

Sustainable methods for Water and Nutrient Retention - Wetlands



WATERAGRI

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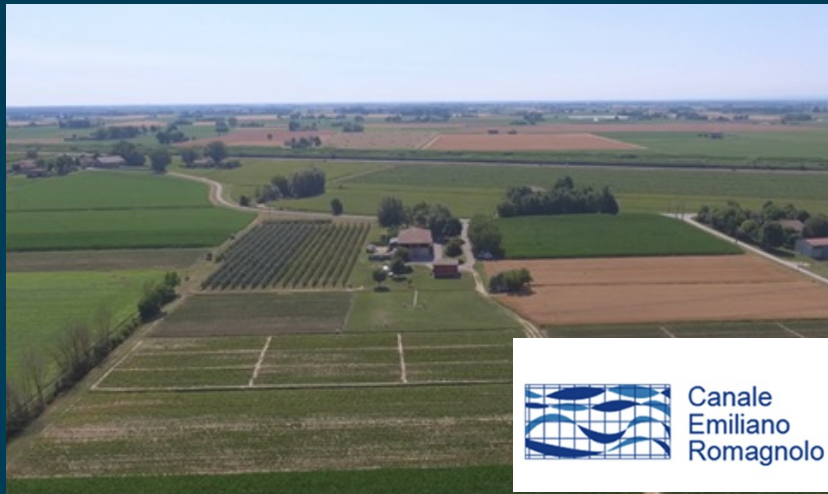
Nature-based solutions



- Nature-based solutions (e.g. constructed wetlands, bio-inspired drainage systems) are artificial systems that mimic processes occurring in nature with a goal of addressing societal and environmental challenges.
- These systems can be applied in the agricultural landscape, leading to a better retention of both water and nutrients, and therefore improving environmental conditions.
- Constructed wetlands are a type of NBS often used in agricultural settings since they can manage variable water flows and pollutant loads.

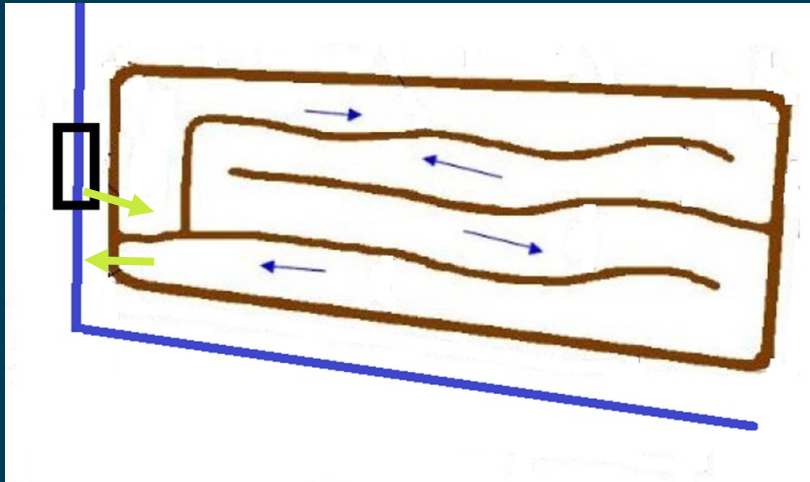


Italian case study - Marsili experimental farm



- The Marsili farm is an example of an open-air laboratory designed to develop the most advanced technologies in irrigation, water saving and water recovery.
- The farm covers 12.5 ha where different crops (fruit trees, cereals, vegetables) are grown.
- Agricultural drainage water from the whole farm area is treated by a 0.4 ha surface flow constructed wetland.
- The farm is owned and managed by the Land reclamation consortium Canale Emiliano Romagnolo, and it is a test site for different projects that UNIBO is working on.

Surface flow constructed wetland



- 3,700 m² (3% of the farm area)
- total volume of 1500 m³
- maximum water level: 0.4 m
- not waterproofed
- operation depends on the presence of rain
- main plant species: *Phragmites australis*, *Typha latifolia* and *Carex spp.*



Surface flow constructed wetland



Surface flow constructed wetland



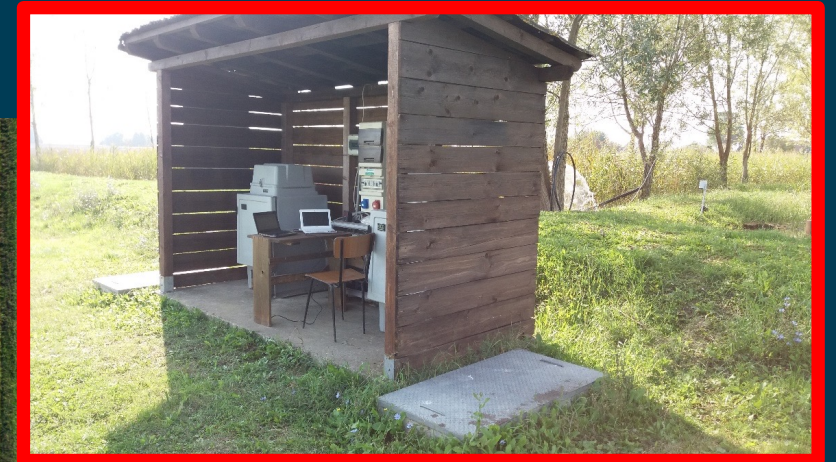
Main ditch and water abstraction



Surface flow constructed wetland



Control/sampling unit



Surface flow constructed wetland



System inlet



Surface flow constructed wetland



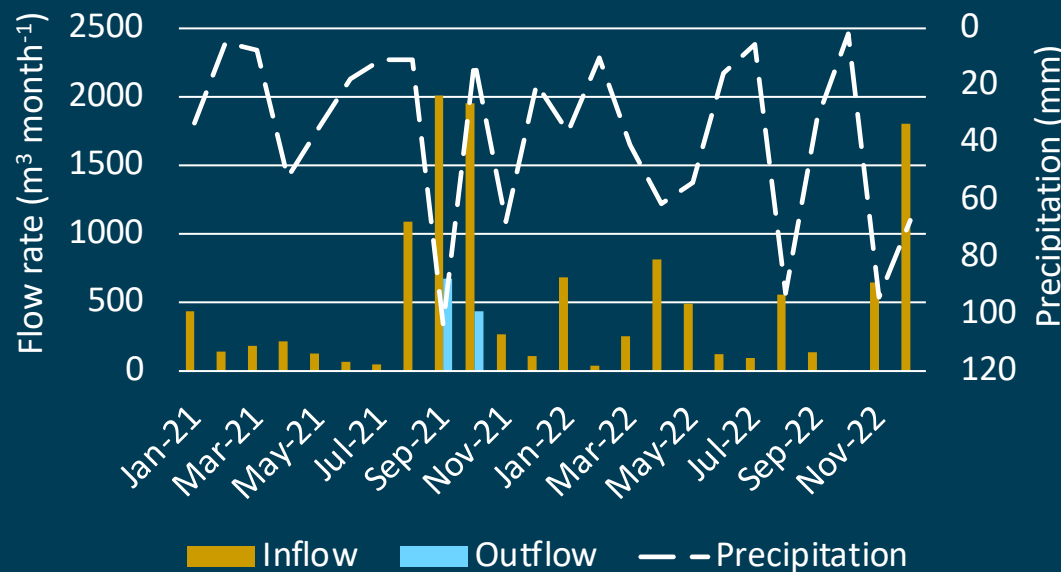
Water course and system outlet



Water quality improvement



- 2021 and 2022 were more dry years and they were characterised by a very small inlet (around 3000 m³ year⁻¹).
- In addition, in 2022 there was no outlet (the SFCW water level never reached the outlet pipe height) and therefore all the pollutants that entered the system were retained there.



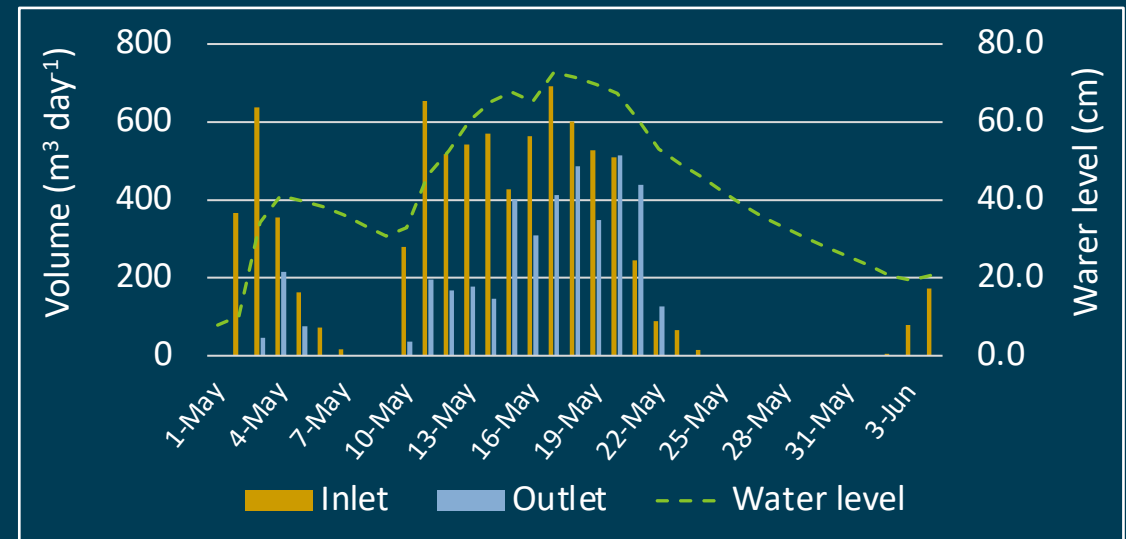
		2021	2022
TOC	Inlet load	73 kg	58 kg
	Retention	41 %	100 %
TSS	Inlet load	458 kg	551 kg
	Retention	80 %	100 %
TN	Inlet load	3,9 kg	0,2 kg
	Retention	65 %	100 %
TP	Inlet load	0,2 kg	0,1 kg
	Retention	45 %	100 %

Intensive rain event



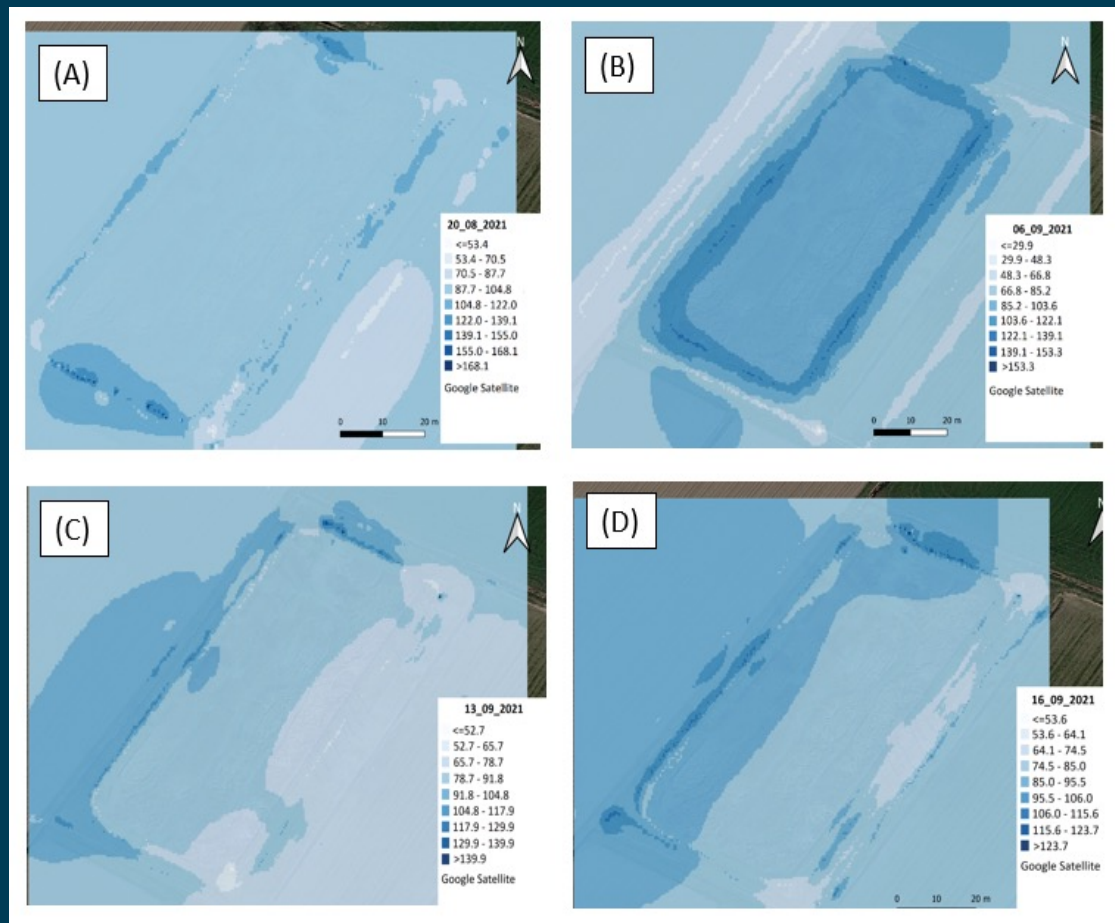
- Some valuable conclusions can be drawn from an intensive rain event that occurred in May and June 2023, causing big floods and damages in Emilia-Romagna.
- Between 1st of May and 4th of June the overall precipitation in the farm amounted to 340 mm (yearly average is 770 mm).
- Despite high flow rate (maximum of 690 m³ day⁻¹) and low HRT (2,4 days during a period when 70% of inflow occurred), the SFCW has achieved rather high removal efficiencies.

COD	TSS	TN	NH ₄ -N	NO ₃ -N	TP
75%	64%	77%	90%	78%	88%



- As for the system hydrology, during the mentioned event the system managed to intercept 48% of the total runoff produced and it retained 56% of the total inflow.

Water infiltration trial



- In order to define hydraulic behaviour of the system when full, electromagnetical measurements of soil water content were performed.
- Measurements have been carried out every few days, however due to calibration problems some measurements could not be considered as relevant.
- From the dates reported (20th August, 3rd September, 13th September and 16th September 2021), the main infiltration points and water movement can be identified, as well as preferential underground flow routes.

Conclusions



- The full-scale SFCW, although slightly over-dimensioned, proved to be a valuable asset for the farm, and nowadays it can be considered as a semi-natural system.
- The pollutant removal efficiencies remain high even 20 years after the construction, adding to the hypothesis of the self-regulation.
- CEC removal is a rather important topic and the system performance seems to be satisfactory.
- The SFCW role in the view of climate-change and modifications in the precipitation pattern is rather important, and it can contribute both to flood control and farm water availability.



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THANK YOU!

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