









Smart Aqua4 FuturE

Workshop 2026

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Decoupled Aquaponics (KW, NUIG)

General Context

- Improving the utilization of the RAS effluent using decoupled aquaponics systems
- Focus on Nutrient Film Technique (NFT)
- Cultivation of edible vegetables & fruits in a greenhouse environment







Decoupled Aquaponics

System description

- Based on the ‘’*decoupled aquaponics*’’ concept
- Plants are growing with 100% fish wastewater only
- Recirculating unit which means very low water consumption
- Soil less culture: reduced the risk of disease transmission
- No use of chemicals, pesticides or herbicides
- Keywater system consists of 2 * greenhouses and a cold frame for seeds incubation.



Photo DA system 1

Decoupled Aquaponics (KW, NUIG)

System 2



Photo DA system 2

Overview of DA trial system

Green:

- Our overall impression is that this system works. RAS waste from a drum filter can be fed directly to a decoupled aquaponics system where the nutrients can be broken down and **plants can be grown successfully**.
- Many plant varieties were successfully grown including spinach, various lettuces, chard, watercress, various mint varieties, chamomile.
- Ammonia, nitrate, nitrite levels all dramatically reduced
- Different system designs all work well including NFT, Flow through, bell syphon technique, deepwater technique.



Photo Pharmaceutical plants

Overview of DA trial system

Amber:

- Plant roots getting tangled up in the biomedia (which we used as a substrate) and in the general pipework.
- Scallion and radish plants were not too successful
- Due to the small scale of the trial some of the fish waste could block the pump and small valves.
- Quality of the end product compared to traditional growing methods and consumer acceptance would need to be investigated further



Photo Edible plants

Overview of DA trial system

Red:

- Phosphate levels remained elevated, so we trialed the use of a barley crop to reduce this. Initial result proved positive but further trials would be needed to maximize the process
- Seasonality of production
- Investment required and additional labour costs
- Climate resilience issues



Photo barley crop

On-site redworm biomass production using duckweed and RAS sludge (KW, ICR, NUIG, ZUT)

General Context

- Duckweed from F-IMTA mixed with RAS sludge and used as feed for redworm (*Eisema fetida*)
- Worm biomass to be collected, washed, dried and milled for characterization as a fish feed ingredient for feeding trials



Photo ZUT site visit Ireland







On-site redworm biomass production using duckweed and RAS sludge

System description

- Insulated container with lights and temperature control
- Insulated worm boxes (obtained from old fish boxes)
- 20 x Ongrowing boxes
- 3 x Eggs incubation box
- 5 x Juveniles boxes



Vermiculture growing container

Overview of the vermiculture system

Green:

- We were **successful in rearing redworms** on a diet containing duckweed and fish waste
- The resulting feed was accepted by fish in the feed trial
- Adult – egg- juvenile- adult stages of the lifecycle were successfully achieved
- Very interesting result was achieved when this process was crossed with the decoupled aquaponics whereby worms could be produced in a hybrid decoupled aquaponics system



Photo Harvesting redworms

Overview of the vermiculture system

Amber:

- The SAFE diet needed the addition of commercial “worm grub” to make it more acceptable, this could be improved upon.
- This industry is soil/compost based and would need further investigation on alternative growing substrates, eg CTICH mushroom stalks, ZUT straw bricks
- Possibility of using dried fish waste as a substrate or dry food additive for commercial worm grub feed eg using Waister technology
- Composting duckweed could be further investigated as it was not readily accepted by the redworms





Top photo SAFE redworm food mix
Btm photo redworm ready for processing

Overview of the vermiculture system

Red:

- Economies of scale. Large scale production is needed.
- Investment costs for year-round production.
- Climate resilience costs
- Processing costs associated with handling redworms would be prohibitive



Photo Frozen redworms

Question 1: Would you consume fish if grown using aquafeed containing redworms?

Question 2: Would you consume vegetables if grown using fish waste as nutrients?

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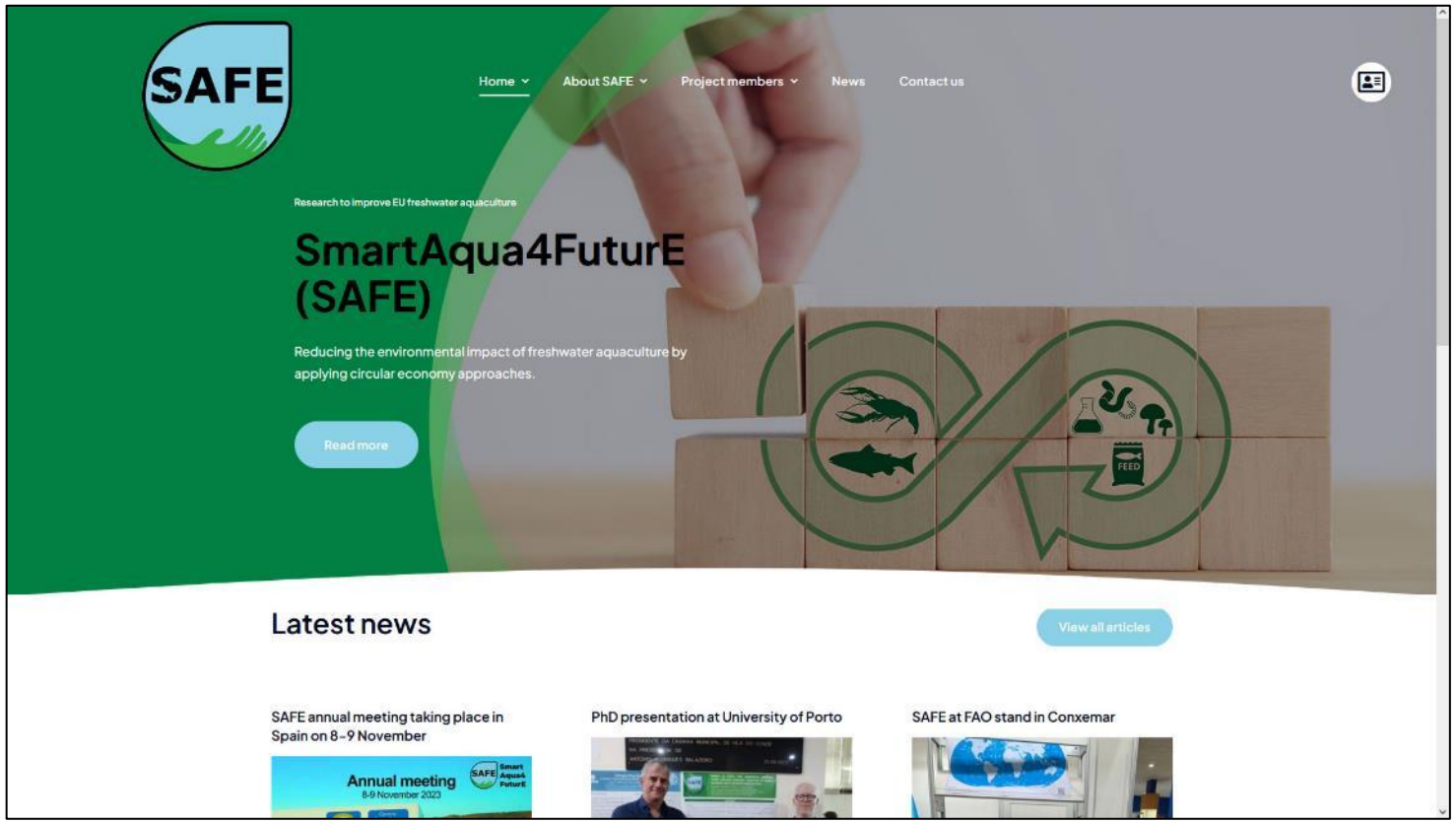


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Thankyou for listening

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