Alqae Service for Life

LIFE17 ENV/LT/000407

AlgaeService for LIFE in Lithuania: results of water quality improvement and bioproducts from wild algal biomass

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Nature Heritage Fund: Zenonas Gulbinas, Vaidotas Valskys, Žydrūnas Sinkevičius

Spila: Vytas Rimkus, Daiva Semėnienė

A circular economy EU Life project:

Algae - economy-based ecological service of aquatic ecosystems

https://algaeservice.gamtostyrimai.lt/background-information/

COORDINATOR:
Nature Research Centre

PARTNERS from Lithuania:

Joint Stock Company

Nature Heritage Fund

Joint Stock Company

PARTNERS from Poland:

Institute of Nature Conservation, Polish Academy of Sciences

Adam Mickiewicz University in Poznan


✓ Declining water transparency and species diversity
✓ Intensified sedimentation of organic matter
✓ The decomposition of biomass consumes oxygen
✓ Produces dangerous cyanotoxins
Kaunas Reservoir, September 2020


✓ Destroys aquatic vegetation,
✓ Reduces habitat heterogeneity,
✓ Reduces flow rate
✓ Covering the bottom - negatively affects fish populations
River Jūra, August 2019

Nodularia spumigena
© Nordic microalgae and aquatic protozoa

Cyanobacterial bloom in the Baltic Sea, July 11, 2005. Satellite image from NASA' s Terra satellite, MODIS instrument.


Oporzyńskie


Łęgowskie


Nielba


Podkamycze

Kuršių marios

Simnas

Kauno marios

Šventoii

Nature Research Centre

Ecological status of the tested water bodies in 2018–2020

Rivers

Country	River	Physical-chemical parameters						Biological parameters
		TN	NO_3^-	NH_4^+	TP	PO_4^{3-}	O_2	MIR index
Lithuania	Dubysa							
	Jūra							
	Nevėžis							
	Šventoji							

Colours refer ecological status:	Very good	Good	Modearte	Bad	Very bad	Value worse than good status

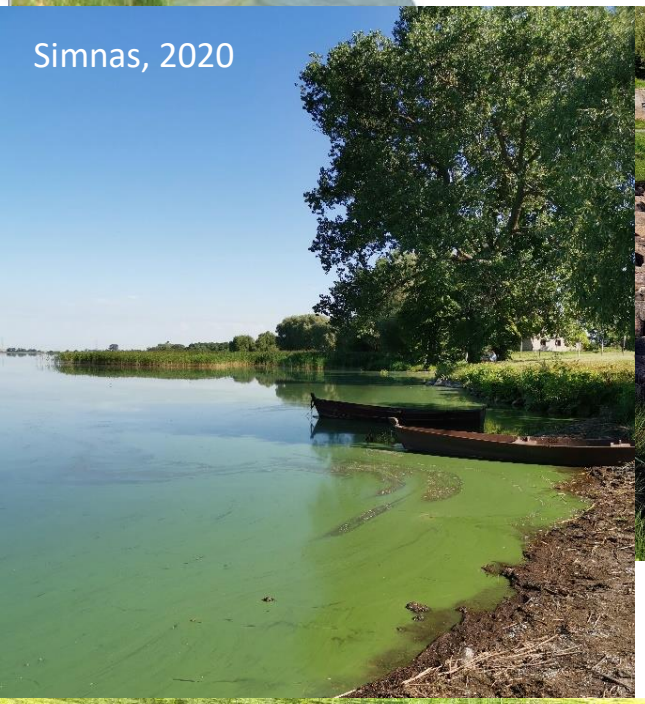
TN – total nitrogen (mg/l); NO_3^- – nitrate-nitrogen (mg/l); NH_4^+ – ammonium-nitrogen (mg/l); TP – total phosphorus (mg/l); PO_4^{3-} – phosphate-phosphorus (mg/l); O_2 – dissolved oxygen (mg/l); MIR index – Macrophyte Index for Rivers

Standing water bodies

Country	Water body	Physical-chemical parameters			Biological parameters
		TN	TP	Water transparency	Chl-a / PMPL indexes
Lithuania	Lake Simnas				
	Kaunas Reservoir			–	
	Curonian Lagoon			–	

Colours refer ecological status:	Very good	Good	Modearte	Bad	Very bad	Value worse than good status

TN – total nitrogen (mg/l); TP – total phosphorus (mg/l); water transparency – Secchi disk, m; Chl-*a* index – Chlorophyll-a index counted based on chlorophyll-*a* value in Lithuania; PMPL index – Phytoplankton Metric for Polish Lakes index counted based on chlorophyll-*a* value and biomass of phytoplankton and cyanobacteria metrics in Poland; "– "– no data


Simnas, 2020


Mastis, 2020


Gineitiškės, 2019

Immediate emergency actions are necessary!


Cladophora, Nevėžis, 2019


Cladophora, Jūra, 2019


Spirogyra, Dybysa, 2019

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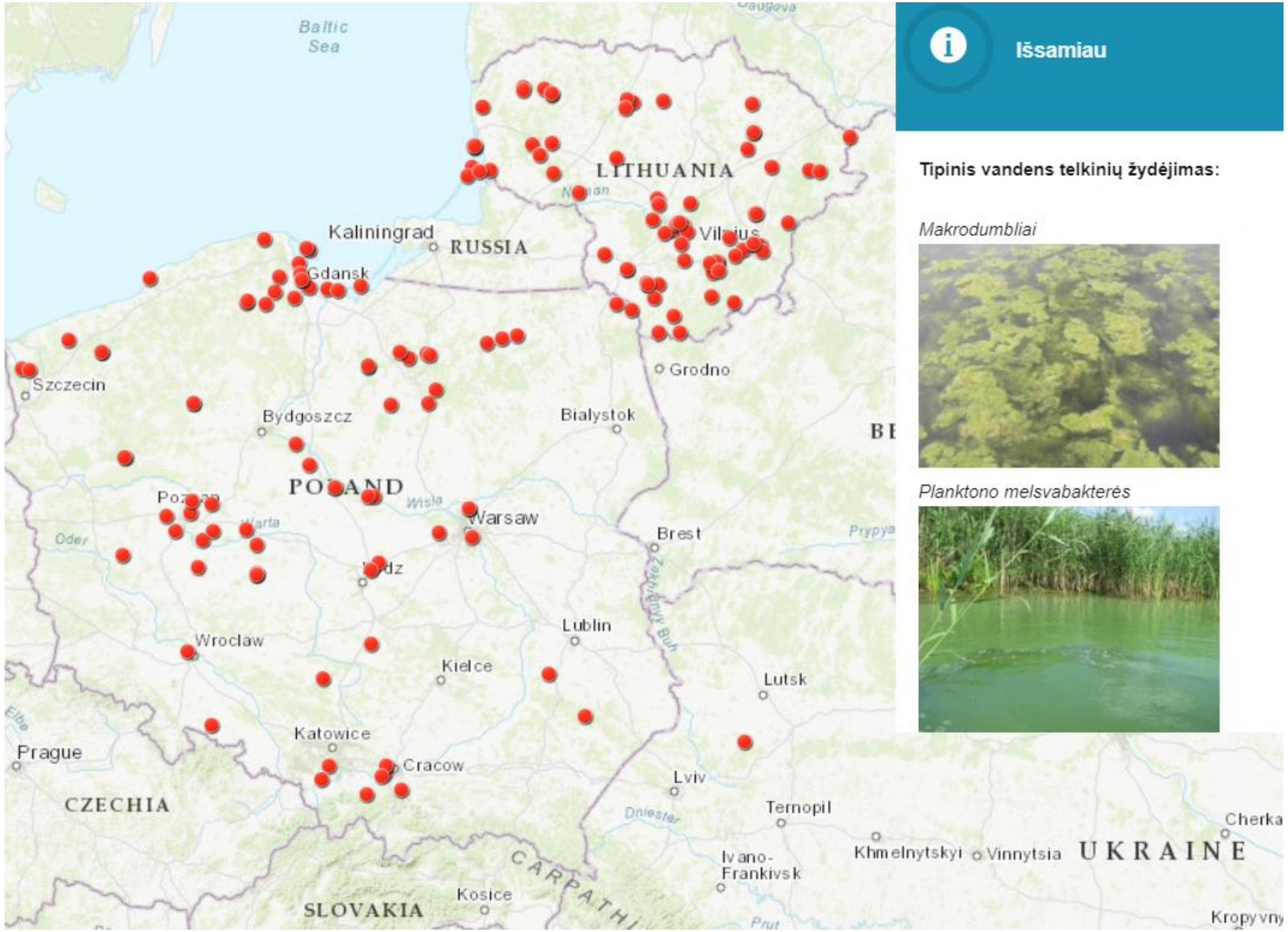
ArcGIS application "Mark a blooming water body" (https://arcg.is/0jqvCn) and **Interactive map** (https://arcg.is/1v5faT) of ArcGIS application have been created.



METHODS FOR DEFINING ALGAL BLOOMS

Traditional phycological methods

Time and labour consuming: require frequent field visiting, sampling and microscopic analysis

Methods of up-to-date remote technologies

Use the light spectral bands, band ratios to construct algortihms as modelled indicators of chlorophyll-a

PREPARATION OF NEW METHODOLOGY

Nature Research Centre

in cooperation with external experts R. Skorupskas, A. Gedvilas

METHODOLOGY OF EVALUATION OF ALGAL AGGLOMERATIONS USING UAV IMAGES

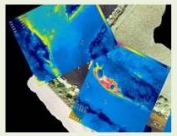
UAV takes images

UAV image of the river segment

Identification of areas based on turbidity and grouping

In-situ analysis

Raster segmentation of riverbed



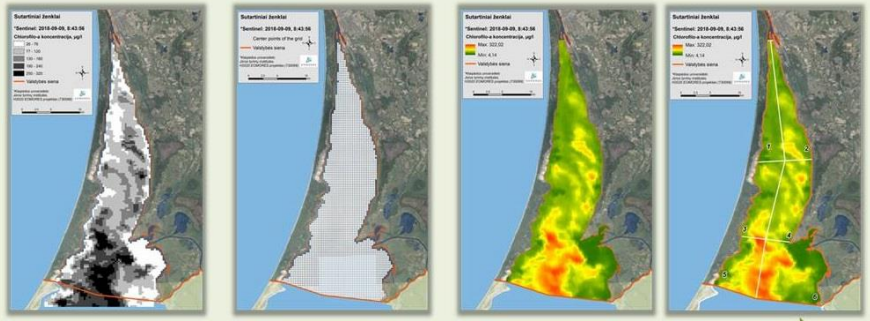
Thermographic scanning

Data collection → Data processing → Identification of types of riverbed → Calculations

River	Length of the stretch, km	Macroalgae agglomerations		
		area covered, ha	total weight, t	average weight, kg/m³
Šventoji	12.7	128.5	3276.8	2.55
Dubysa	14.0	22.3	1264.5	5.67
Nevėžis	6.9	118.3	6234.4	5.27
In total:	**33.6**	**269.1**	**10775.7**	**4.34±1.64***

*average±SD

DISTRIBUTION OF CHLOROPHYLL-A CONCENTRATION IN THE CURONIAN LAGOON BASED ON SENTINEL DATA



Raw Sentinel data → Data processing → Final result → Calculations

2018-09-09, 8:43:56	Chlorophyll-a, ppb					
	Points	Min.	Max.	Mean	SD	Variance
1 zone	394	30.16	178.68	76.56	17.23	296.77
2 zone	538	36.63	213.41	104.96	38.76	1502.65
3 zone	528	34.30	280.19	115.67	46.13	2128.01
4 zone	744	28.98	254.28	119.65	33.96	1152.95
5 zone	557	26.64	322.04	169.47	67.53	4559.71
6 zone	1117	25.66	318.63	134.02	81.91	6709.02

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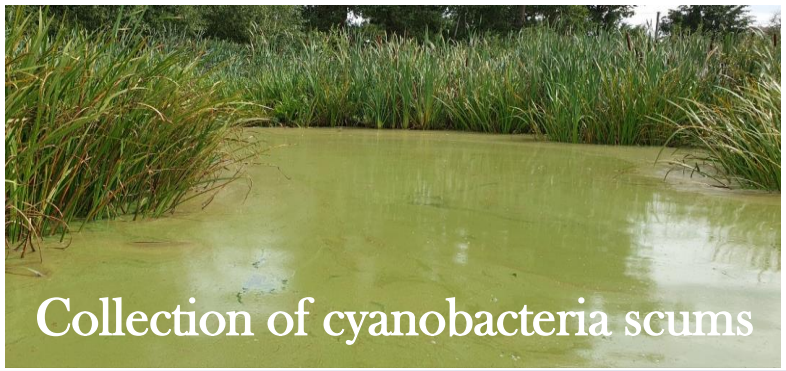
in cooperation with Klaipėda University (Horizon 2020 project EOMORES)

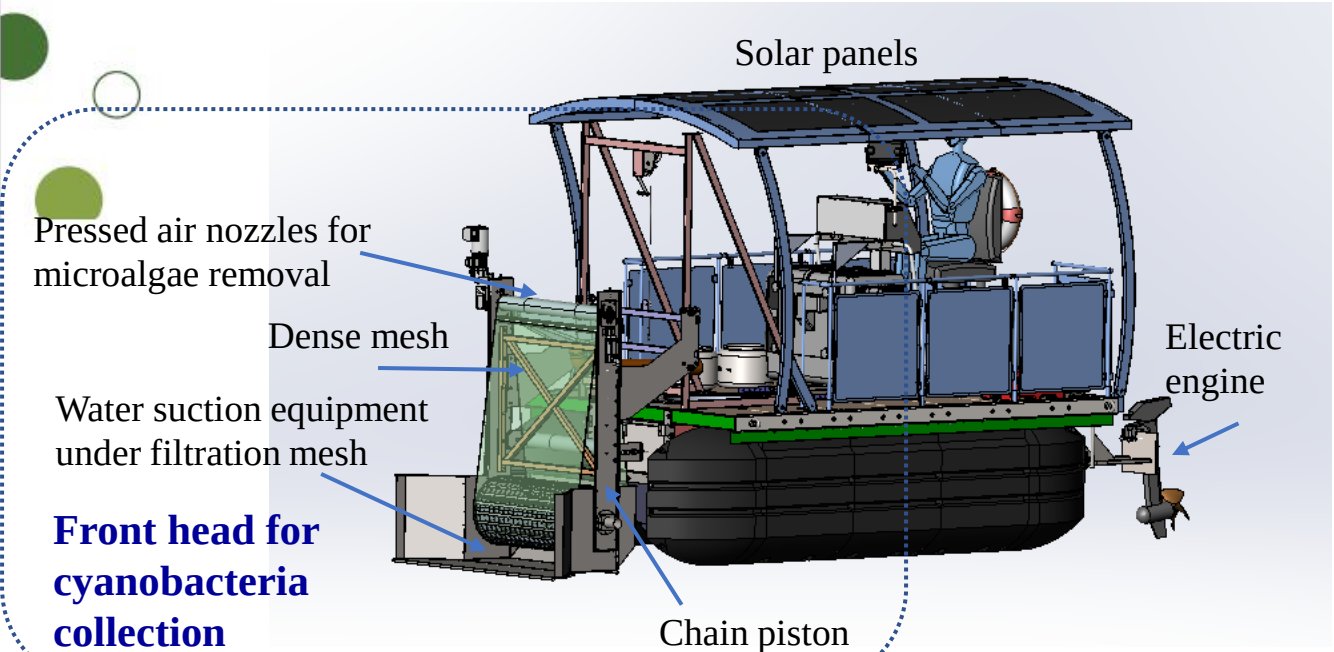
Nature Research Centre

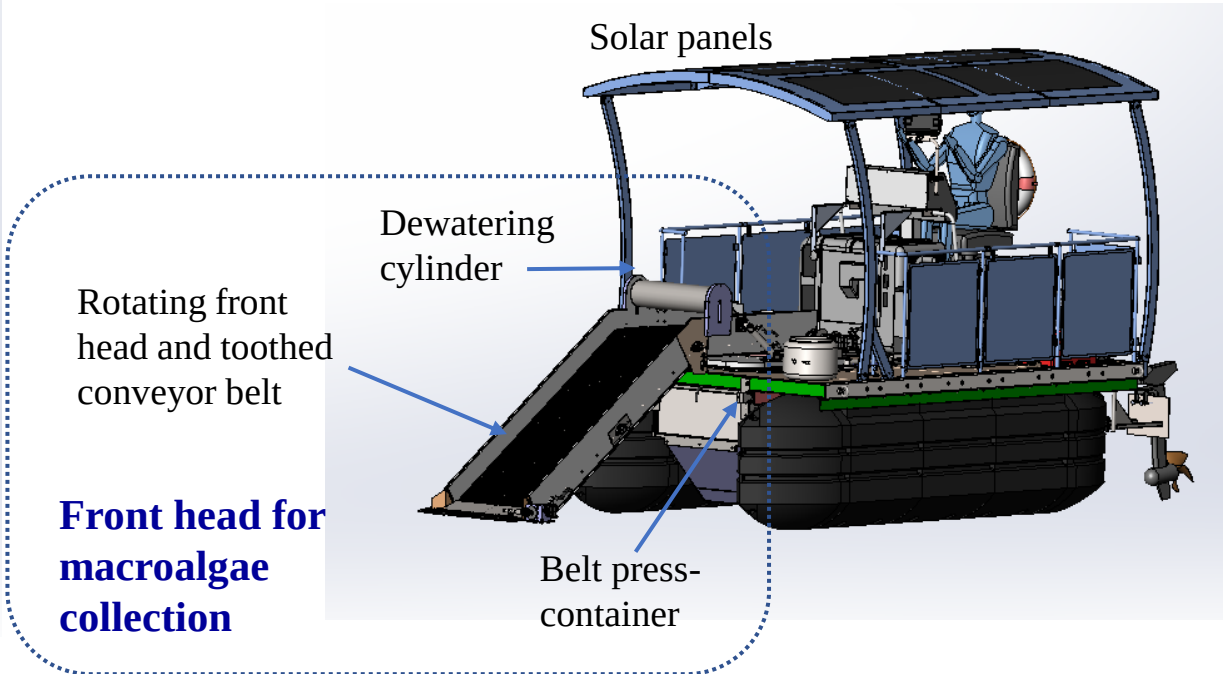
in cooperation with external experts R. Skorupskas, A. Gedvilas

Baltic Environment

AS-S prototype-harvester







Baltic Environment

AS-S prototype-harvester – cyanobacteria harvesting

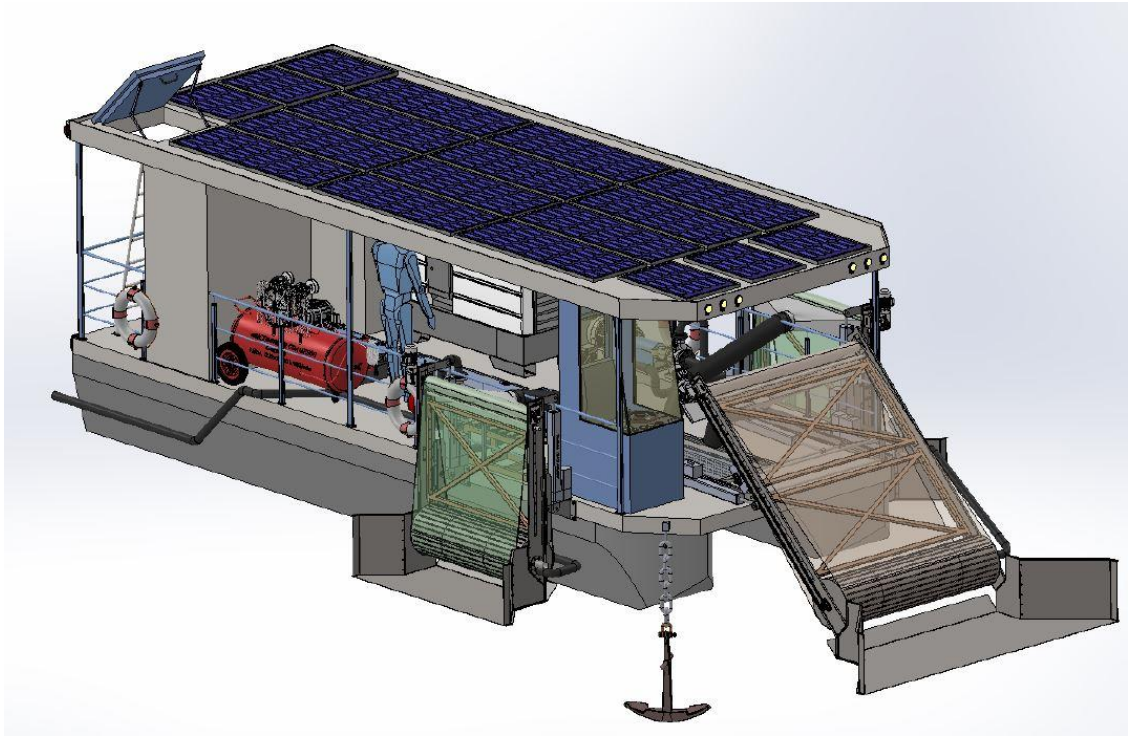
Cladophora packed in a roll

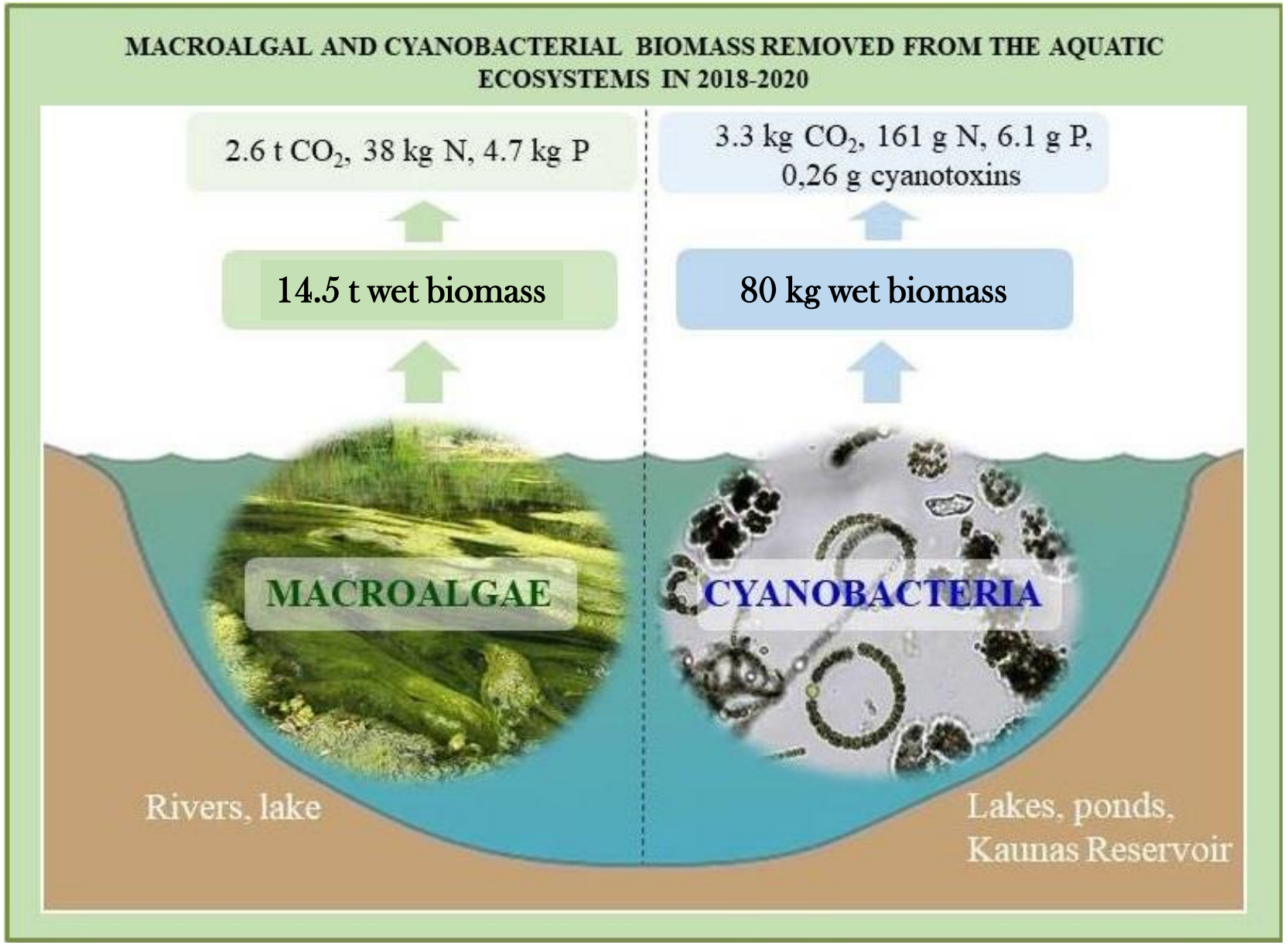
Baltic Environment

AS-L prototype-harvester

– cyanobacteria harvesting in large aquatic eqosystems

Technical information	Value
Platform length	8500 mm
Platform width	3440 mm
Height with pontoons	3250 mm
Pontoons height	1050 mm
Maximum draft	50 cm
Weight	3500 kg
Carrying capacity	3000 kg
Pontoons type	M+
Platform adapted to which category waves and wind strength	C-D[1]
Platform type	Trimaran
Number of pontoons	3





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Macroalgal biomass

BIOGAS

FERTILISERS

LOW VALUE BIOPRODUCTS

Cyanobacteria biomass

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PHYCOCIANIN

HIGH VALUE BIOPRODUCTS

Baltic Environment

Biogas production from macroalgal biomass combined with cattle manure

3 m^3 biogas reactor

Biogass reactor

Macroalgal biomass shredded and mixed with cattle manure →

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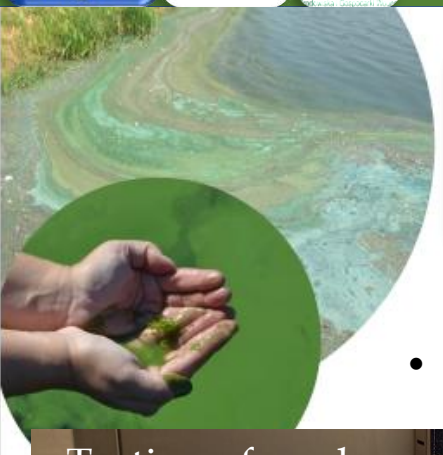
MACROALGAL BIOMASS TESTING AS FERTILIZER

Testing in laboratory and greenhouse

Testing in experimental fields

Testing in agricultural fields



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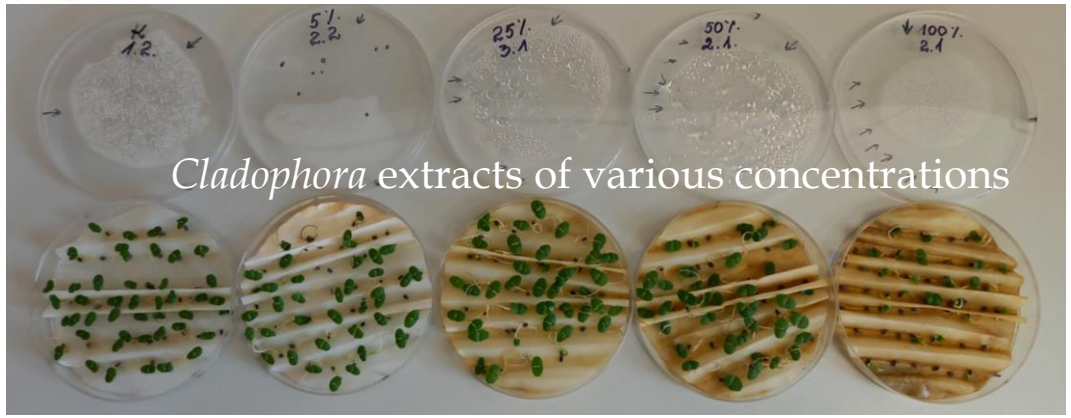
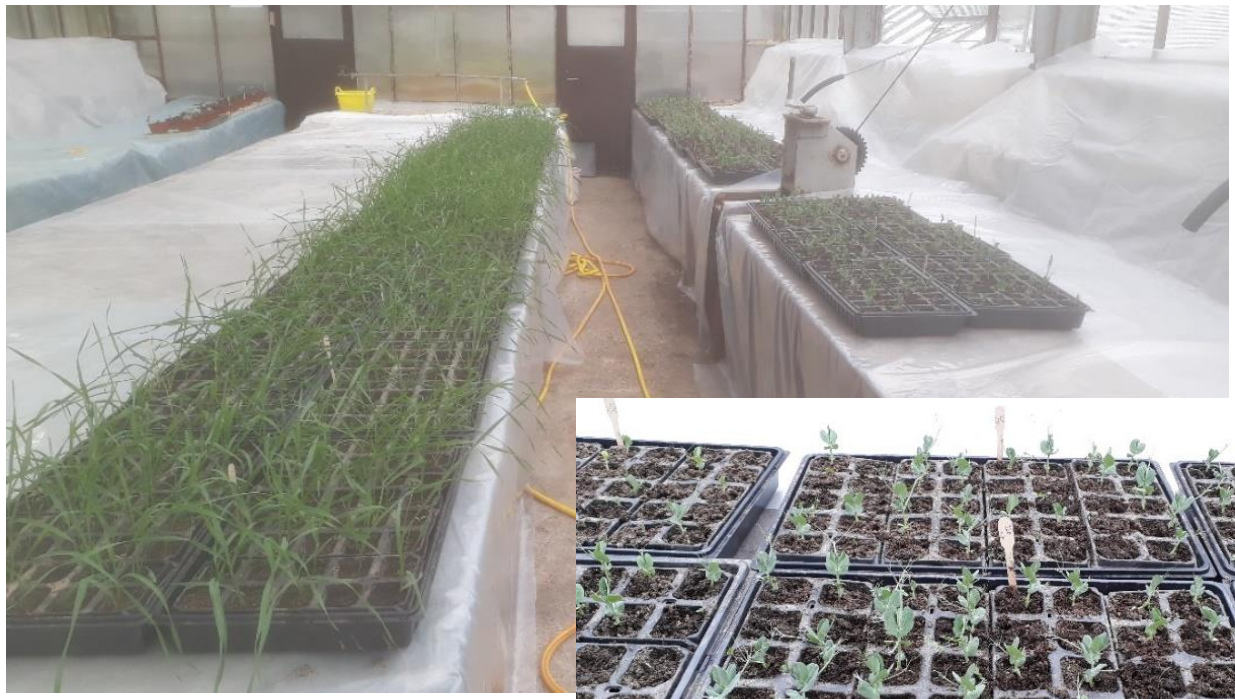
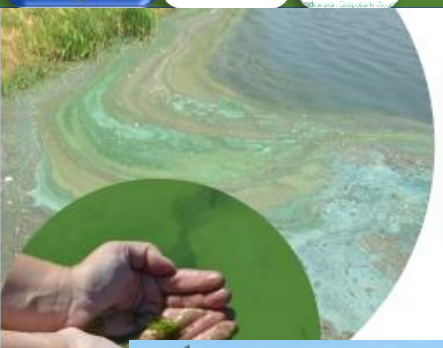
- Testing of seed germination



LAB SCALE: testing of seed germination

- Biomass of macroalgae for testing was prepared in 4 different ways
- Wheat and peas seed germination





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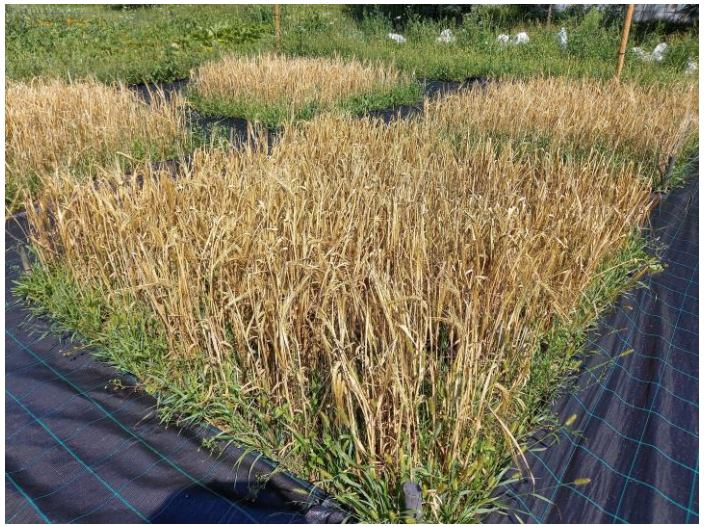
Experimental fields: Testing macroalgal biomass as slow-release organic fertilizers for barley

Testing in 4 m^2 experimental fields

- Two sets of testing fields
- Three sampling periods
- Growth and yield
- Soil quality



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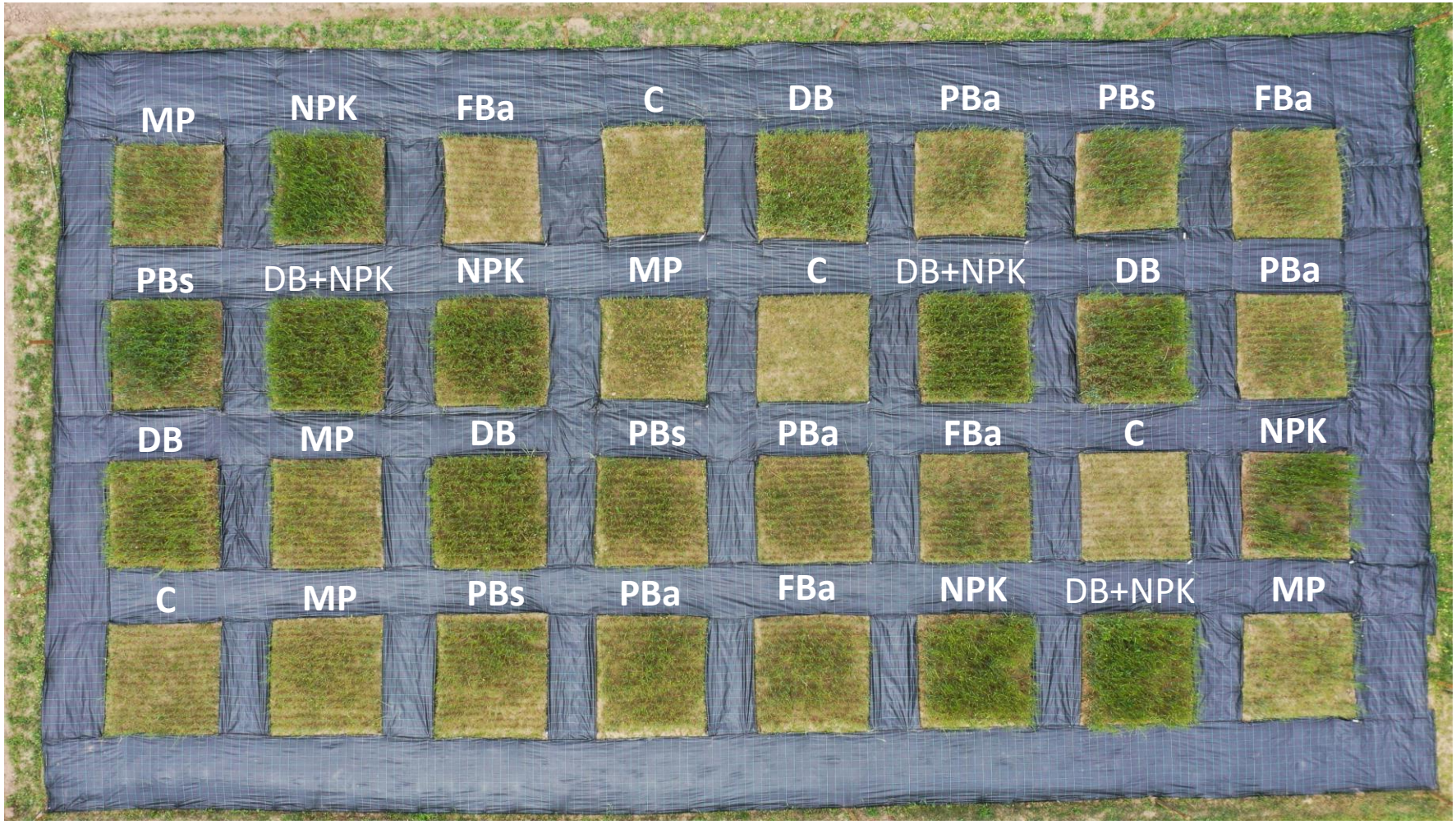
Experimental fields: Testing macroalgal biomass as slow-release organic fertilizers for barley

Image of experimental 4 m² field from drone

C – control
NPK – chemical fertilisers
DB – dried biomass (spring)
PBa – decomposed biomass (autumn)
PBs – decomposed biomass (spring)
FBa – fresh biomass (autumn)
MP – manure pellets
DB+NPK – dried biomass + chemical ferilisers



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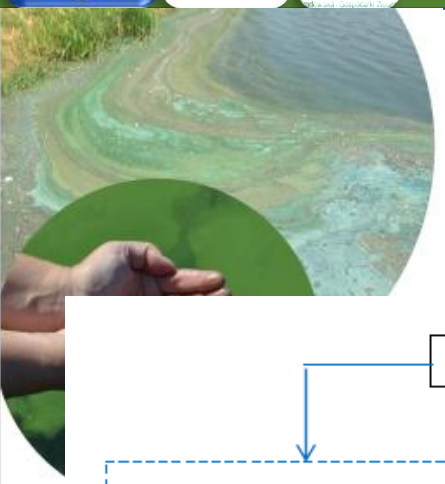
Experimental fields: Testing macroalgal biomass as slow-release organic fertilizers for corn and barley

Testing in 0,25 m^2 experimental fields

in 2021

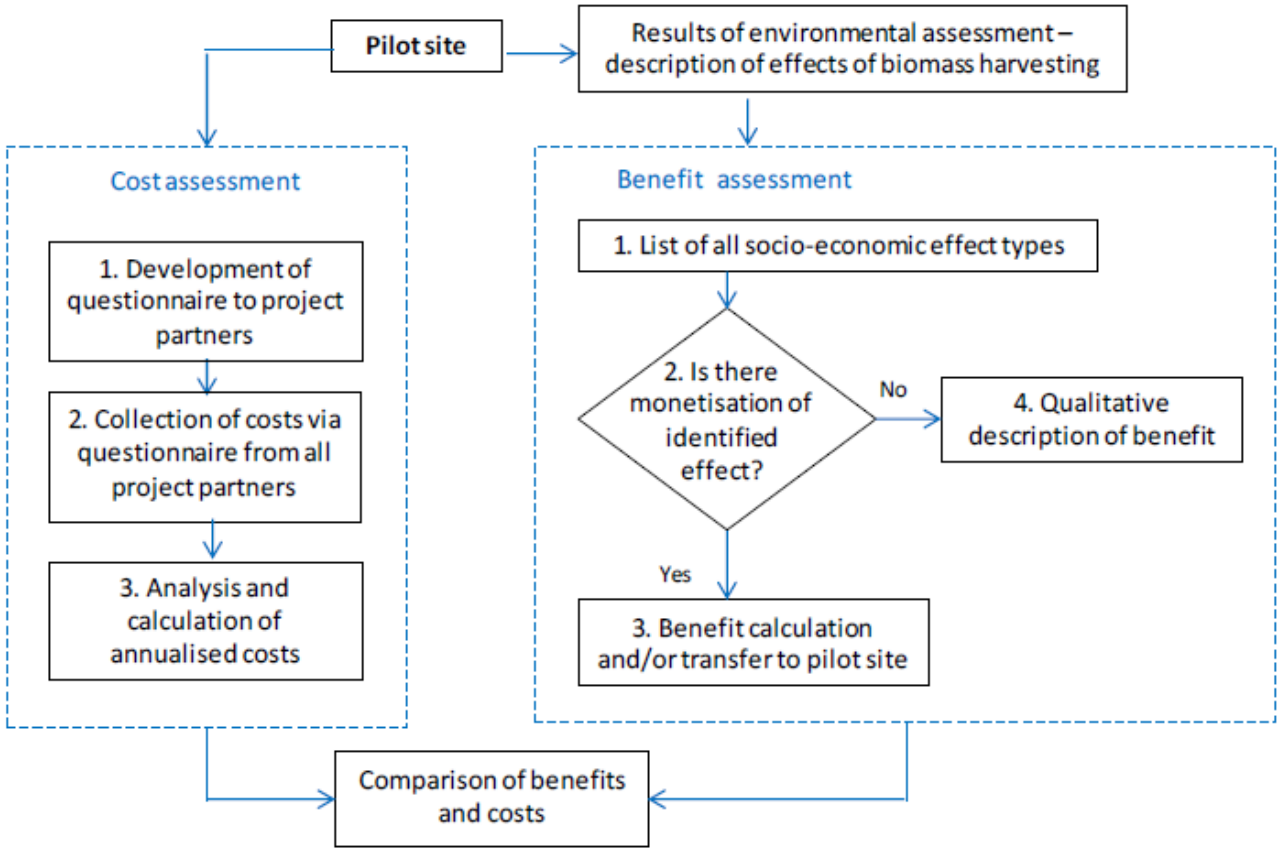
Tested variants

1. Control
2. Dried algal biomass
3. Fresh algal biomass
4. Algal biomass – chemical fertilisers
5. Algal biomass + *Trichoderma*
6. Composted algal biomass
7. Decomposed algal biomass



Spila

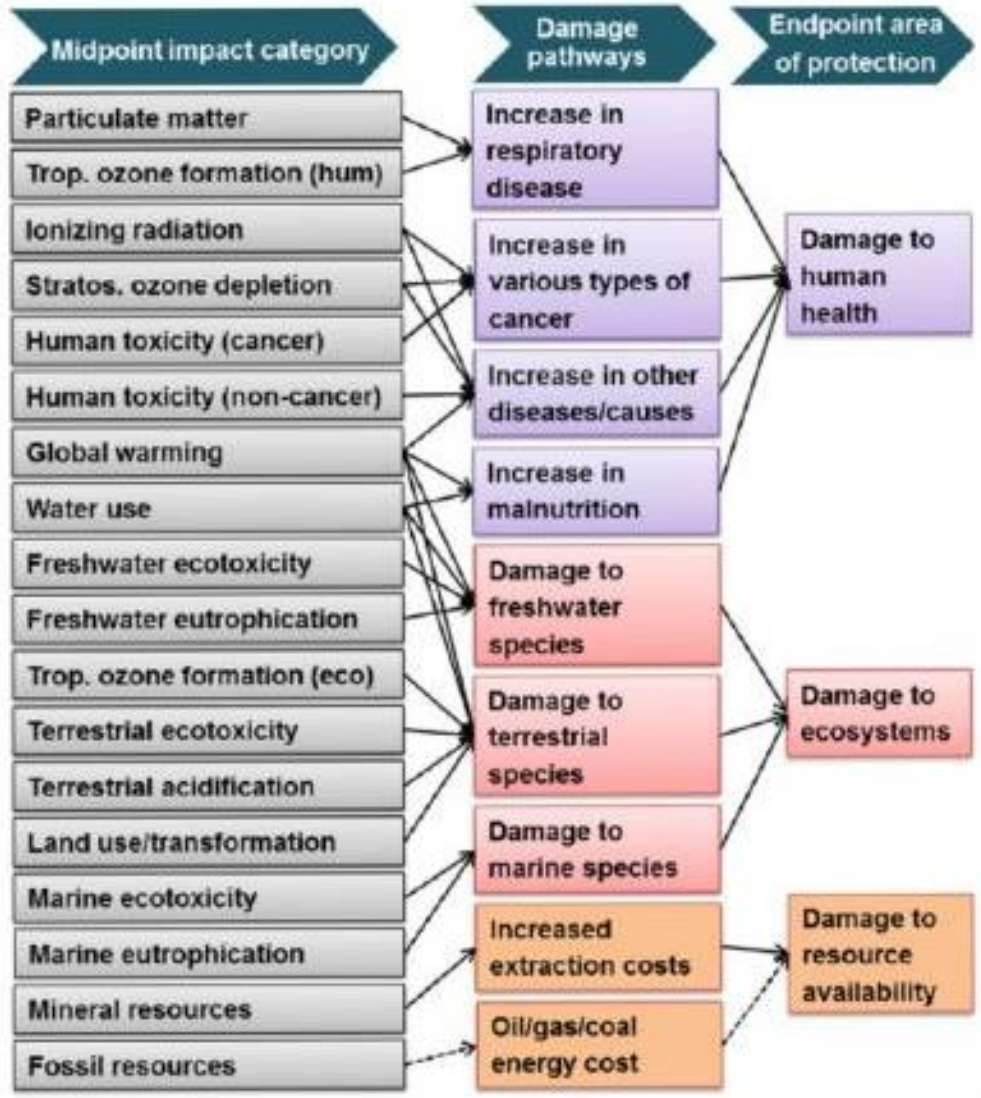
Socio-Economic Impact Assessment



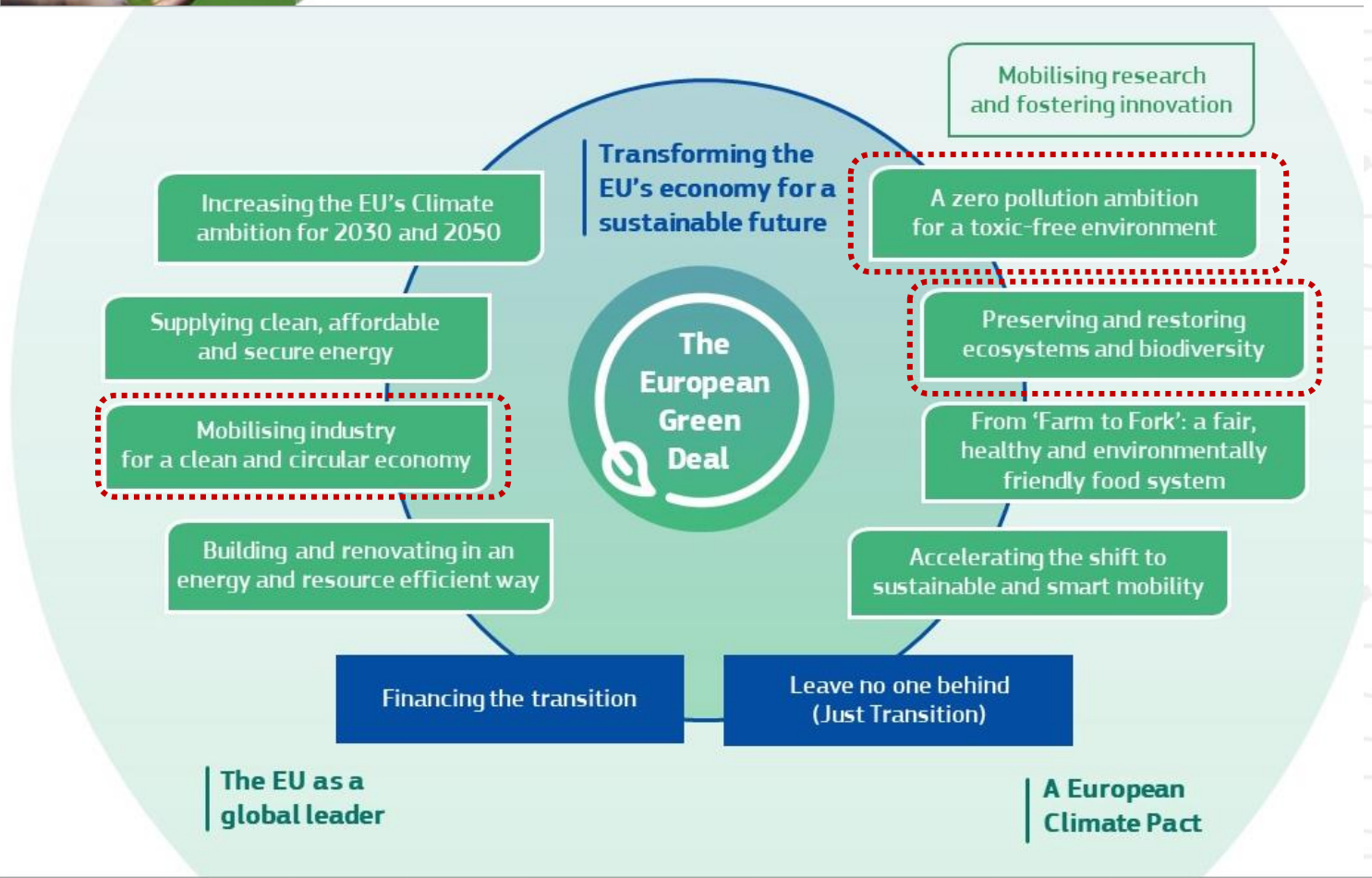
Logical scheme of the socio-economic impact assessment of the biomass harvesting

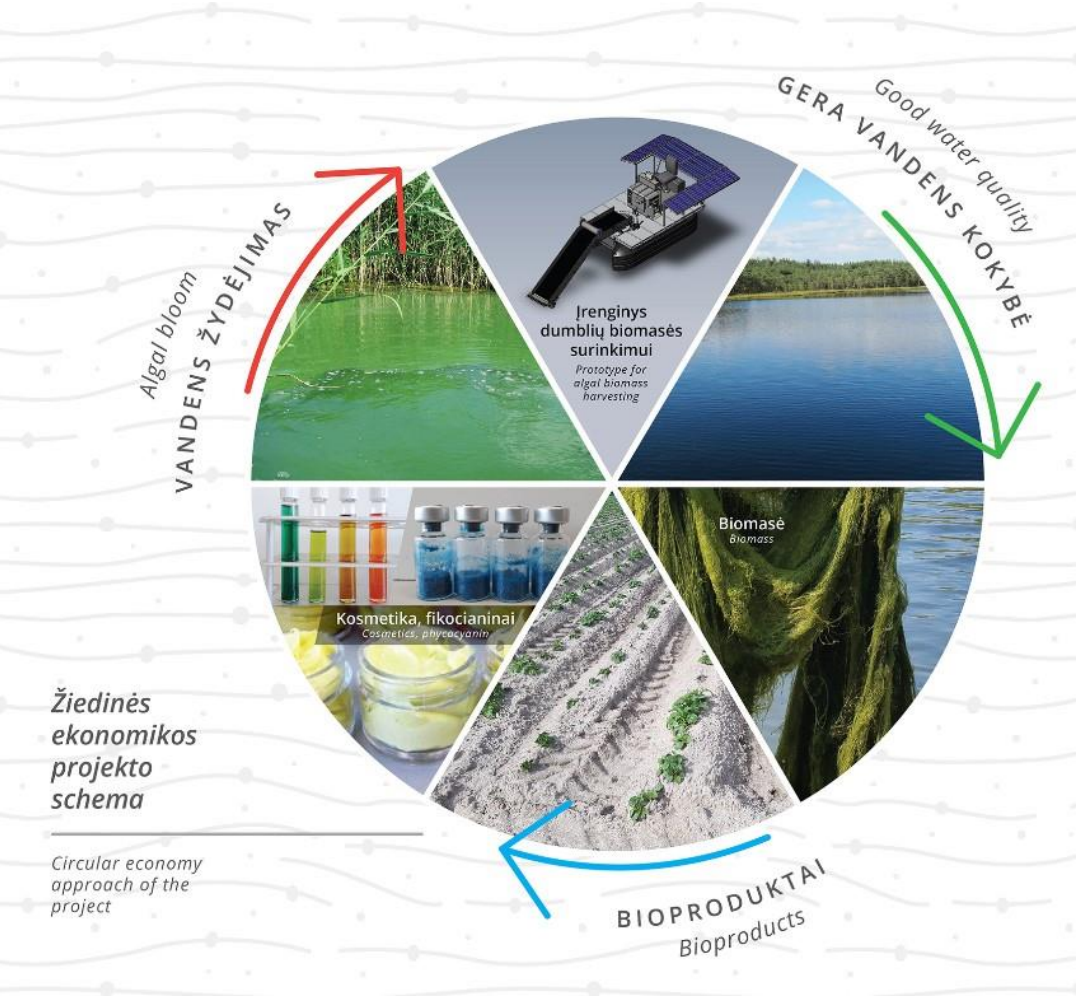
Life Cycle Impact Assessment

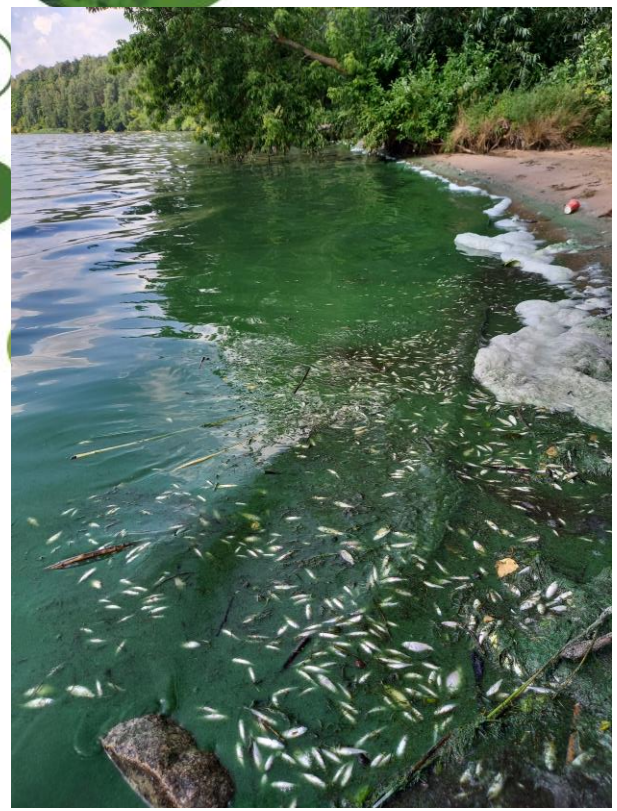
The impact categories that covers ReCiPe2016 methodology



The project seeks to promote best practices in ecological service and the circular economics approach by implementing innovative complex system







Thank you very much for the atention

Kaunas Reservoir, August 12, 2021