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Constructed Wetland: Multi-Functional Benefits of an Ecological Engineered System

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INTRODUCTION & AIM

Constructed wetlands (CWs) are engineered systems inspired by natural wetlands and commonly used for decentralized wastewater treatment. Although their efficiency in pollutant removal is well recognized [1], other ecosystem services they provide are often overlooked.

This work highlights these broader multifunctional benefits through a real-scale horizontal subsurface flow CW (HSSF-CW) operating at a tourism facility in northern Portugal.

METHOD

Location: Rural guesthouse in Calheiros, northern Portugal.

Operation: In service since 2010, treating domestic wastewater from 6–40 occupants.

System design: HSSF-CW with a total area of 40.5 m² with LECA® substrate

Vegetation: Polyculture species selected for treatment efficiency and aesthetic value.

Climate: Mediterranean conditions; effluent discharged into a small polishing pond.

Background: Builds on previous research on pathogen removal [2] and microbial communities [3] at the same site.

Current focus: Identification and evaluation of additional ecosystem functions provided by this long-running CW.

Fig. 1. Study Site

RESULTS & DISCUSSION

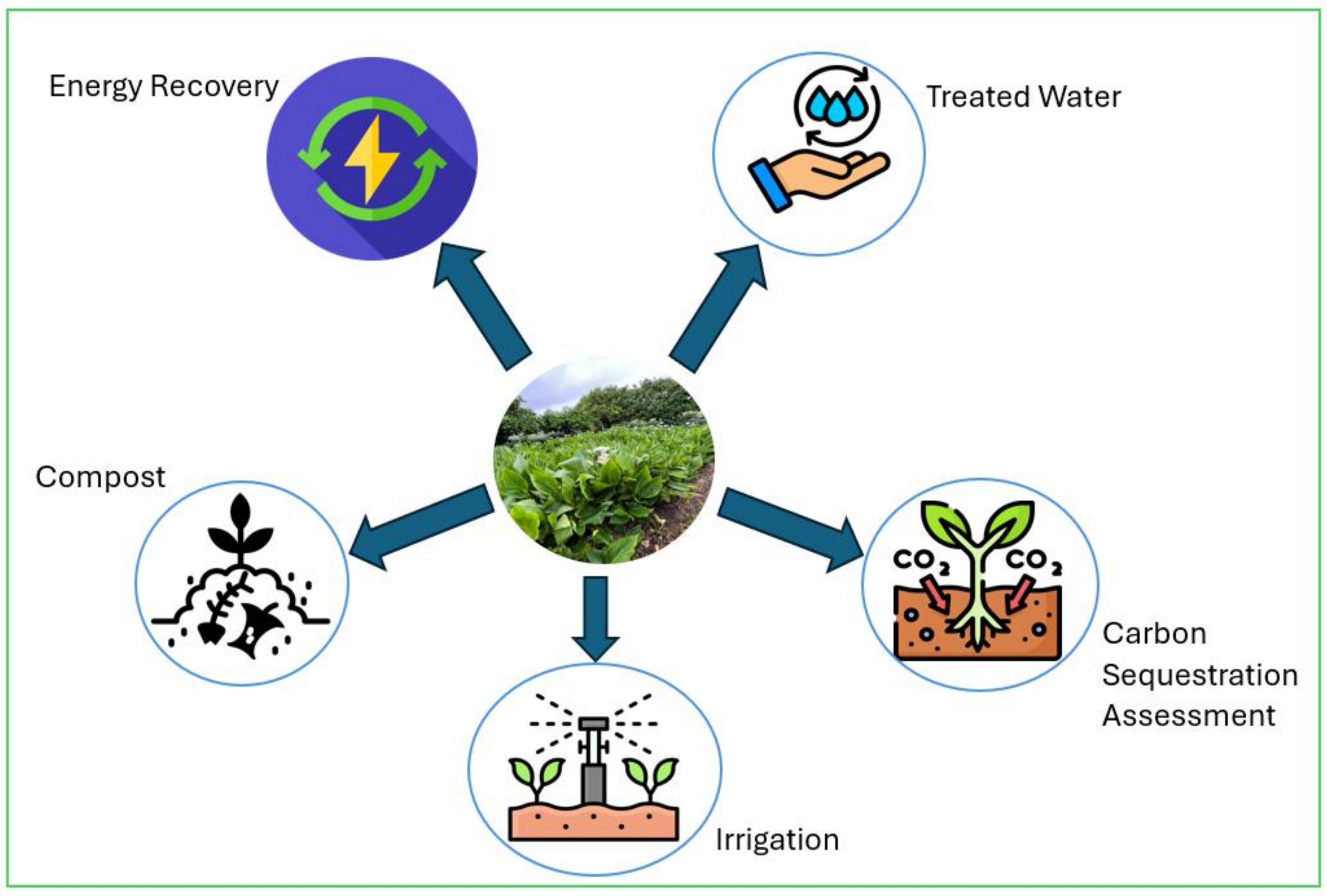

Fig. 2. CW multifunctional benefits

System has shown **stable long-term operation**, providing a reliable basis to explore additional ecosystem services beyond conventional wastewater treatment.

Carbon sequestration is being assessed through biomass accumulation and carbon retention in the substrate.

Energy recovery is under evaluation using microbial fuel cell integration

Harvested plant biomass is being tested for **composting and soil amendment**, supporting nutrient recycling within the system.

The **treated effluent** demonstrates potential for safe water reuse in irrigation, promoting circular water use on site.

Treatment performance is being enhanced using **photocatalytic and nanostructured filter modules**.

Future research would be advanced system optimization and modeling.

CONCLUSION

Recognizing other broader functions of CWs is essential to repositioning them as more than just wastewater treatment technology but rather as multifunctional ecosystem systems that they are.

REFERENCES

[1] http://dx.doi.org/10.1016/j.ecoleng.2015.03.001
[2] https://doi.org/10.1016/j.ecoleng.2017.02.013
[3] https://doi.org/10.3390/w11081535

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