

# BRAINWAVES

Agri Prospecting  
Archwilio Amaethyddol  
Taiscéalaíocht Talmhaíochta



## Newsletter 1

May 2021

## Welcome to our first Newsletter!



We're delighted to welcome you to the first newsletter of the Brainwaves project. Here you'll find all the latest news and updates from the project activities. We'll keep you informed of our progress via newsletter twice a year.

**Read on for more!**

## Project Partners



**Funded by the European Regional Development Fund through the Ireland Wales Cooperation Programme**



# About the Project

Brainwaves is a 3.5-year, cross-border, circular economy research and development project, aimed at optimising agricultural waste management while also delivering economic benefits. It's all focused on one small but fast-growing plant – the common duckweed (*Lemna minor*), native to Ireland and Wales.

Our plant scientists are developing and optimising duckweed-based systems for the remediation of farm waste. As duckweed grows on waste streams, it uptakes (i.e. removes) nutrients such as nitrates and phosphates from the waste. This is game-changing for farmers trying to manage waste, and for policymakers aiming to achieve good ecological status of our rivers, lakes and coastal waters. What's more, the resulting duckweed biomass can make for a high-protein feedstuff and imported soy replacement – a win-win for our farmers.

Our goal, together with farmers, SMEs and other stakeholders, is to develop workable indoor and outdoor models and provide practical guidance for incorporating duckweed systems onto farms. Timely and topical, this research is a great example of a sustainable, closed loop approach to agriculture.

## Foreword by Prof. Marcel Jansen (PI)



### 'The Circular Economy and a Tale of Two Worlds'

*Image: Commercial duckweed farm in Co. Offaly, Ireland*

We live in a world where plant nutrients, such as nitrogen and phosphorus, are a waste product. Water treatment plants are built and operate to remove these chemical elements from sewage industrial wastewater, and other sources.

Ammonia-nitrogen is converted to nitrate-nitrogen through bacterial nitrification, and nitrate-nitrogen is converted to nitrogen gas.

Phosphate is removed by precipitation with calcium, aluminium or iron, resulting in the formation of non-soluble crystals.

Yet, despite treatment facilities, too many of these plant nutrients end up in the water column, leading to eutrophication, and the degradation of freshwater as well as marine environments.

At the same time, plant nutrients such as nitrogen and phosphorus are highly valued as fertilisers, enabling us to feed the world. Nitrogen-based fertilisers

are produced from nitrogen gas at the expense of considerable amounts of climate change-causing fossil fuel. Phosphorus-based fertilizers are produced from a dwindling stock of mined ores.

The world we live in is both a world of waste, and a world of increasingly scarce resources. The concept of the circular economy relates to an economy that is regenerative by design, i.e. new economic activities are decoupled from the exploitation of finite resources such as mined ores and fossil fuels. The Brainwaves project centres on the capturing of valuable plant nutrients in liquid waste (the new resource) and on recycling these nutrients back for plant growth, thus avoiding eutrophication problems, and saving finite resources. Brainwaves exploits the abilities of the duckweed *Lemna minor* to grow rapidly on a wide variety of waste streams, to take up nitrogen and phosphorus from the water, and to produce a protein-rich biomass that can be used as an animal feed or a nitrogen- and phosphorus-rich soil improver. Thus, Brainwaves is developing the use of liquid waste as a new resource for a green farming sector.

Interested in this exciting work? Please visit our [website](#), follow us on [Twitter](#), or contact Project Manager Anna Power at [anna.power@ucc.ie](mailto:anna.power@ucc.ie)

## Launch Activity



*"This is a great way to help the transition to a sustainable, circular economy. Through cross-border collaboration, Wales and Ireland are taking a novel, innovative approach to preserving resources, creating local jobs - and treating waste water as a resource and an opportunity to create something good" -Counsel General for Wales Jeremy Miles on Brainwaves*

Image: Welsh Government media service

February 2020 marked our official project launch announcement by the Welsh government. As part of the European Territorial Cooperation (ETC) programme to enhance cross-border innovation, Brainwaves was hailed for creating a "reduce, reuse, recycle, full-circle use of nutrients, by using natural plant

growth to create new nutrients to feed the agri-economy, and addressing pollution problems by minimising waste water.”

Full press release

## Indoor Systems



The start of our duckweed journey...

### Indoor Growth Systems

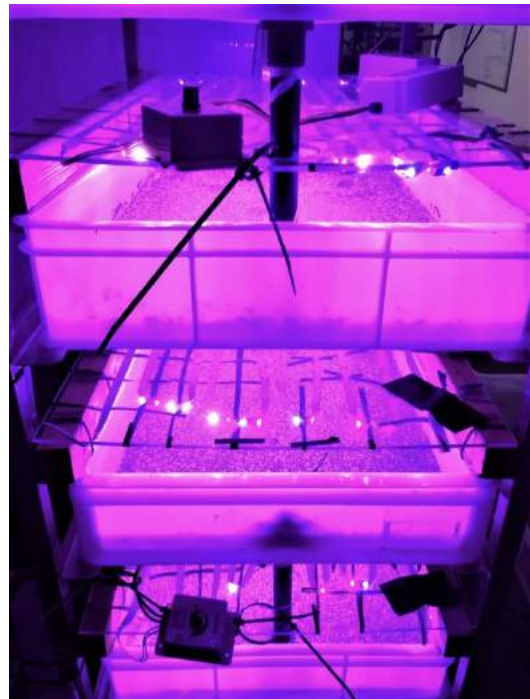
Left: A close-up of duckweed stock cultures at UCC's School of BEES

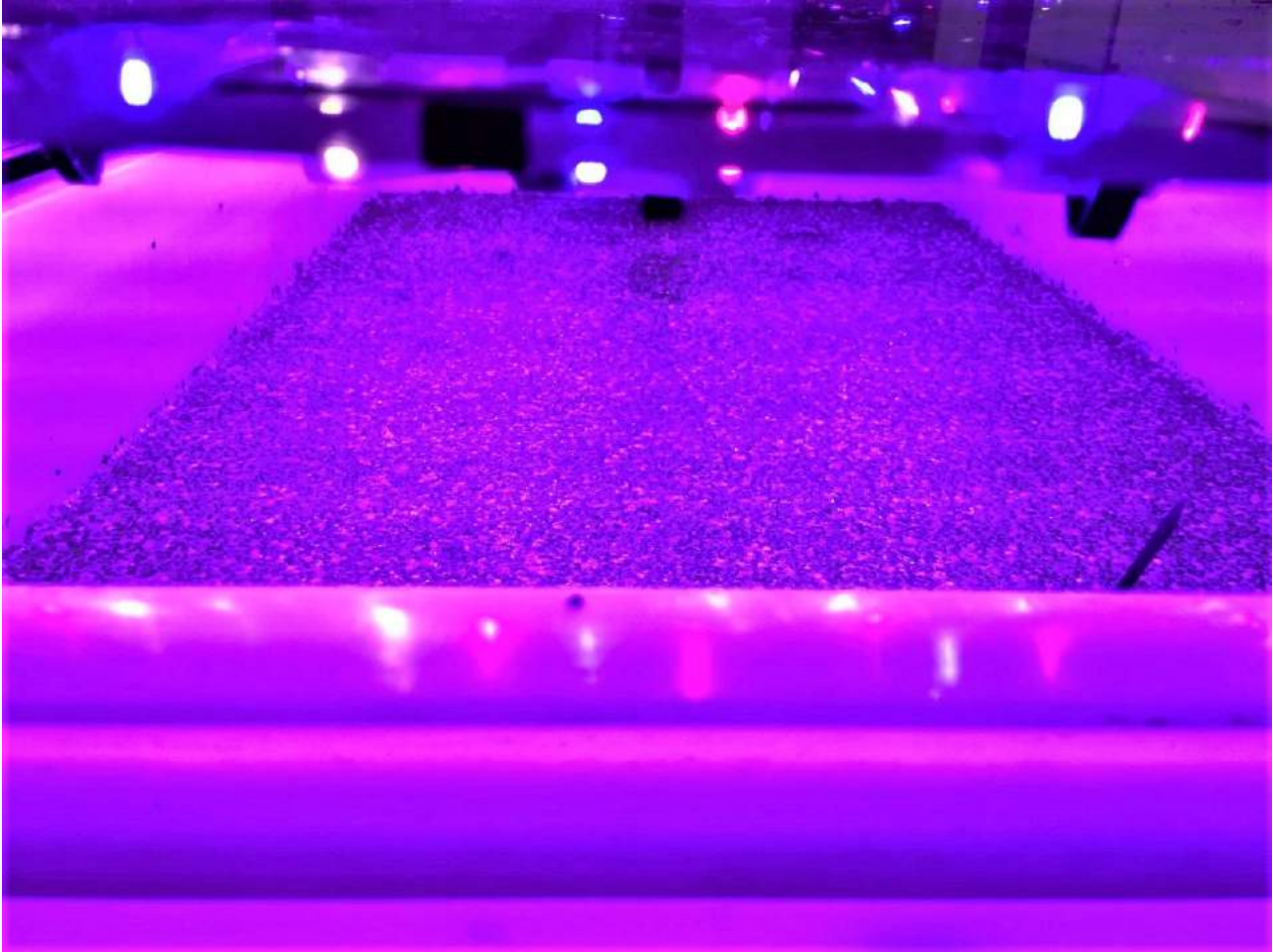
At UCC, Principal Investigator Prof. Marcel Jansen and Postdoctoral Researcher Dr. Neil Coughlan lead the indoor growth system components as part of Work Package 3. Work began on indoor cultivation systems in October 2020.

These systems will enable duckweed growth 24 hours a day, 7 days a week, for 12 months a year! This maximises plant biomass production and water remediation.

The basic design (right) is a stacked system with multiple 'duckweed shelves' placed on top of each other, with LED lighting in between. Water is pumped from a sump tank to the top shelf, and then gradually trickles down from shelf to the next until it reaches the sump tank. Initially, we focused on basic testing of various operational parameters (e.g. water depth and flow rate) within a 125-litre laboratory-scale system.

In essence, a series of scoping experiments are being used to facilitate our understanding of how various operational parameters effect duckweed growth and its ability to phytoremediate selected waste streams. This will inform our approach to operating larger systems.





A view of plants being tested for growth optimisation (including growth rate, nutrient uptake, water remediation and protein content) on standardised synthetic wastewater under lab conditions, as a first-step to help manage soiled water, such as yard-washings.



The construction of an intermediate system has already commenced (left, and below). This system allows us to test a suite of operational parameters at a scale more consistent with the needs of end-users. Over the next 6 months, we intend to operate this larger system at a capacity of up to 600 litres. At the same time, we'll carry out smaller scale experiments to determine the ability of duckweeds to survive on different farmyard and/or food processing waste streams. This will allow us to focus on the most interesting waste streams during later-stage assessments of the intermediate system.

Consideration will also be given to optimising LED light regimes and the testing of sensors to facilitate system automation in the future.

All these experiments are important parts of the testing process, and will help to ensure the delivery of the most optimised duckweed system possible, by the end of the Brainwaves project.



A view of the intermediate duckweed cultivation system at BEES, UCC. This system will allow us to better understand the challenges of up-scaling duckweed growth, and will be operated at a capacity of up to 600 litres.

## Outdoor Systems



### Outdoor growth systems

Left: Our Lemna growing in the wild - its original home

Co-PI Dr. Dylan Gwynn Jones and Postdoctoral Researcher Dr. Gruff Jones at Aberystwyth University are leading the development of outdoor growth systems as part of WP2. These interconnected pond systems are intended to be functional for the majority of the year.

In January 2021 we began work on the design of the outdoor system. A sunny windowsill in the laboratory was the first home for the Lemna samples gathered. (right)

A scoping study was carried out to identify and compare options for design. The findings of the scoping study allowed the AU team to agree on the direction for further inquiry in early February 2021.



Now, the duckweed is ready to grow!

Our aim is to grow the duckweed in an outdoor system developed to closely monitor all environmental factors. We'll then assess the duckweed growth performance under different growing conditions.

An outline outdoor system design is scheduled to be complete by early summer 2021. In the meantime, we continue to work on identifying key system design and monitoring requirements. We have identified suitable sources of Lemna and have collected specimens for cultivation. We have also been able to identify suitable outdoor locations available for hosting the system.

Moving full steam ahead, we plan to have the outdoor system installed by summer 2021, and hope to see on-site experiments commence by the late summer.



We are ready to grow! A view of duckweed samples at IBERS, Aberystwyth University.

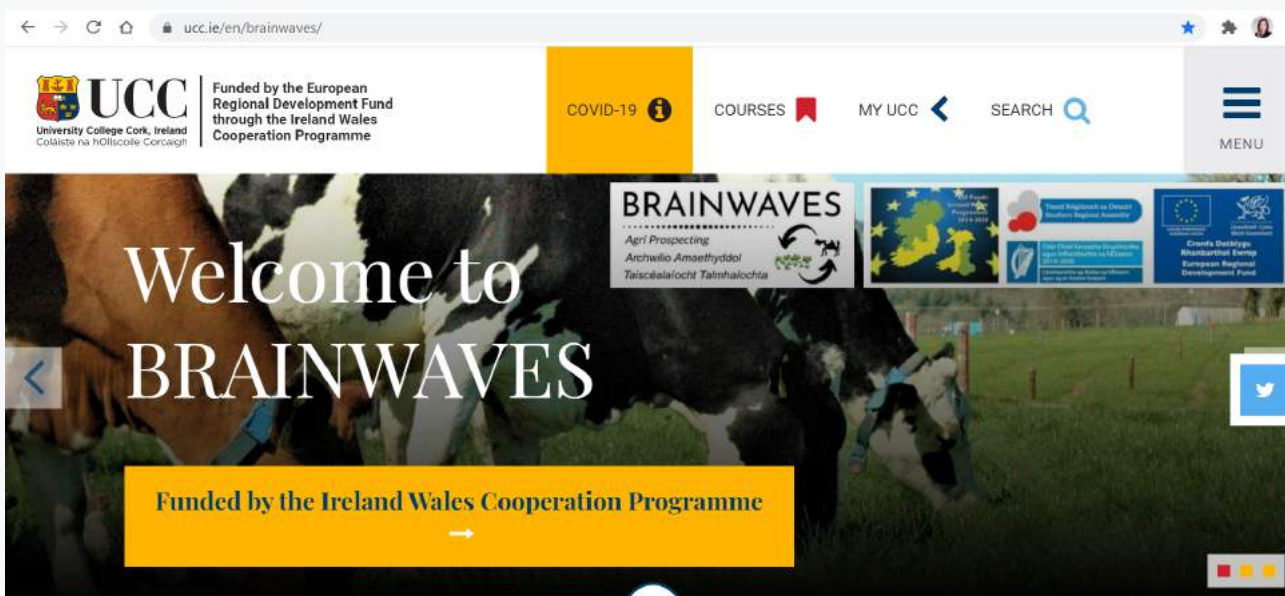
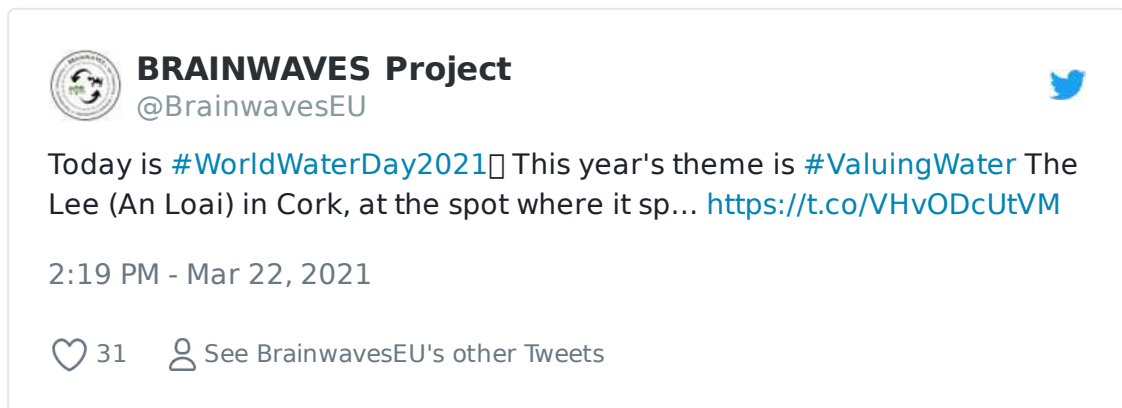
# Get involved

Brainwaves is now looking for interested enterprises to become stakeholders in the project. Engineering, LED, water quality industries and farmers can all play a part. Click to learn more.

[Become a stakeholder](#)

# We're tweeting!

In October 2020 we officially launched our Twitter account [@BrainwavesEU](#). We're delighted to have 275+ interested followers already! We invite you to follow us & be part of our journey. DMs are always open if you'd like to get in touch.





# Shiny new website!

In March 2021 we were so excited to go live with very our own project [website](#). We hope you'll find all the Brainwaves-related information and resources you need here. Content is available in English, Welsh and Irish. We'll be adding more regular News features in the coming months, so bookmark & watch this space.

[Visit our website](#)

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School of Biological Earth & Environmental  
Sciences  
University College Cork  
Distillery Fields, North Mall  
Cork T23N73K  
Ireland



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