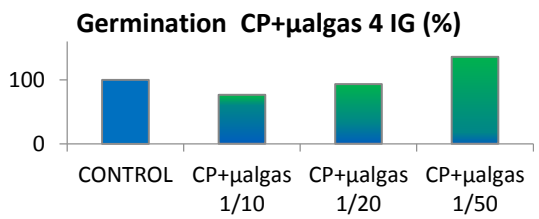
**Layer 1 and 2: inoculated with fresh microalgae directly cultivated in the bio-reactors and centrifuged for its concentration;*
***Layer number 3: was inoculated with lyophilized microalgae without drying previously;*
****Layers 5 and 6: inoculated with microalgae conserved in refrigeration at 4 ° C.*

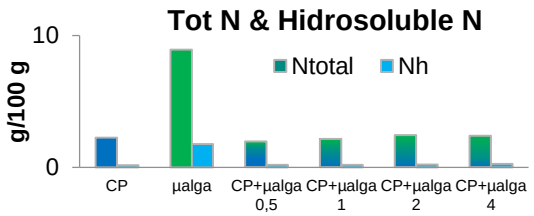
### b) Microalgae biomass characterization as biobased fertilizer component.

Find below some significant results regarding fertilizing / biostimulant properties of liophyllised microalgae biomass.



## Section I. Personal Details

**1. Country:**

☐ ES ☐ UK ☐ DE ☐ FR ☐ IT ☐ Other (Specify: _____)

**2. Gender:**

☐ Female
☐ Male
☐ N. A.

**3. Age:**

☐ < 29
☐ 30-39
☐ 40-49
☐ 50-59
☐ > 60
☐ N. A.

**4. Which is your Educational level? :**

☐ Primary school
☐ High school
☐ University
☐ N. A.

**5. Which is your occupation? :**

☐ Student
☐ Unemployed
☐ Related to wastewater treatment sector
☐ Related to agriculture sector
☐ Other (Please, specify: _____)
☐ N. A.

## Section II. Please answer this section if your occupation/interests are related to wastewater treatment sector.

**6. Do you live in an environmentally sensitive area (estuaries, reservoirs, protected areas, etc.) with special water quality requirements?**

- ☐ Yes
- ☐ No
- ☐ I don't know
- ☐ N. A.

**7. Indicate the size of the local WWTP of your village/town expressed in population equivalent (p.e.)?**

- ☐ < 2000 p.e. (Very small WWTP)
- ☐ 2,000 - 10,000 p.e. (Small WWTP)
- ☐ 10,000 - 20,000 p.e. (Small- Medium WWTP)
- ☐ > 20,000 p.e. (Medium – Big WWTP)

**8. What kind of microalgae cultivation systems do you know?**

- ☐ Open cultivation systems (open channel raceways)
- ☐ Closed cultivation systems (photobioreactors)
- ☐ None
- ☐ N. A.

**9. According to your own perception, how relevant could be the following potential positive impacts associated to the proposed innovative technology in comparison with conventional wastewater treatment systems?**

*(1: Lower positive impact; 5: Higher positive impact).*

| | | | | | | |
|---|---|---|---|---|---|---|
| a) Better compliance of water quality requirements in sensitive areas | 1 | 2 | 3 | 4 | 5 | N. A. |
| b) Reduction of environmental impacts | 1 | 2 | 3 | 4 | 5 | N. A. |
| c) Creation of links between wastewater treatment sector and agriculture sector at local level | 1 | 2 | 3 | 4 | 5 | N. A. |
| d) Creation of new bio-based fertilizers market | 1 | 2 | 3 | 4 | 5 | N. A. |
| e) Jobs creation/sustainable rural economy development | 1 | 2 | 3 | 4 | 5 | N. A. |

**10. According to your own perception, how relevant could be the following potential negative impacts associated to the proposed innovative technology in comparison with conventional wastewater treatment systems?**

*(1: Lower negative impact; 5: Higher negative impact)*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| a) | Investment | 1 | 2 | 3 | 4 | 5 | N. A. |
| b) | Increase space requirements in the WWTP | 1 | 2 | 3 | 4 | 5 | N. A. |
| c) | Variation in nutrients removal efficiency due to seasonal and geographical conditions | 1 | 2 | 3 | 4 | 5 | N. A. |
| d) | Microalgae separation from effluent | 1 | 2 | 3 | 4 | 5 | N. A. |

**11. Please, select key advantages of the Twin Layer system for an efficient implementation within existing small-medium size WWTPs?**

- ☐ Overcome technical constraints (light use efficiency, contamination risks, evaporation, cost-efficient microalgae cultivation and harvesting systems, etc.)
- ☐ Reduced consumption of chemicals
- ☐ Successful implementation of Circular Economy strategies
- ☐ Others (Please, specify: _____)
- ☐ N. A.

**12. From a consumer point of view, would you be willing to buy food products which have been produced using microalgae-based biofertilizers coming from nutrients recovered from wastewater?**

- ☐ Yes
- ☐ No (Please, specify why:_____)
- ☐ N. A.

_____ *End of Section II*_____

*Thank you for your contribution.*

*TL-BIOFER Project Consortium*

*The TL-BIOFER Project is co-funded by the European Union, LIFE+2013 Programme.*

## Section III. Please answer the following questions if your occupation/ interests are related to agricultural sector.

**13. Please, indicate the kind of crops which are primarily cultivated in your region:**

- ☐ Cereals
- ☐ Oilseeds
- ☐ Fruit
- ☐ Vegetables
- ☐ Greenhouse
- ☐ Wine
- ☐ Other (Please, specify :_____)
- ☐ N. A.

**14. Which kind of fertilizers are primarily applied to land in your region?**

- ☐ Mineral fertilizers
- ☐ Biochar
- ☐ M.S.W. Compost
- ☐ Green compost
- ☐ Manure
- ☐ Crop residues
- ☐ Slurry
- ☐ Sewage sludge
- ☐ None
- ☐ N. A.

**15. In the case that mineral fertilizers are mainly applied, please indicate why:**

- ☐ Non availability of good quality biofertilizers in your region
- ☐ Unawareness of bio-based fertilizers safety risks
- ☐ Lack of knowledge about bio-based fertilizers properties and associated benefits
- ☐ Cost
- ☐ Others (Please, specify:_____)
- ☐ N. A.

**16. How important are the following properties of marketed fertilizers?**

*(1: Less important; 5: Very important)*

| | | | | | | |
|---|---|---|---|---|---|---|
| a) Nutrient content (N,P,K) | 1 | 2 | 3 | 4 | 5 | N. A. |
| b) Microelement content | 1 | 2 | 3 | 4 | 5 | N. A. |
| c) Ease of handling and application | 1 | 2 | 3 | 4 | 5 | N. A. |
| d) Cost | 1 | 2 | 3 | 4 | 5 | N. A. |
| e) Dose | 1 | 2 | 3 | 4 | 5 | N. A. |
| f) Recycling nutrients (from waste products etc.) | 1 | 2 | 3 | 4 | 5 | N. A. |
| g) Environmentally friendly | 1 | 2 | 3 | 4 | 5 | N. A. |
| h) No toxic elements / Impurities content | 1 | 2 | 3 | 4 | 5 | N. A. |
| i) Information about origin and fertilizers production process employed | 1 | 2 | 3 | 4 | 5 | N. A. |
| j) Efficiency | 1 | 2 | 3 | 4 | 5 | N. A. |

**17. According to your own perception, how relevant could be the following potential positive impacts associated to the agricultural application of microalgae-based biofertilizers coming from wastewater tertiary treatment when compared to conventional fertilizers?**

*(1: Lower positive impact; 5: Higher positive impact)*

| | | | | | | |
|---|---|---|---|---|---|---|
| a) Improve of crops productivity and quality | 1 | 2 | 3 | 4 | 5 | N. A. |
| b) Reduction of chemical fertilizers use and dependency of producer countries | 1 | 2 | 3 | 4 | 5 | N. A. |
| c) Close anthropometric water and nutrients recycling system | 1 | 2 | 3 | 4 | 5 | N. A. |
| d) Link between agriculture sector and wastewater treatment sector | 1 | 2 | 3 | 4 | 5 | N. A. |
| e) Jobs creation and sustainable rural economy development | 1 | 2 | 3 | 4 | 5 | N. A. |

**18. Do you think that microalgae-based biofertilizers must be regulated by European legal framework on fertilizers?**

☐ Yes
☐ No (please, specify why: _____)
☐ N. A.

**19. Select which are the key roles for an efficient integration of microalgae-based biofertilizers in the existing market?**

- ☐ Easy management, storage and transportation
- ☐ Demonstrate the agricultural efficiency in terms of productivity and quality
- ☐ Adequate information to the users
- ☐ Good marketing and distribution strategy
- ☐ Competitive price
- ☐ Other, (please, specify: _____)
- ☐ N. A.

_____ *End of Section III*_____

*Thank you for your contribution.*

*TL-BIOFER Project Consortium*