



LIFE17 ENV/LT/000407



Algae  
Service  
for  
Life

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After-Life Plan

# “After-LIFE” Plan 2023-2028

## PROJECT AND BENEFICIARIES’ DATA

<b>TITLE:</b>	Algae – economy based ecological service of aquatic ecosystems/ Glony – gospodarka ekologiczna
<b>ACRONYM:</b>	AlgaeService for LIFE
<b>DURATION:</b>	01/08/2018 – 30/11/2023
<b>LOCATION:</b>	Lithuania & Poland
<b>BUDGET:</b>	3 674 830 Eur
<b>EU FINANCIAL CONTRIBUTION REQUESTED:</b>	2 193 710 Eur
<b>CO-FINANCED BY:</b>	935 760 Eur
<b>PROJECT PARTNERS:</b>	413 587 Eur
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<b>WEBSITE:</b>	<a href="https://algaeservice.gamtostyrimai.lt">https://algaeservice.gamtostyrimai.lt</a>
<b>COORDINATING BENEFICIARY:</b> <b>ASSOCIATED BENEFICIARIES:</b>	Nature Research Centre A. Mickiewicz University (Poznan, Poland) Baltic Environment (Vilnius, Lithuania) Institute of Nature Conservation of Polish Academy of Sciences (Krakow, Poland) Nature Heritage Fund (Vilnius, Lithuania) SPILA (Vilnius, Lithuania)
<b>CO-FINANCED BY:</b>	Ministry of Environment of the Republic of Lithuania National Fund for Environmental Protection and Water Management (Poland)

# PROJECT OVERVIEW

## INTRODUCTION

The five-year project "AlgaeService for LIFE" is part of the LIFE Environment sub-program (priority area "Environment and Resource Efficiency") and aims to promote best practices in the field of eco-services and circular economy through the implementation of an innovative complex system. The project was implemented by six partners from Lithuania and Poland: three scientific research institutes, two companies and one non-governmental organization.

The purpose of the After-LIFE plan is to utilize the progress, know-how and technologies developed during project implementation. The After-LIFE plan discloses how the project partners will continue some of project activities, outlines the framework and schedule for implementation activities, and the funding source. The plan also lists how the project results will be disseminated after the project ends.

## PROJECT SCOPE AND OBJECTIVES

The project promotes an ecosystem-based approach to control harmful blooms and reduce nutrient loading to the Baltic Sea from river basins.

### Objectives

- To demonstrate integrated, efficient management of nutrients and algal blooms by harvesting macroalgal mats and cyanobacteria scums in a various types of waterbodies
- To test and demonstrate the redesigning of harvested biomass into potentially low- and high-value products for sustainable management and recycling of environmental resources
- To raise awareness of environmental, water quality, and health risks.

New solutions have been developed to support effective implementation of European Union policy set in The European Green Deal. The testing of harvested algal biomass for the production of environmentally friendly bioproducts promotes the transition to a green circular economy.

# RESULTS ACHIEVED



## Management of water quality

- Two floating prototypes (AS-S, AS-L) and a nearshore biomass prototype-collector (AS-LAND) were produced for harvesting macroalgae and cyanobacteria agglomerations in small and large aquatic ecosystems.
- In total, more than 95 t of macroalgae and 13 t of cyanobacteria biomass were collected per project. Together with the biomass, 34.1 kg of phosphorus, 362.2 kg of nitrogen, 20.5 t of CO<sub>2</sub>, and 0.37 kg of cyanotoxins were removed from aquatic ecosystems.
- The methodology to assess *Cladophora* macroalgae and cyanobacteria agglomerations in inland aquatic ecosystems by remote sensing was prepared and validated. Analysis of UAV images of 140 km of waterways revealed that macroalgae can cover more than 270 ha of area with a calculated total amount over 10776 tonnes. However, the amount of biomass depends on precipitation, temperature, and varies from 40 to 904 t/km at different river sections.
- Analysis of UAV images covering 1 km<sup>2</sup> of Kaunas Reservoir revealed a total amount of over 33 000 tonnes of accumulated cyanobacteria biomass in the littoral zone of the water body. Over 98% of cyanobacteria biomass was accumulated in the dispersed distribution areas, which covered 0.724 km<sup>2</sup>. Nevertheless, the concentrated cyanobacteria accumulations comprised less area (0.286 km<sup>2</sup>), the total amount of harvestable biomass comprised 578 tons with the density varying from 20 to 28 kg/m<sup>2</sup>.
- Created an interactive map to record and monitor water blooms with the help of the public.



## Bioproducts from algal biomass

- A total of 832 m<sup>3</sup> of biogas (4925 kWh of energy) was produced by using 35.6 tons of macroalgae and 9 tons of cyanobacteria as wet biomass. The methane concentration reached 65–75% and a yield of 0.58–0.80 m<sup>3</sup>/d/m<sup>3</sup> of substrate. The installed photobiofilter for biogas upgrading led to an increase in methane concentration by 5–8% and a reduction of CO<sub>2</sub> by 8–15% and H<sub>2</sub>S by 12–40%.
- *Cladophora* biomass applied to the soil has the same fertilizing effect on plant productivity as conventional organic fertilizer. Of the macronutrients, an average of 3.0±1.0% nitrogen, 0.3±0.1 % phosphorus, 4.8±1.9% potassium and 54.4±15.5% organic matter was determined in the macroalgae biomass, and the heavy metal concentrations were far below the safe limits for the use of biomass in agriculture. The amount of mobile phosphorus in the soil increased by an average of 10–50, and potassium by as much as 20–60 mg/kg of soil.
- Testing differently processed macroalgal biomass at different scales applied as fertilizer on infertile soils increased the yield of cereals and storage crops by 47–104%. The grain yield of oats (up to 20%) and barley (up to 60%) increased, the green mass of the corn was up to 31% higher when macroalgal biomass was added. The yield of potatoes increased up to 83% and their starch content increased up to 21% when they were grown in algae-enriched soil.
- The method for extracting and purification of phycocyanin from the biomass of wild cyanobacteria was optimized. Pigment quality from food to analytical grade was obtained from non-toxic wild cyanobacteria biomass and tested as a component of feed additives during the EUREKA „Eco-Aqua-Recycle” project.
- The preparation of macroalgae extracts for cosmetics requires species verification, careful separation and cleaning within 4 hours of collection, and selection of a suitable extraction method. Formulations of three products (cream, peeling butter and shampoo) were prepared. The positive effect of the extract on skin elasticity and on the stability of the cosmetic emulsion was confirmed.
- The results of the willingness to pay for the improvement of water quality in Kaunas Reservoir showed that citizens are willing to pay on average between 7.59 and 9.16 euros/person/year and that aggregated benefits of improving water quality is between 18.5 and 22.3 million euros/year in Lithuania.
- Awareness of environmental, water quality and health risks was raised among national governments, local authorities, businesses and society through the following communication channels: i) scientific conferences, networking events and workshops; ii) digital materials such as website, videos, social networks; and iii) media outreach (newspapers, TV, radio). In addition to the technical reports, flyer, brochure, roll-up and Layman report were published as dissemination material.

# LESSONS LEARNED FROM THE PROJECT



- The differences between water bodies, algal biomass and its concentration in the water require more time for *on-site* testing to adapt specific technologies for harvesting algal biomass under different environmental conditions and to increase harvesting efficiency.
- The combination of satellite and UAV imagery offers an advantage in the selection of water bodies, determination of periods with the highest biomass and the location of hot spots for the efficient harvesting of algal biomass.
- The amount of excess biomass suitable for harvesting in aquatic ecosystems can reach up to ten thousand tonnes of macroalgae and cyanobacteria. The amount of biomass is probably sufficient to produce high-value products, but data needs to be evaluated over a longer period of time to determine whether the biomass is a sufficient resource for the bioproducts.
- Environmental factors have a major impact on the amount of biomass of *Cladophora* macroalgae and scum-forming cyanobacteria in inland aquatic ecosystems in different years, resulting in instability of the resource for up-scaling the harvesting and processing the biomass into valuable products.
- The changes in the catchment may result in the predominant cyanobacteria species changing from scum formers to species distributed in the water column, limiting their harvesting by the technologies developed in current project.
- Fast and easy uptake of macronutrients, high nutrient concentration in biomass, high performance and biodegradability, excellent solubility and miscibility with agrochemicals are the main advantages of macroalgae as biofertilizers.
- Currently, the potential applications for toxic cyanobacteria biomass are very limited and further efforts need to be made to recycle it into valuable metabolites or low-value products.
- Due to the COVID-19 pandemic situation organization of training and demonstration seminars was much more difficult: i) live seminars were banned or restricted thus these had to be organized in mixed (live/online) way; ii) preparation for management of the technical part of the seminars. These challenges helped to improve skills in organizing of the project events.

# AFTER-LIFE IMPLEMENTATION PLAN



Some implementation activities extend beyond the duration of the AlgaeService for LIFE project.

- As an After-LIFE activity, a six-year collaborative trial was initiated with poplar plantings using macroalgae, cyanobacteria biomass and sewage sludge as fertiliser through networking with "NutriBiomass 4LIFE". In addition, the NRC started willow fertilising with algal biomass tests in the experimental field station. These two experiments will contribute to knowledge about the potential of using toxic cyanobacteria biomass as a growth promoter for growing plant biomass for biofuels. The results will serve as a background for a discussion on a possible exemption from the current EU regulations, which currently do not allow the use of cyanobacteria as fertilisers.
- An agreement on the control cyanobacteria blooms in the fish ponds of the Simnas experimental fish farm using the AS-LAND prototype was signed with the Fisheries Service under the Ministry of Agriculture of the Republic of Lithuania. The necessary modifications to the AS-LAND prototype have been made and the tests will be carried out in the summer of 2024.
- Remote sensing methods provided promising results during the implementation of the current project, so networking with the Łukasiewicz– Institute of Aviation (Poland) will continue in order to develop indicators for monitoring cyanobacterial blooms in small water bodies using UAVs or SENTINEL images.
- The findings and results of the WTP ("Willingness to Pay") study of the current project will be basis for other two WTP studies as part of the LIFE SIP "Vanduo" (starts in 2024), which will focus on fresh and marine waters.
- Two proposals were submitted for the transfer of project results for the development of high-value products from harvested algal biomass: i) „CYANOMETICS", HORIZON-MSCA-2023-PF-01: MSCA Postdoctoral Fellowship 2023, submitted on 09/2023, coordinator University of Aveiro (Portugal), NRC serves as the internship organisation; ii) Pre-proposal „CYANOGUARD" for the Biodiversa+ submitted on 11/2023, coordinator Lucerne University of Applied Sciences and Arts (Switzerland), partners NRC and INC. The projects will start in 2025 if the proposals will be funded.
- The interactive map "Mark the blooming water body" created as part of the project will continue to be available to the public and experts. The supplemented questionnaire in English and German will open up the possibility of using the tool in other European countries.

# AFTER-LIFE COMMUNICATION PLAN



- **Dissemination of project results**

The website <https://algaeservice.gamtostyrimai.lt/> will continue to serve as the main hub for the dissemination of important project information and results. NHF has managed the website during the project and will be responsible for maintaining and updating it until December 2028. The following information will be maintained, updated and shared on project website: i) the interactive map and ArcGIS application; ii) the brochure and Layman's report; iii) the questionnaires; iv) the presentations of the project workshops and training seminars; iv) videos and recordings on YouTube; v) social networks.

All materials will be maintained and disseminated by the project partners. The associated beneficiaries will link information about the "AlgaeService for LIFE" project to their institutional websites.

- **Publication of the project results**

Project reports with sensitive content are currently not available on the project website. The results will be published in scientific journals or patented and the data will be made available to interested parties.

- **Continuous exchange of know-how and results at conferences and workshops** to present results and expand collaborations for the transfer of project ideas on a broader scale. Beneficiaries will also use the dissemination materials printed during the project.

- **Maintain the acquired patents are planned for at least five-year period**

Maintenance of the patents acquired as part of the project:

- The State Patent Bureau of Republic Lithuania: Patent No. 6681 „Dumblių surinkimo kombainas“ (AS-S prototype), date of patent issuance, 11/2019;
- The State Patent Bureau of Republic Lithuania: Patent No. 6844 „Mikrodumblių surinkimo kombainas“ (AS-L prototype), date of patent issuance, 05/2021
- The Patent Office in Poland: patent No P.438915 “Bio-fertilizer for increasing the starch content in potato tubers” [„Bionawóz do zwiększania zawartości skrobi w bulwach ziemniaków”], date of patent issuance 09/2021.
- State Patent Office of the Republic of Lithuania: "System and method for the collection and concentration of cyanobacterial surface scum formed near the banks of water bodies", application No. LT2023 545, submission date 11/29/2023.

- **Share the information on the events with bachelor, master, PhD students and general society.**

Among the partners there are lecturers from Vilnius University, Vilnius Tech University, A. Mickiewicz University in Poznan, thus the information about project ideas and results can be discussed with the young generation. In addition, the partners intend to give lectures and organise workshops in order to promote bioproducts from algae and raise awareness of society about water quality in inland aquatic ecosystems.

- **Maintenance and expansion of the cooperation networks established with stakeholders.**



# AFTER-LIFE TARGET AUDIENCE



During the implementation of the project, the beneficiaries cooperated with a large number of different people and institutions. The stakeholders and organisations were invited to the project events.

The target groups of the After-LIFE plan are the same as the target groups of the project: officials in local communities, authorities of protected areas, researchers, general public, etc.

The After-LIFE communication activity will address three target groups:

- **Representatives of policy makers and governmental institutions**

The continued success of the follow-up of the results of “AlgaeService for LIFE” and the adoption of the project’s tools, techniques and approaches will depend on communication with representatives of environmental legislation and water quality regulators in Lithuania and Poland.

We will focus on representatives from:

- Ministry of Environment;
  - Environmental Protection Agency;
  - The Fisheries Service under the Ministry of Agriculture of the Republic of Lithuania;
  - Regional Municipalities.
- **Business companies**
    - Poznan Science and Technology Park (Poznan, PL)
    - Fishing production and processing company (MAJ, PL)
  - **Scientific community**
  - **Society**
    - In Poland: Primary School No. 1 named Karol Marcinkowski in Murowana Goślina, High Scholl in Zbąszyń, High School in Wągrowiec, University of the Third Age in Grodzisk Wielkopolski
    - In Lithuania: Gymnasiums and primary schools, Third Age University, society.

# Timeline of the After-LIFE plan, responsible partner and funding

In general, the activities of this plan will be divided according to the specific competences and responsibilities of the partners and are specified in the table below. All partners will continue to collaborate in development and testing their products, publication of the results, preparing projects, etc.

After-LIFE Action	Responsible partner	Time table	Budget	Source of finance
<b>IMPLEMENTATION ACTIONS</b>				
Networking with „NutriBiomass 4LIFE” Six-year experiment with poplar plantation using algal biomass and sewage sludge as fertilisers.	NRC	2023-2029	€	NRC AMEL resources
Three-year experiment with willow fertilisation using algal biomass.	NRC	2023-2026	€	NRC AMEL resources
Testing algal and cyanobacterial biomass for high-value products (if applications get success).	NRC, INC PAS	2025-2028	€€€	HORIZON-MSCA-2023-PF-01; BIODIVERSA+
AS-LAND Lithuanian patent annual fee and submission of the European patent.	NRC	2023-2028	€€	From AS-LAND service resources
Visit to Department of Marine Biotechnology & Resources (National Sun Yat-sen University) for knowledge exchange and collaboration development.	NRC	2023	€	National Sun Yat-sen University & NRC resources
Agreement with Simnas Experimental Fish Farm for mitigation cyanobacteria blooms in fish ponds using AS-LAND prototype.	NRC	2024-2024	€	Simnas Experimental Fish Farm resources
Cooperation with Wągrowiec Commune Office for mitigation <i>Planktothrix</i> blooms in Lake Łekneńskie.	AMU	2024-2024	€	AMU resources
Follow-up collection of macroalgae biomass from Lake Oporzyńskie and the Nielba River and assessment of changes in water quality after algae collection.	AMU	2024-2026	€	AMU resources
Repetition of the field experiment with winter barley cultivation using macroalgae biomass	AMU	2023-2024	€	AMU financial resources
Algae collection in Dane river in Klaipeda for further demonstrative activities.	BE	2024-2026	€€	BE and Klaipeda municipality resources
AS-S and AS-L patent fee.	BE	2023-2028	€	BE resources
Cooperation with Vilnius Tech University for assessment of biogas and other algae products.	BE	2023-2028	€€	BE resources
Further technological development of prototypes for cyanobacteria and Lemna collection.	BE	2023-2028	€€	BE resources
Rent of biogas bioreactor for biomass testing and utilization.	BE	2024-2026	€	BE resources
Networking with Łukasiewicz–Institute of Aviation to develop indicators for monitoring cyanoblooms in small water bodies using UAVs or Sentinel.	INC PAS	2024-2024	nr	INC PAS, statutory funds

DISSEMINATION AND COMUNICATION ACTIONS				
Project results presentation at national or international conferences (2-3 events/per partner).	AMU, NRC, BE, INC PAS	2023-2027	€	Resources of AMU, NRC, BE, INC PAS or Research Council of Lithuania, Scientific agencies
Seven scientific papers published.	NRC, AMU, BE, INC PAS	2023-2028	nr	
Maintenance and updating of the project website and Facebook page, Facebook profile, ArcGIS application and Interactive map.	NHF	2023-2026	nr	
Presentation of the results at public events "European Research Night" and "Biologists' Night", "Researchers' Night", etc.	AMU, NRC	2024- 2026	nr	
Continuation of survey research on public knowledge about cyanobacterial blooms (an average of 100 surveys per year)	AMU	2024-2027		AMU resources
The continuation of the information campaign about the project results – to increase the number of views on the YouTube website about the products created during the project.	AMU	2024-2027		AMU resources
Advertising project results during the lectures at Vilnius University, Vilnius Tech, A. Mickiewicz University (Poznan) and for patron schools.	NRC, BE, AMU	2024-2026	nr	
Popular articles in local newspapers.	BE	2024-2027	€	BE resources
Dissemination of the results on institutional Facebook.	INC PAS, NRC	2024-2028	nr	
Dissemination of the results to Polish and Lithuanian Phycological Societies.	INC PAS, NRC	2024-2028	nr	
Promoting Algae service paid services and products coming out of it for new potential clients, client search.	SPILA	2023-2027	nr	

Abbreviations: AMU – A. Mickiewicz University; BE – JSC Baltic Environment; INC PAS - Institute of Nature Conservation of Polish Academy of Sciences NHF - Nature Heritage Fund; NRC - Nature Research Centre; SPILA - JSC SPILA;

**Key to Cost estimate symbols:** € = up to €5.000; €€ = between €5.000 - €10.000; €€€ = between €10.000 - €50.000; nr = no incremental costs envisaged