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BIOrural

Microalgae related processes for nutrients recovery from wastes

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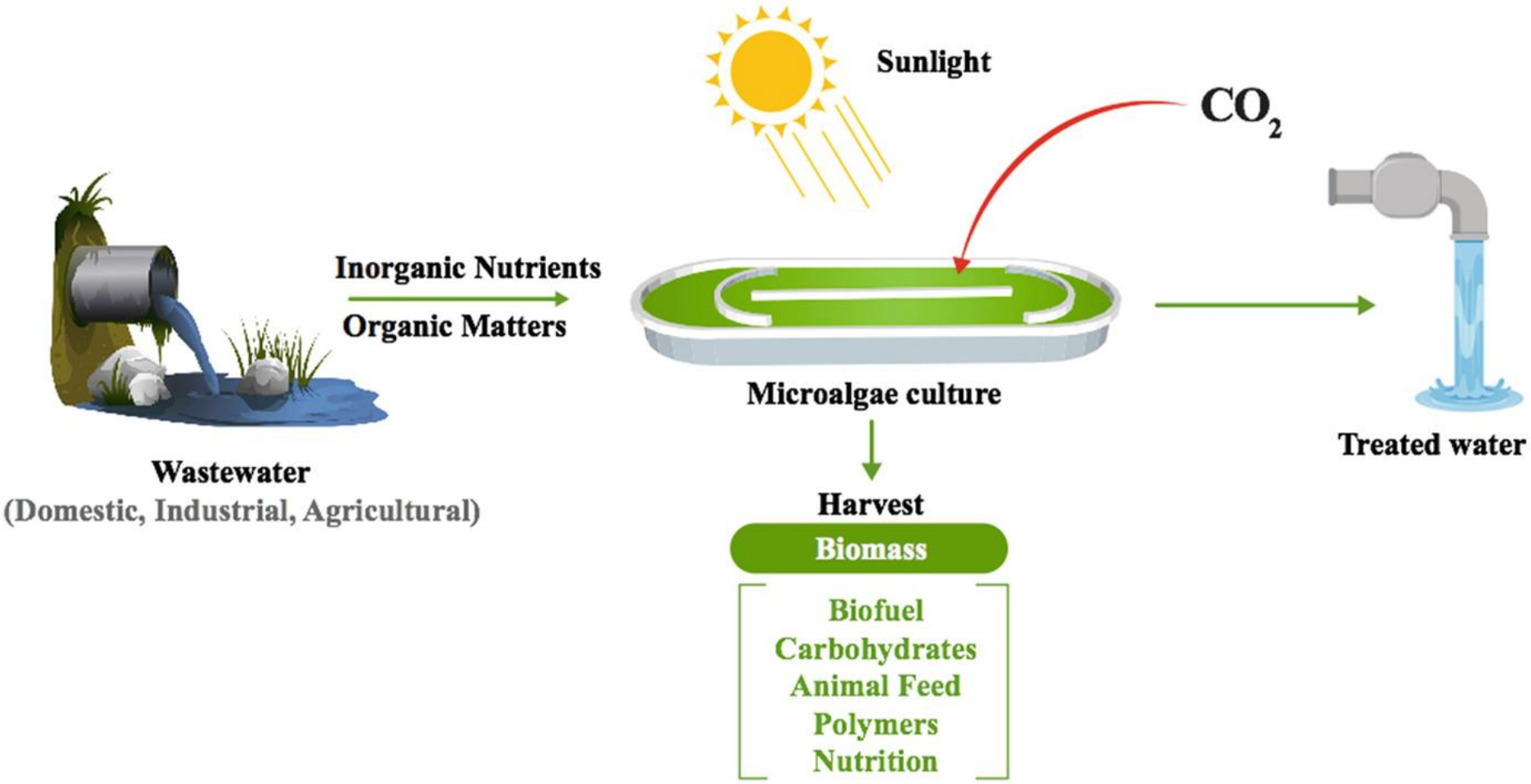
Aim



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Feedstock

Wastewater as nutrients source

The composition of sewage and centrate are similar to standard microalgae culture media, but digestate and manure contain too much contaminants

Effluent	COD/BOD, mg/l	N, mg/l	P, mg/l	Total Suspended Solids, mg/l	Turbidity, NTU
Digestate	9000/7000	8000	400	10000	30000
Manure	16000/12000	9000	500	3000	9000
Agro-industrial (Breweries)	4000/3800	30	10	1000	3000
Centrate	300/200	500	12	1000	3000
Sewage	700/500	65	11	300	900
Microalgae culture medium		**50**	**10**	**0**	**0**

Microalgae can be produced using whatever of these wastewater as only nutrients source, recovering up 90% of nutrients inlet

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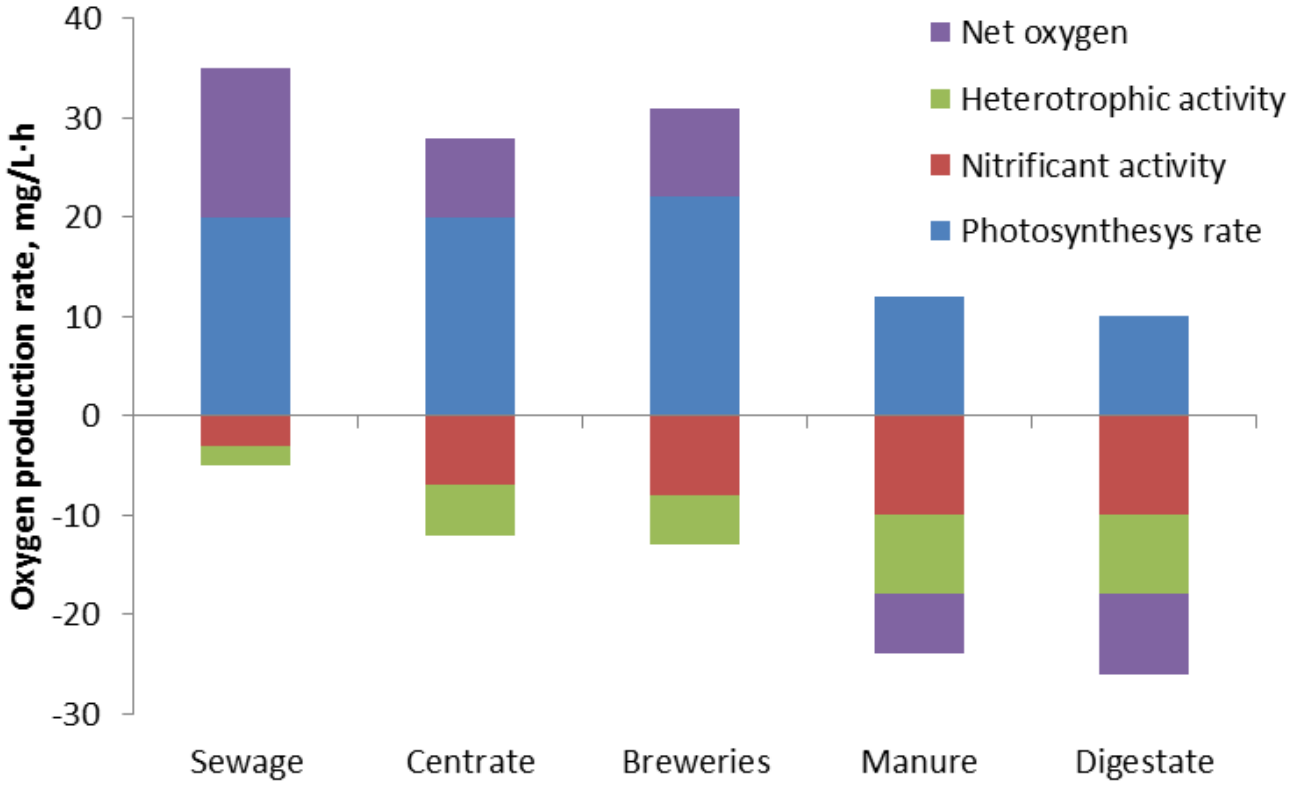
Microalgae consortia

Management of microalgae consortia

According to the wastewater composition different design/operational conditions are required



Composition of the consortia largely modifies as a function of wastewater type used, thus modifying the entire performance of the system

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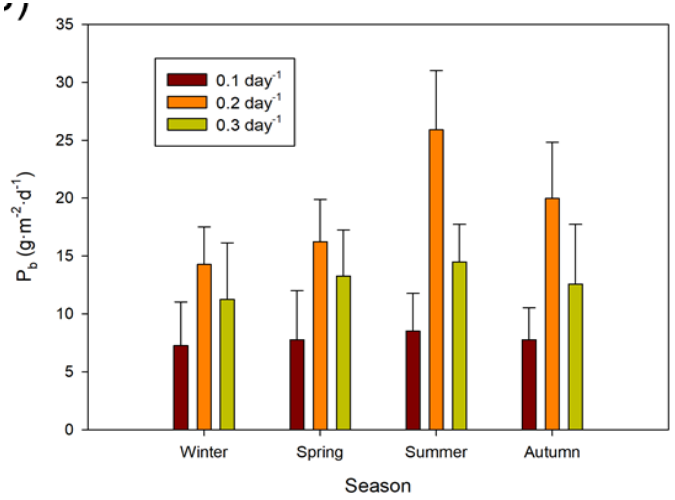
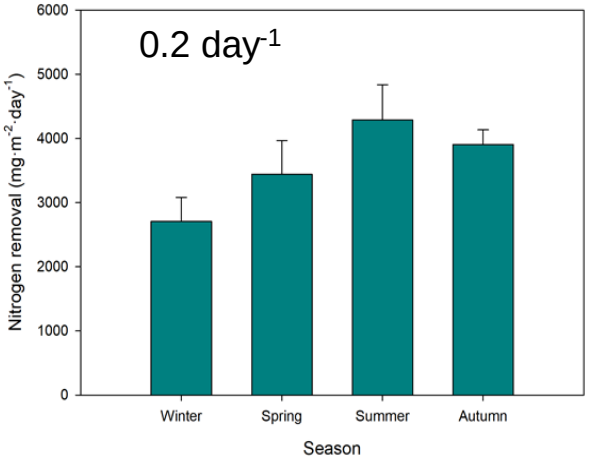
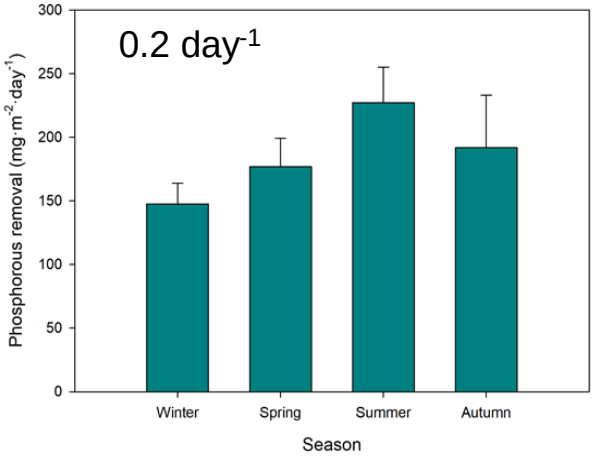
Domestic wastewater

Year-long evaluation of microalgae production using wastewater

BOD is always removed but N/P is only removed when maximizing productivity







Mean values on annual basis:

- Wastewater treatment = 400 m^3/ha·day
- Biomass production = 200 kg/ha·day
- BOD removal = 200 kg/ha·day
- N removal = 35 kgN/ha·day
- P removal = 1.8 kgP/ha·day
- Complete accomplishment of regulation (BOD, N, P)

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Domestic wastewater

Firsts industrial demonstrators

aqualia

20,000m²

10,000m²

22,200m²

3,000m²

All-gas biosol water recycling SABANA INCOVER

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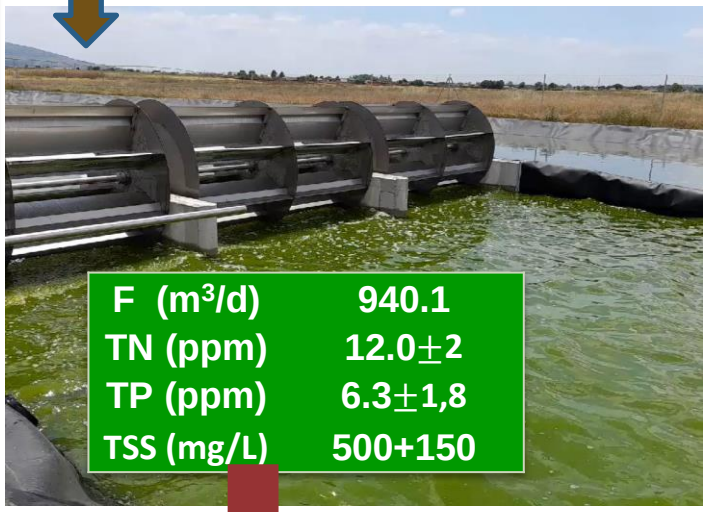
Domestic wastewater

Firsts industrial demonstrators

F (m^3/d)	1000
TN (ppm)	50.4±8
TP (ppm)	10.3±3
COD (mgO_2/L)	525±120



Biomass
110±32
Ton/Ha yr

TN (ppm)	12.0± 2,2
TP (ppm)	1.01±0,75
COD (ppm)	80.2±20
TSS (ppm)	25.4±7,5

Simultaneous COD, TN and TP removal , 80%, 74% and 88%, respectively

Energy requirement 0,17kWh/m^3

2 to 3 m^2/PE

Simple process:
No external carbon
Single stage

Biomass rich in:
N and P

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Domestic wastewater

5000 PE
Simultaneous
N, P, COD & TSS removal
Below directive 91/271/EC

Firsts industrial demonstrators

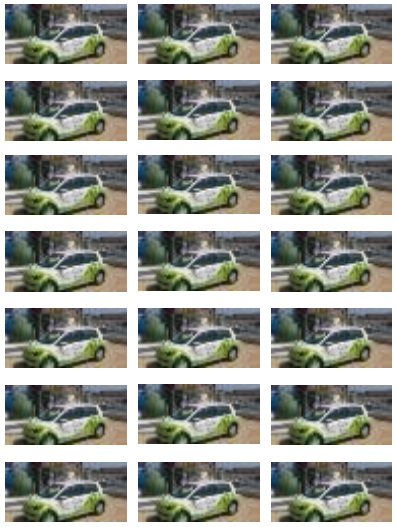
1000 m^3/d WW

950 m3/d Reuse

1 hectare

40-60 Ton/ yr biomass

15 000 kg / 4,5 = 330.000 km
15 000 km/yr, 22 cars



13,000 kg CH4/yr

- 0,3kWh/m3

Energy saving 106.800 kWh/yr

50-60% VS bio-CH4

>100 Ton/ yr

aqualia industrial

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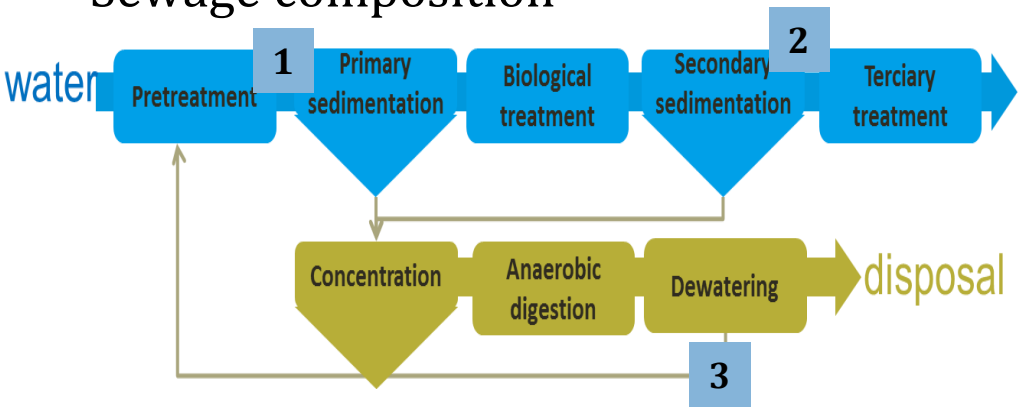
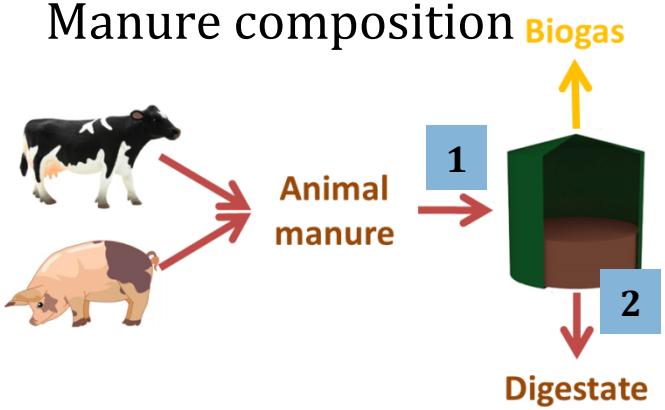
Agroindustrial effluents

Manure from animal farming

Sewage composition



Manure composition



Conc., mg/L	Arnon	1 Primary treatment	2 Secondary treatment	3 Anaerobic digestion
TKN	114	65	20	511
TP	41	11	10	12
TC	47	296	82	247

Conc., mg/L	1 Undigested	2 Digested
TKN	9000	8000
TP	500	400
TC	16000	9000

Composition of waste water is different, thus them must be managed differently
Manure/digestate must be diluted consuming large amounts of water

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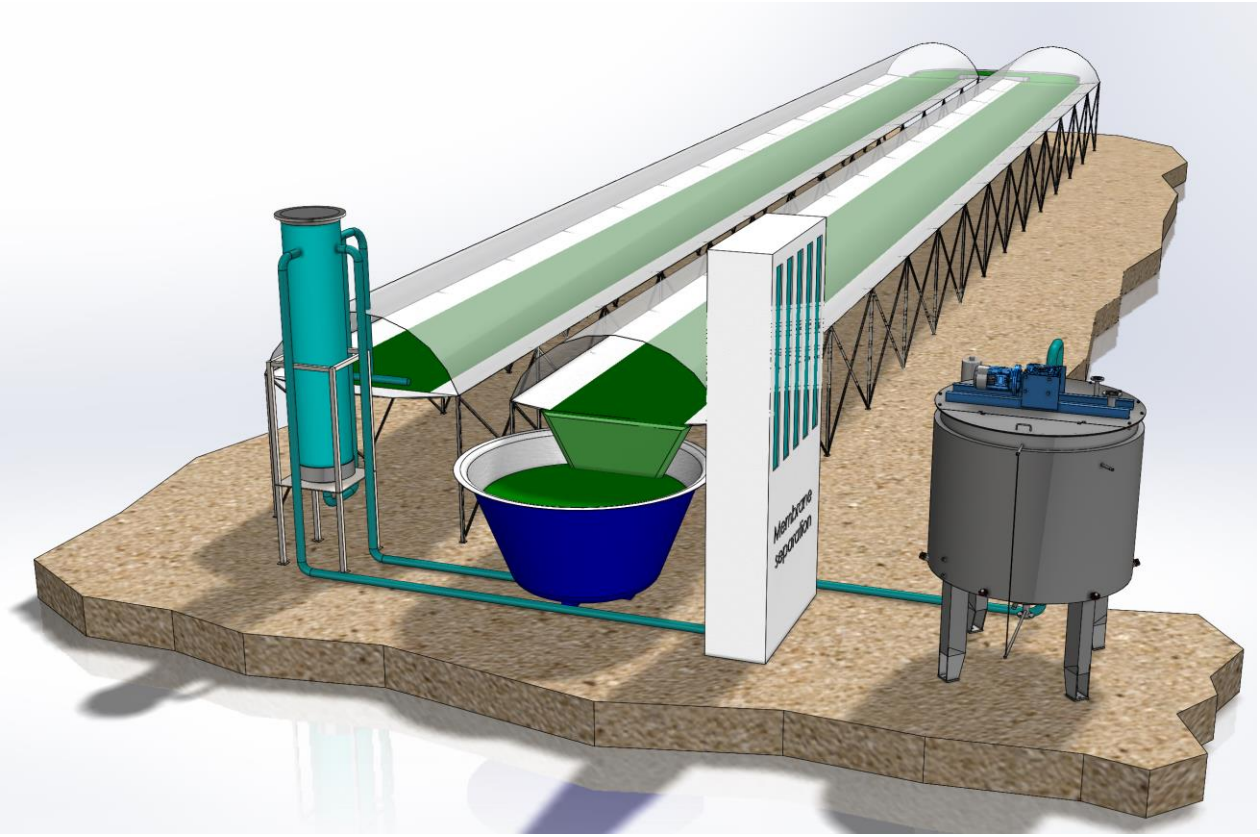
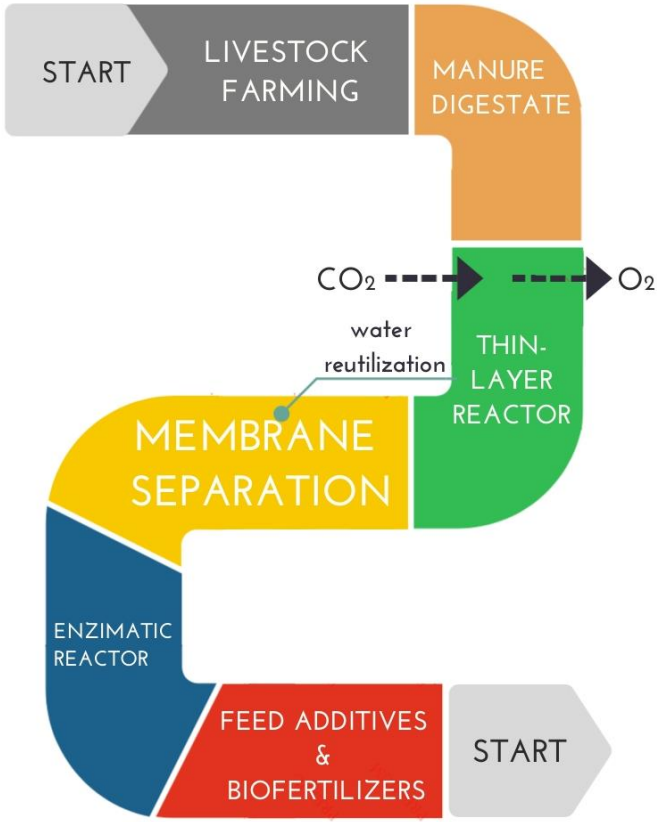
Agroindustrial effluents

Proposed technology





Covered reactors to minimize water losses
Membrane technologies for water recovery/recirculation
Robust technologies

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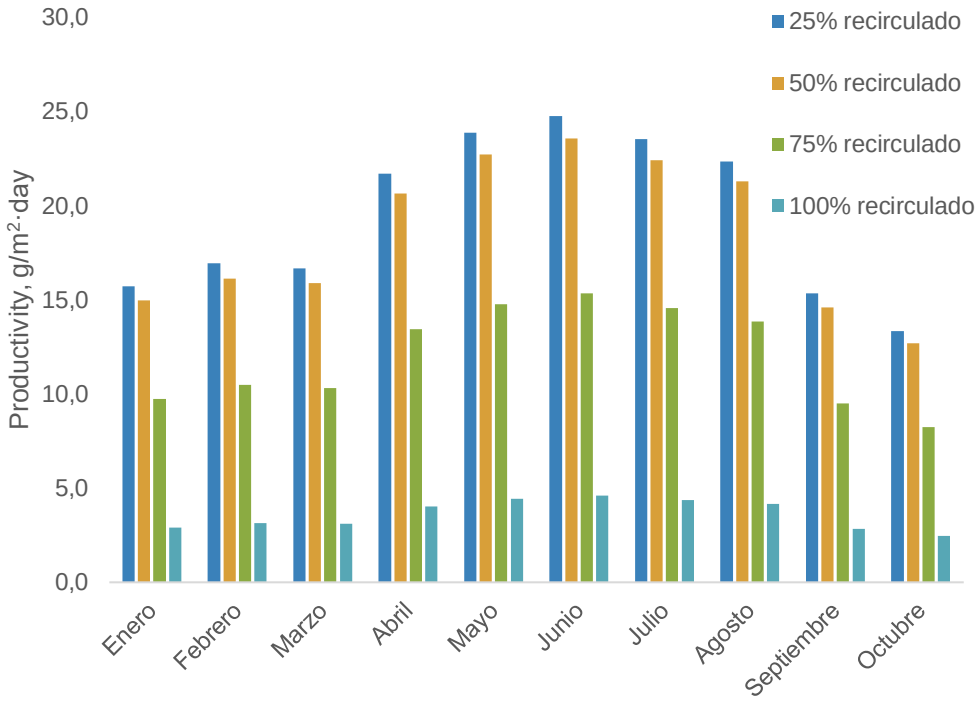
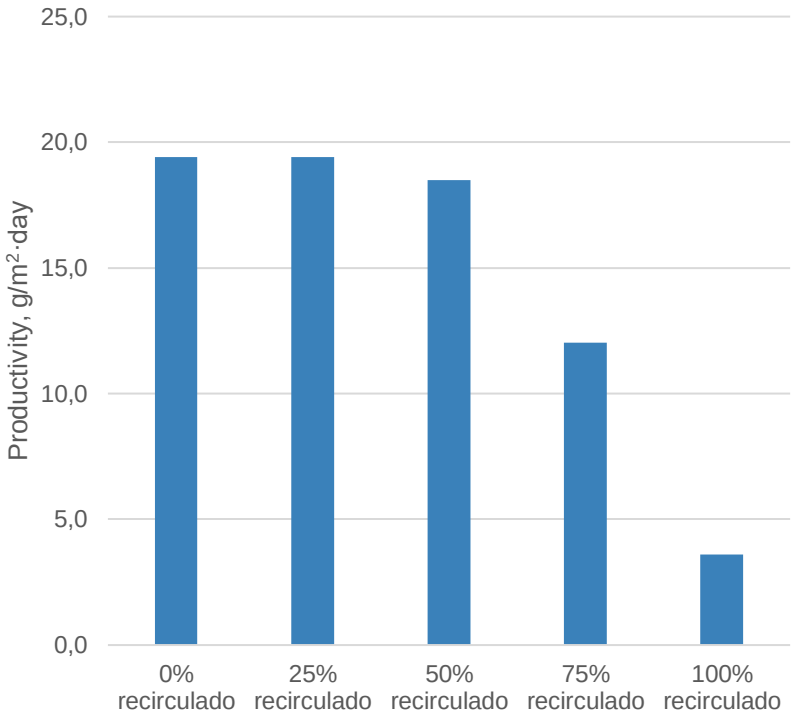
Agroindustrial effluents

Performance of the system





Biomass productivity remains constant at recirculation rates up to 50%
Seasonal variations largely influences the performance of the cultures
The behavior is analogous to conventional microalgae production systems

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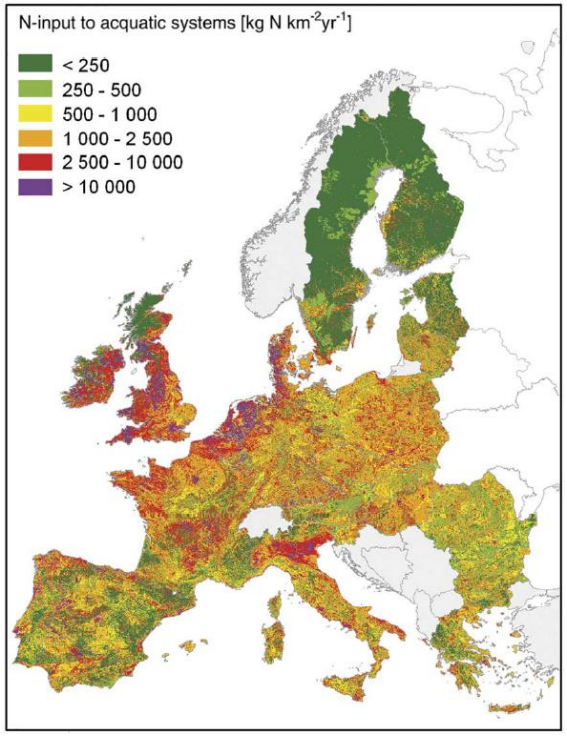
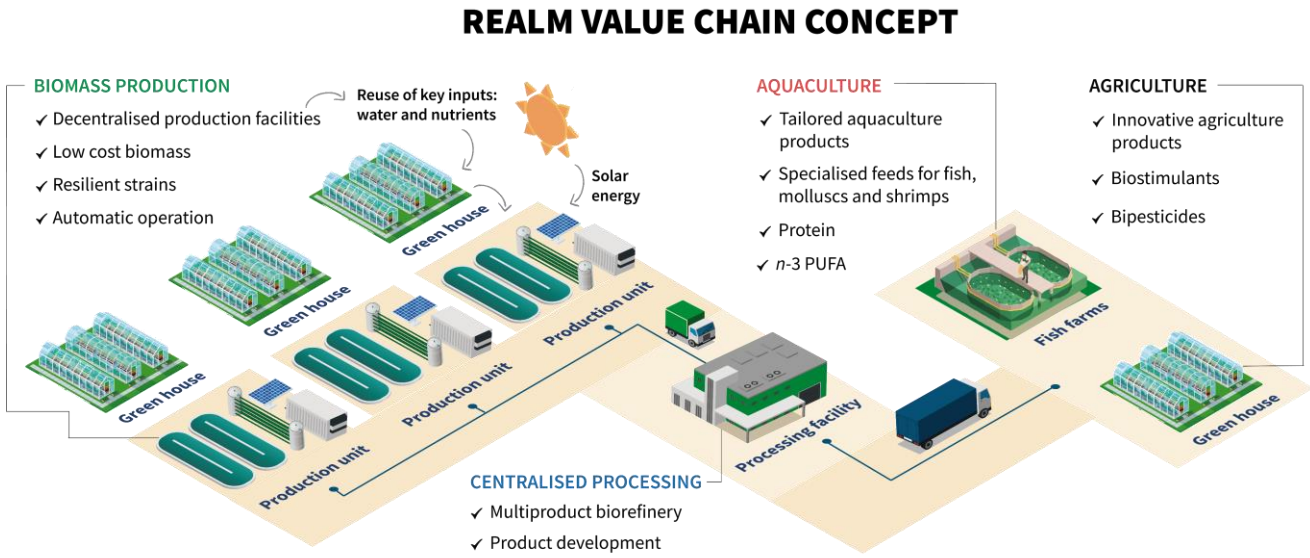
Drain water

REALM

HORIZON-CL6-2021-CIRCBIO-01-09 — Unlocking the potential of algae for a thriving European blue bioeconomy. Innovation Action . TRL 7

REUSING EFFLUENTS FROM AGRICULTURE TO UNLOCK THE POTENTIAL OF MICROALGAE (GA 101060991)





Distributed production of microalgae recovering nutrients from drain water and integrated valorization in foods production systems (agriculture and aquaculture)

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Drain water

REALM

Data from commercial producers

Inlet		
Water	3	L/m2·day
NO3-	1000	mg/L
TKN	226	mg/L

	Use	Losses
Water	67%	33%
NO3-	30%	70%
TKN	30%	70%

1 ha scenario		
Water	10	m3/day
TKN	158	mg/L
N total	1581	g/day
N biomass	10%	
Biomass productivity	20	g/m2·day
Biomass production	16	kg/day
Surface required	**790**	**m2**

Outlet		
Water	1	L/m2·day
NO3-	700	mg/L
TKN	158	mg/L

Challenges:

- Avoid contamination of water bodies
- Reuse of water/nutrients
- Remove pathogens

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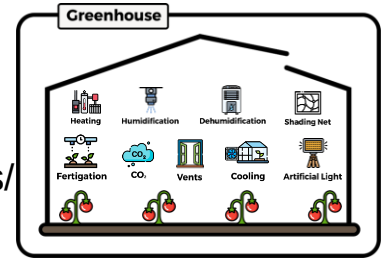
Drain water

Demonstration scale facility

1100 m^2, hydroponic

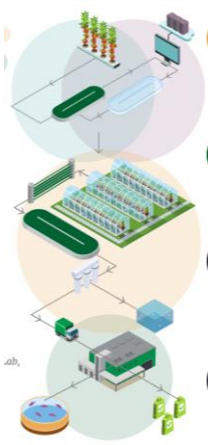
100 m^2, raceway

http://agroconnect.es/



Samples: Inlet, Outlet
Periodicity: twice per week
Measurements: pH, CE, TIC, COD, turbidity

- Continuous cultures
- Influence of environmental conditions
- Bioactivity tests
- Evaluation of removal of compounds of emerging concern



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Products

Agriculture applications

Produced biomass can be used to obtain valuable product as biofertilizers among others, otherwise it would be a waste

Biorizon

Biomass is highly valuable to produce biofertilizers/biostimulants for agricultural uses, quality of the product being validate in field trials

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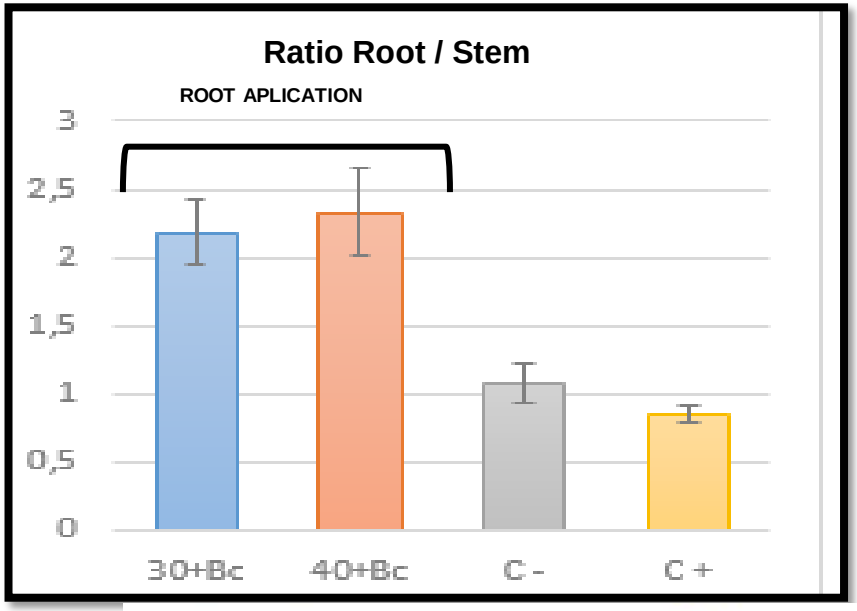
Products

Biostimulants

Protective effect



- Higher productivity/quality (>20%)
- Reduction on fertilizers consumption (<10%)
- Reduction of fungi adverse effects (>40%)
- Larger root development and tolerance to stress factors

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Products

Irrigation water

Evaluation of the reuse of regenerated water from microalgae-related wastewater treatment processes in horticulture

Tatiana P.L. Cunha-Chiamolera[a*], Ainoa Morillas España[b], Raúl Ortega[c], Isabel Miralles[c], Cynthia Victoria González-López[b], Ireri A. Carbajal-Valenzuela[d], Miguel Urrestarazu[a]

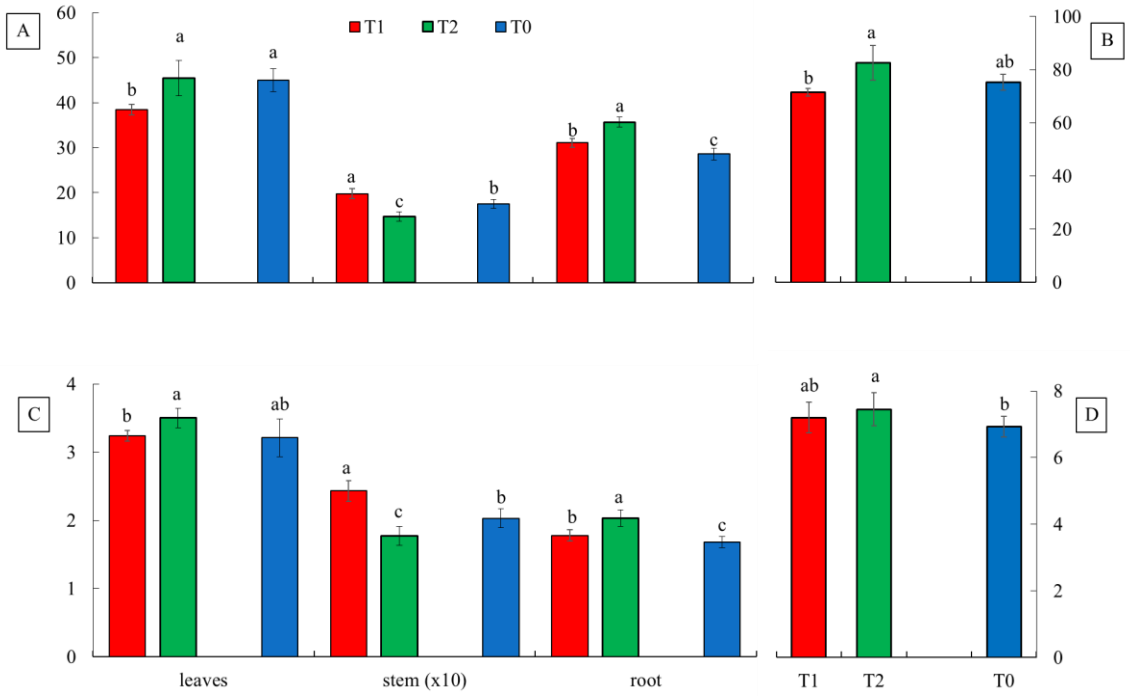

Figure 6.- Fresh (A and B) and dry weight (C and D) of lettuce crop (g plant^{-1}) versus application of untreated (T1) and treated wastewater (T2) using microalgae, compared to the control with nutrient solution (T0). Different letters indicate significant differences at $p<0.05$ according to Tukey's test for each organ and total weight.

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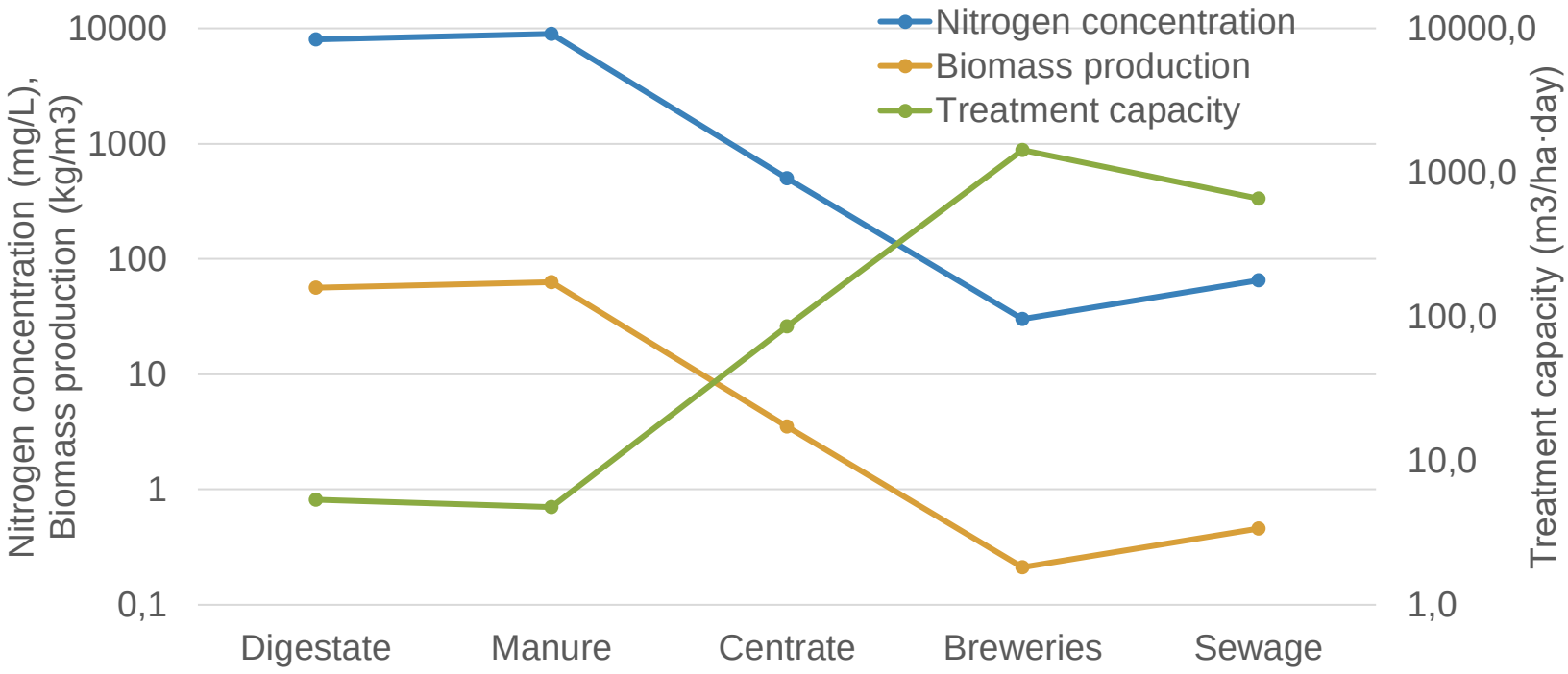
Marketability

Overall capacity is a function of nutrients source

Both biomass production and wastewater treatment capacity is a function of composition of the wastewater, mainly N/P concentrations



Capacity of the process is limited by the performance of photosynthetic reaction

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