Capturing and valorising freshwater aquaculture waste streams to enhance climate resilience and resource efficiency

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”Strengthening Circular Economy and Valorisation of side-streams in RAS Aquaculture”

AQUALOOP International Conference

West Pomeranian University of Technology Szczecin

Centro Tecnológico de Investigación del Champiñón de La Rioja

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Interreg South Baltic — Co-funded by the European Union

aqua loop

SAFE

BLUE BOOST

OCCAM

NCBR National Centre for Research and Development

Sustainable Blue Economy Partnership

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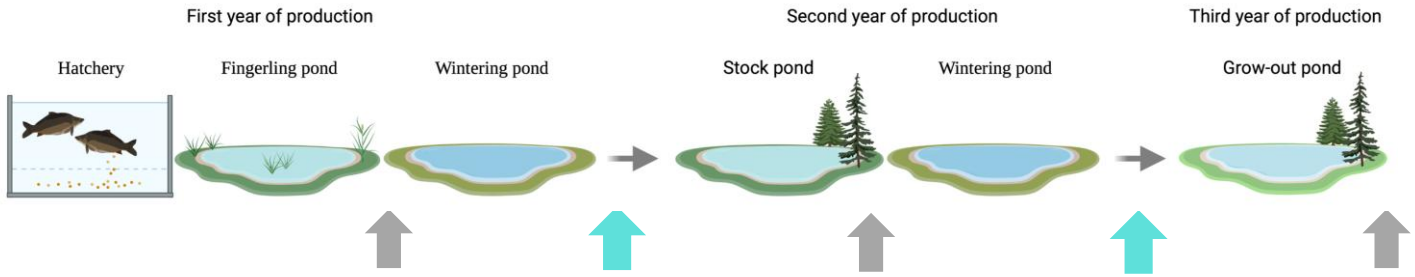
Pond aquaculture

- Highly integrated into the landscape,
- Key stages in pond production,
- Legislation aspects.



Sediments and their origin

- Annual build-up of 0.76–3.2 t ha^{-1},
- In streams 0.16–19.08 kg m^{-2} weekly,
- Uneaten cereals, faeces, turnover of plankton, decaying hydrophytes, and organic and inorganic matter entering the farm (inflow water, wind).

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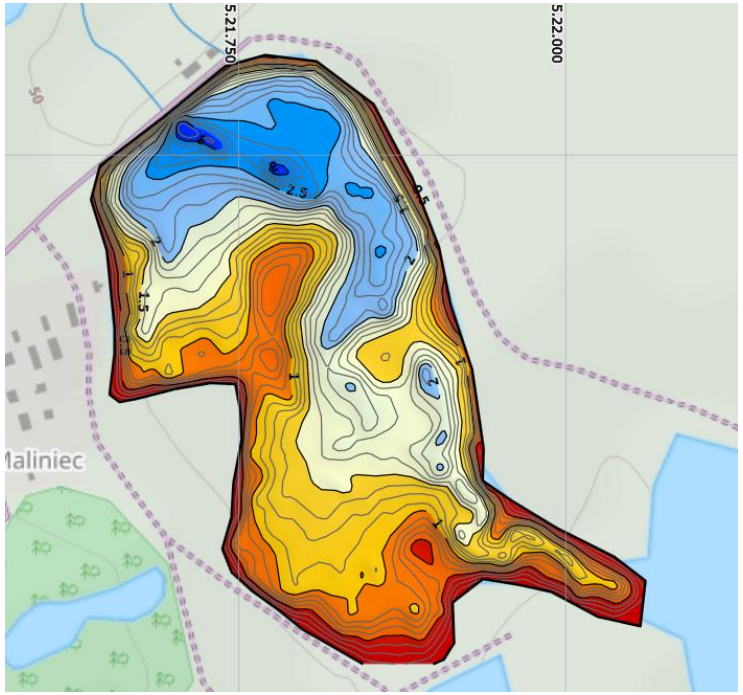
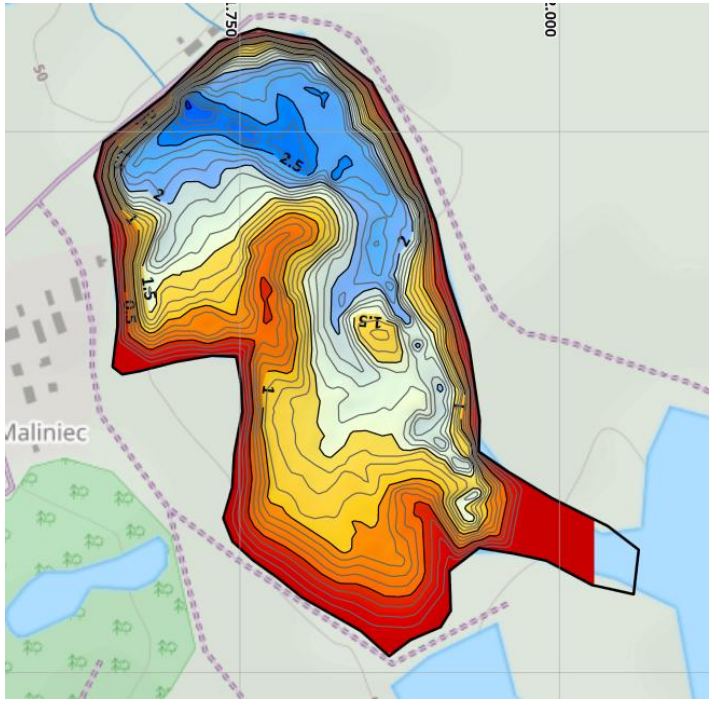
Sediment buildup



April 2023



September 2023

Month	TSS (g/L)
Jan-23	0.2718
Feb-23	0.0015
Mar-23	0.0054
Apr-23	0.0039
May-23	0.0039
Jun-23	0.0055
Jul-23	0.0050
Aug-23	0.0069
Sep-23	0.0054
Oct-23	0.0083
Nov-23	0.0164
Dec-23	0.4675

Annual load of the TSS measured in the discharge channel was 119.15 tones

The thickness of the sediment in the analysed pond increased on average by 18 cm

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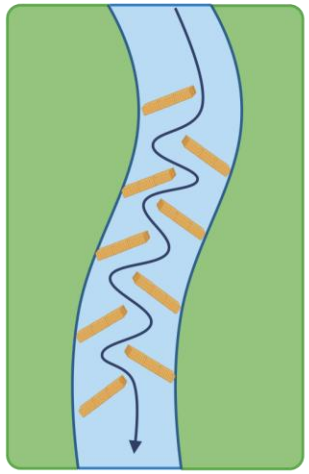
Sediment filtering system

- Low-cost and low-tech solution,
- Straw bricks,
- Total length 134 m,
- 69 sets of straw bricks (herringbone pattern).



- Valuable biomaterial for different purposes.

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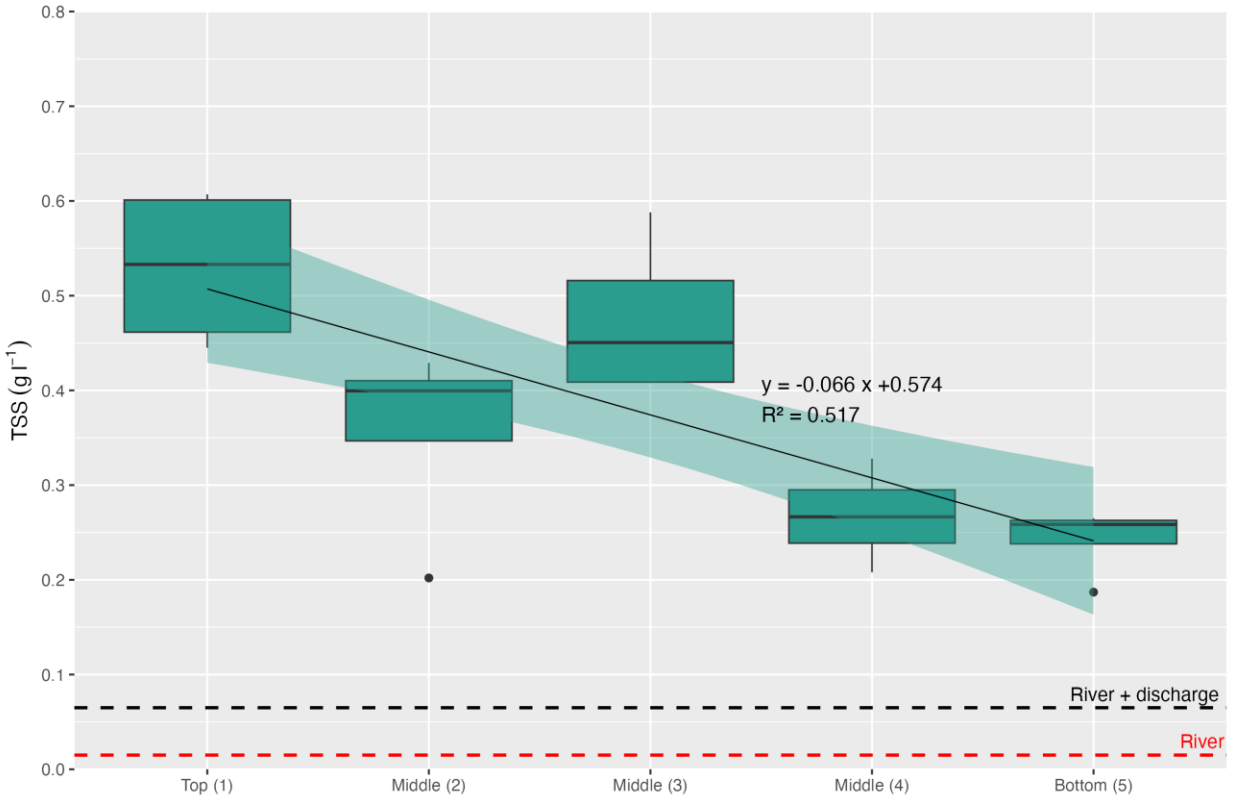
Impact of the system

- 1/3 of farm sediments captured (40 t),
- Minimised impact on biodiversity,
- Carp farmers' initial interest,
- Lack of market for biomaterial (seasonality).



- The replicability issue is to be solved in **OCCAM**.

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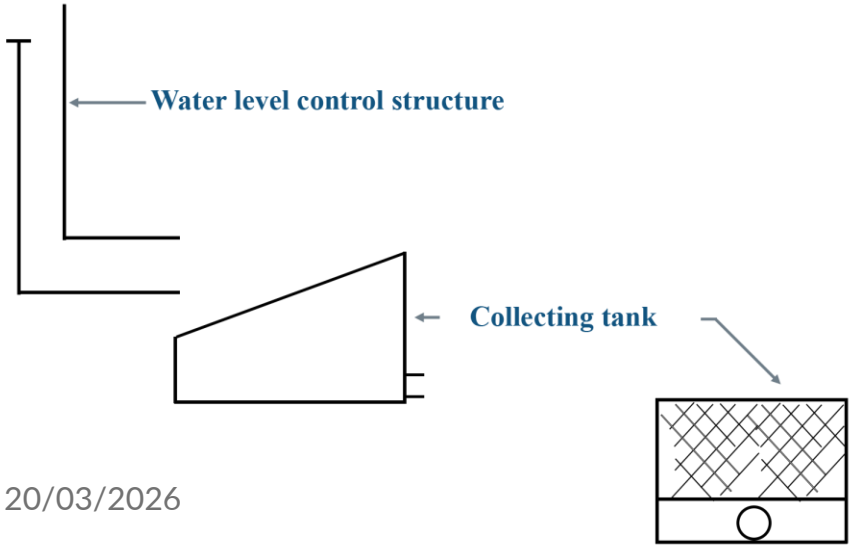
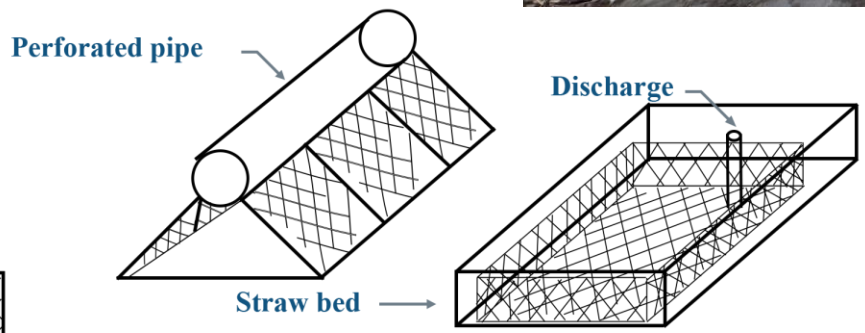
OCCAM solution

- Modular design,
- Two separate units connected with pipes,
- Sieves to reduce the mineral fraction,
- Goal: mitigate climate change effects.





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Biomass characterisation

- quality and safety:
  - 10 elements,
  - 24 antibiotics,
  - 646 biocides (insecticides, herbicides, fungicides, other),
- grain size, porosity, density and moisture.

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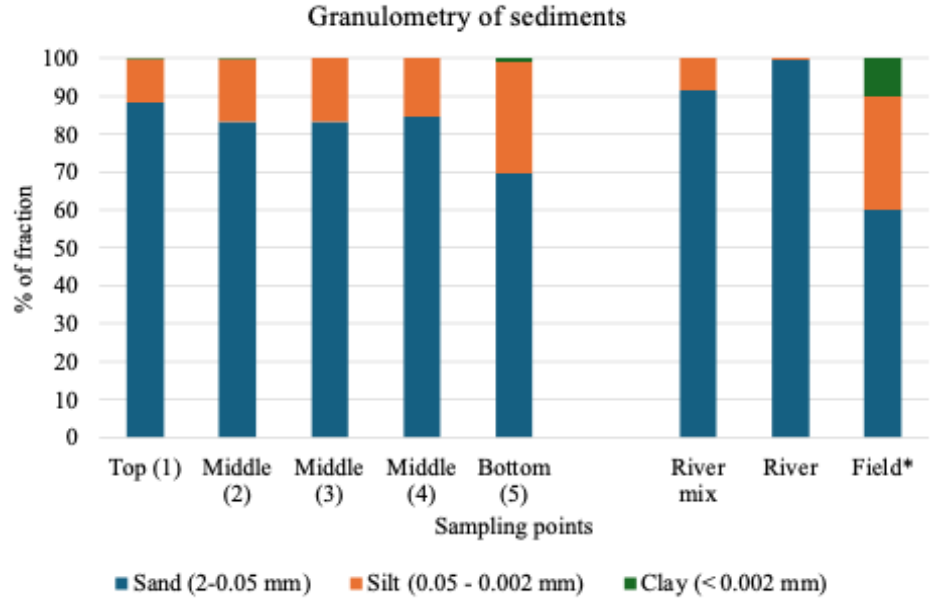
Biomass characterisation

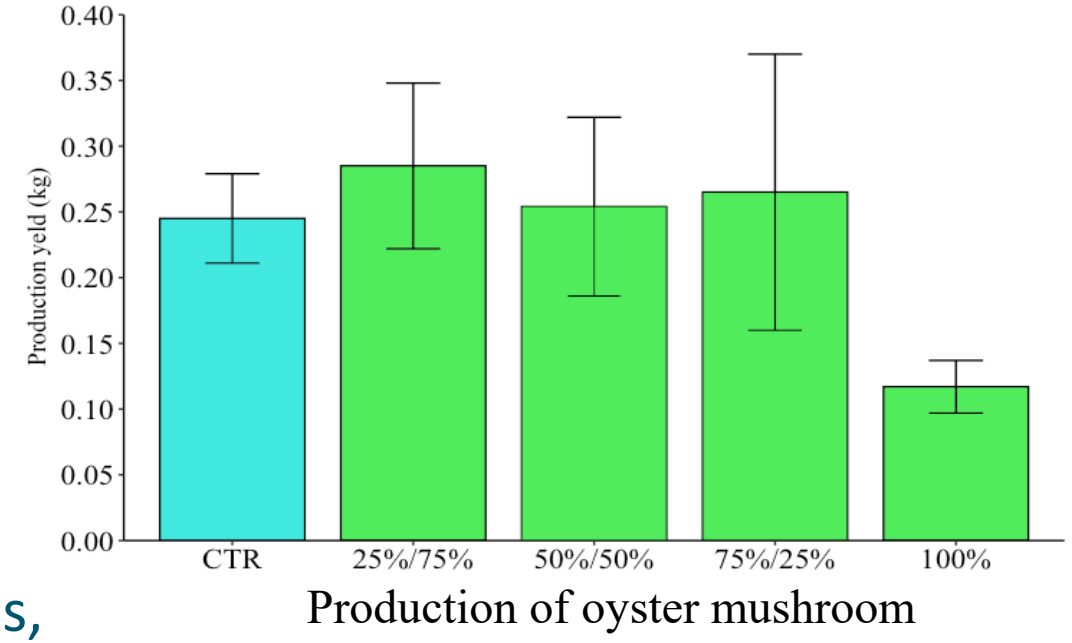
- High level of mineral fraction,
- No antibiotics detected,
- No biocides detected,
- Average content of nitrogen 17.9 g/kg of sediments,
- Average content of phosphorus 0.33 g/kg of sediments,
- Average content of TOC 3.39%,
- Low levels of heavy metals.



Referencia	Humedad	Cenizas	Nitorg	pH	Conduct	MatOrg	RelCN	LIGNINA	CELULOSA	HEMICELULOSA
SEDIMENTS	49,80	93,77	0,31	8,15	0,14	6,23	11,54	1,98	1,59	2,60
STRAW	17,84	4,84	0,44	8,21	1,00	95,16	124,61	5,22	52,37	31,22
SEDIMENTS STRAW	78,84	24,78	0,72	7,62	0,14	75,22	60,71	10,95	31,86	22,48
STRAW	17,40	6,79	0,55	7,38	1,26	93,21	99,04	11,37	40,03	32,32

Mushroom production

- Up to 75% inclusion level works like a standard substrate,
- Full-scale trial using sediments,
- 2200 kg of straw bricks ➡ 1800 kg of mushrooms,
- Stems (by-product) for further valorisation (400 kg).



Production of oyster mushroom

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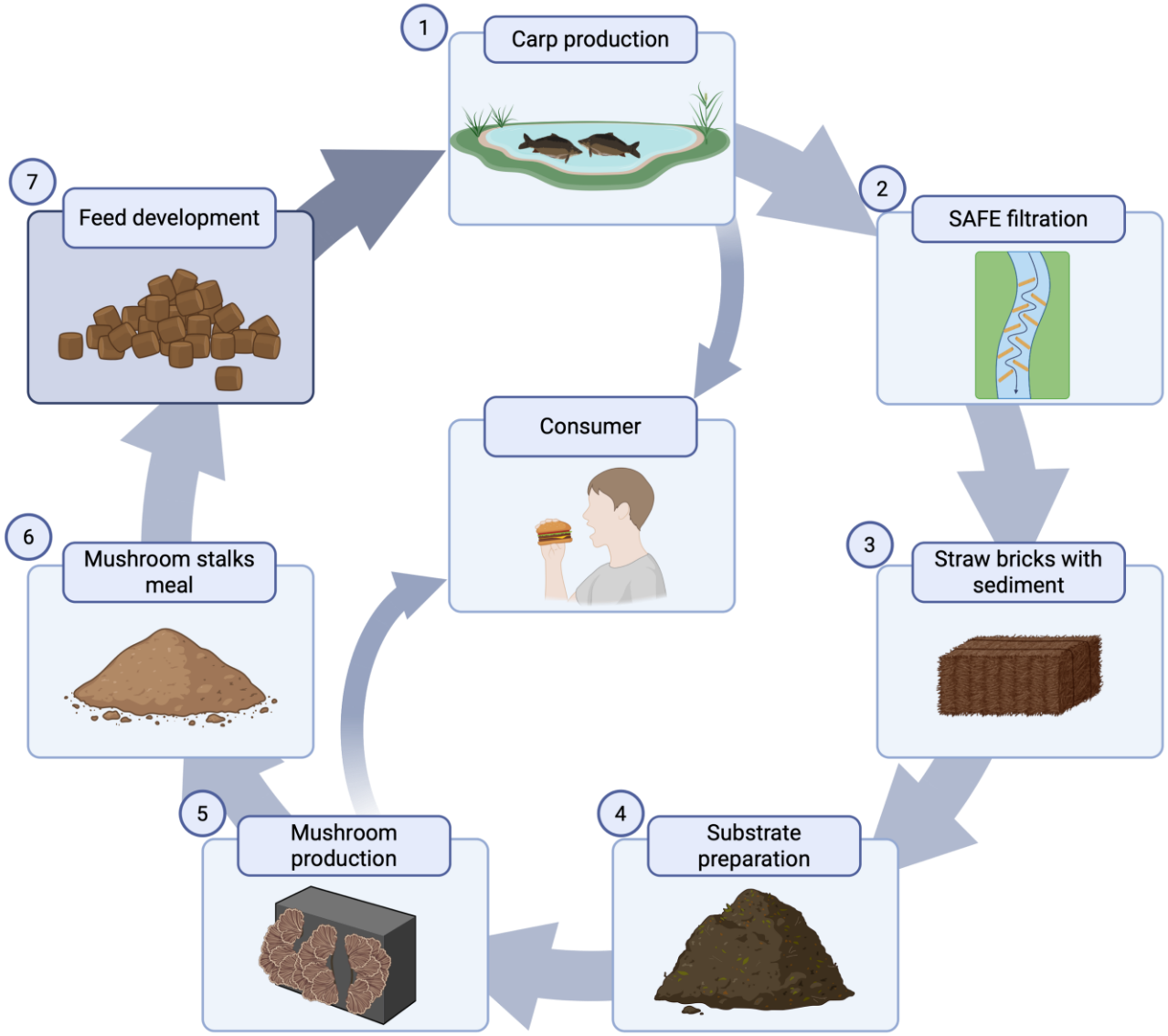
Beta-glucan trials

- Trials with common carp, rainbow trout, Atlantic salmon, and perch,
- Goal: increase survival and modulate immunological response.

- Feeding carp experimental diets increased winter survival and eliminated a serious bottleneck.



Other biomases valorisation

Salmon sludge trials

- For different mushroom species, good results with the inclusion of 2.5-12%,

Duckweed and watercress trial

- The inclusion of 11% fresh duckweed gave good yields,
- The inclusion of 17% fresh watercress also increases yields.



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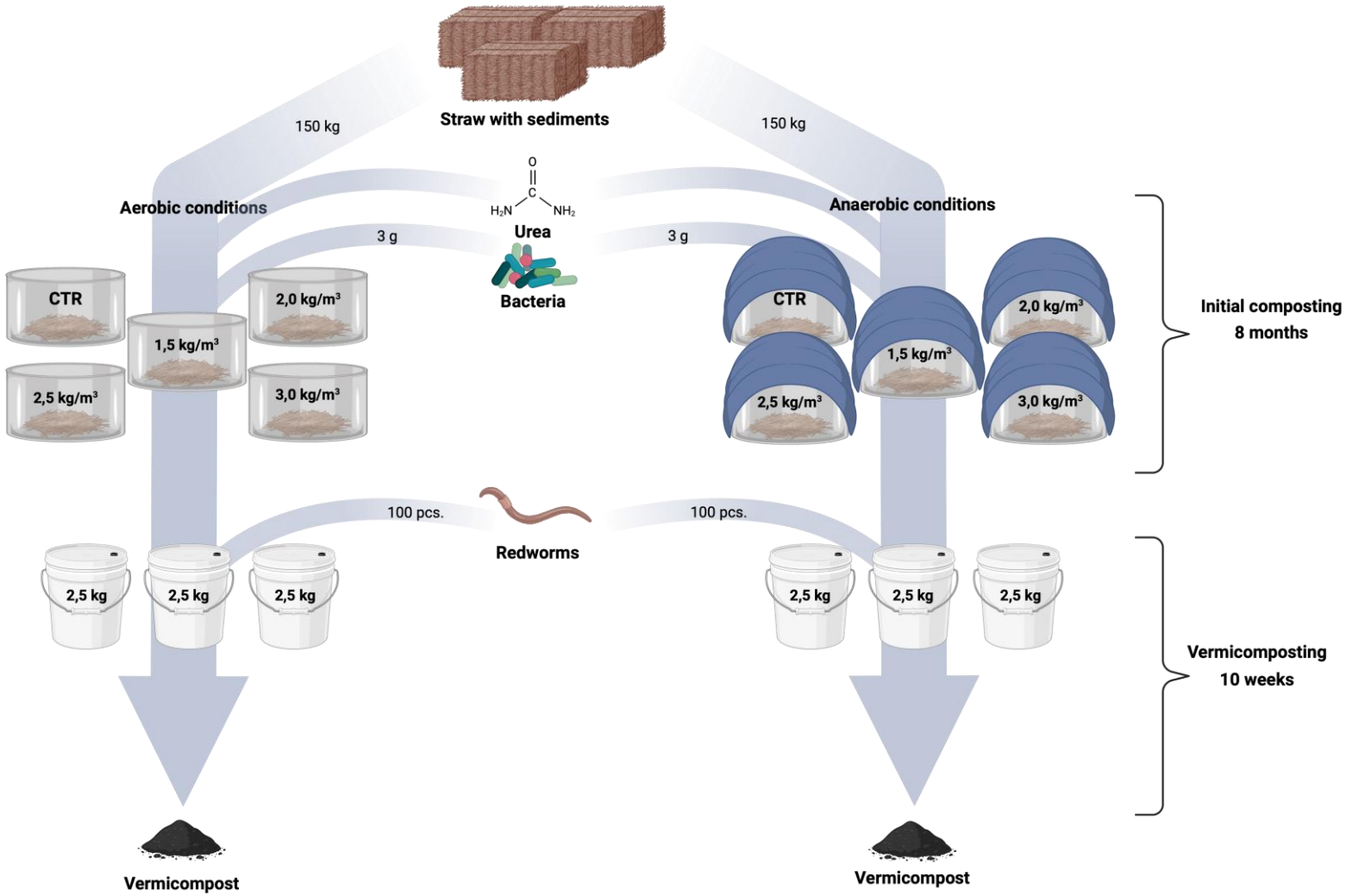
Redworm production

- Initial tests to establish optimal conditions,
- Several different options were tested.



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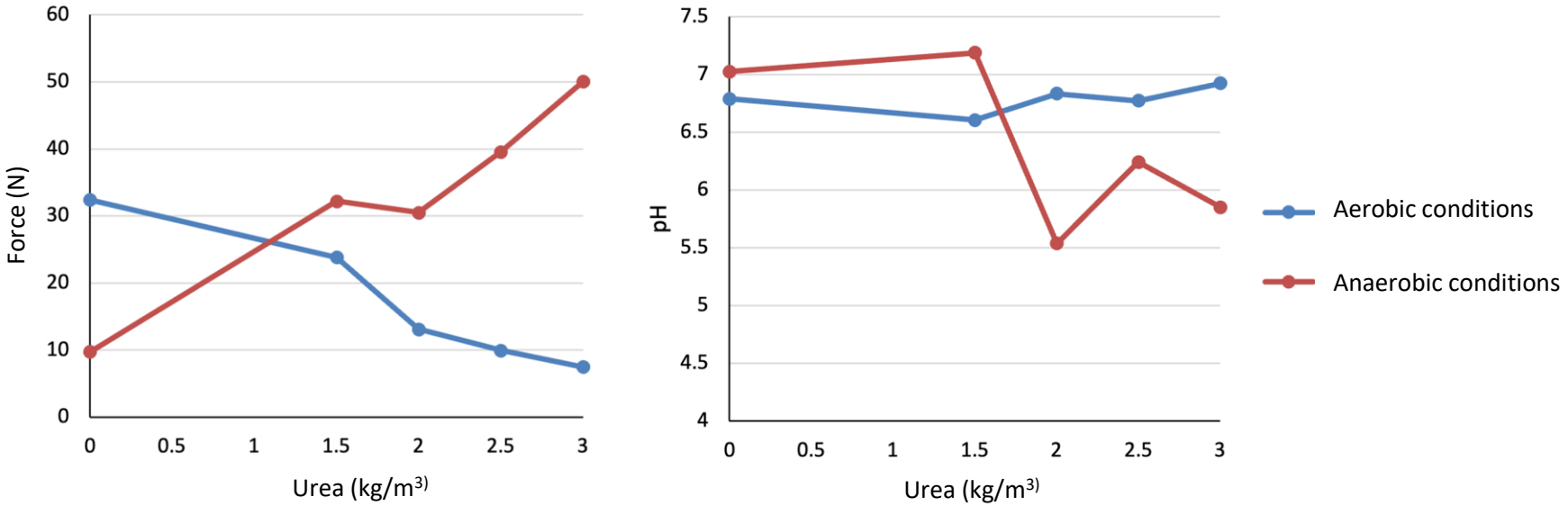
Redworm production

- Results suggest more stability with aerobic conditions,
- Higher urea additions help soften the straw and allow redworms to feed,
- Results used in ongoing full-scale trail



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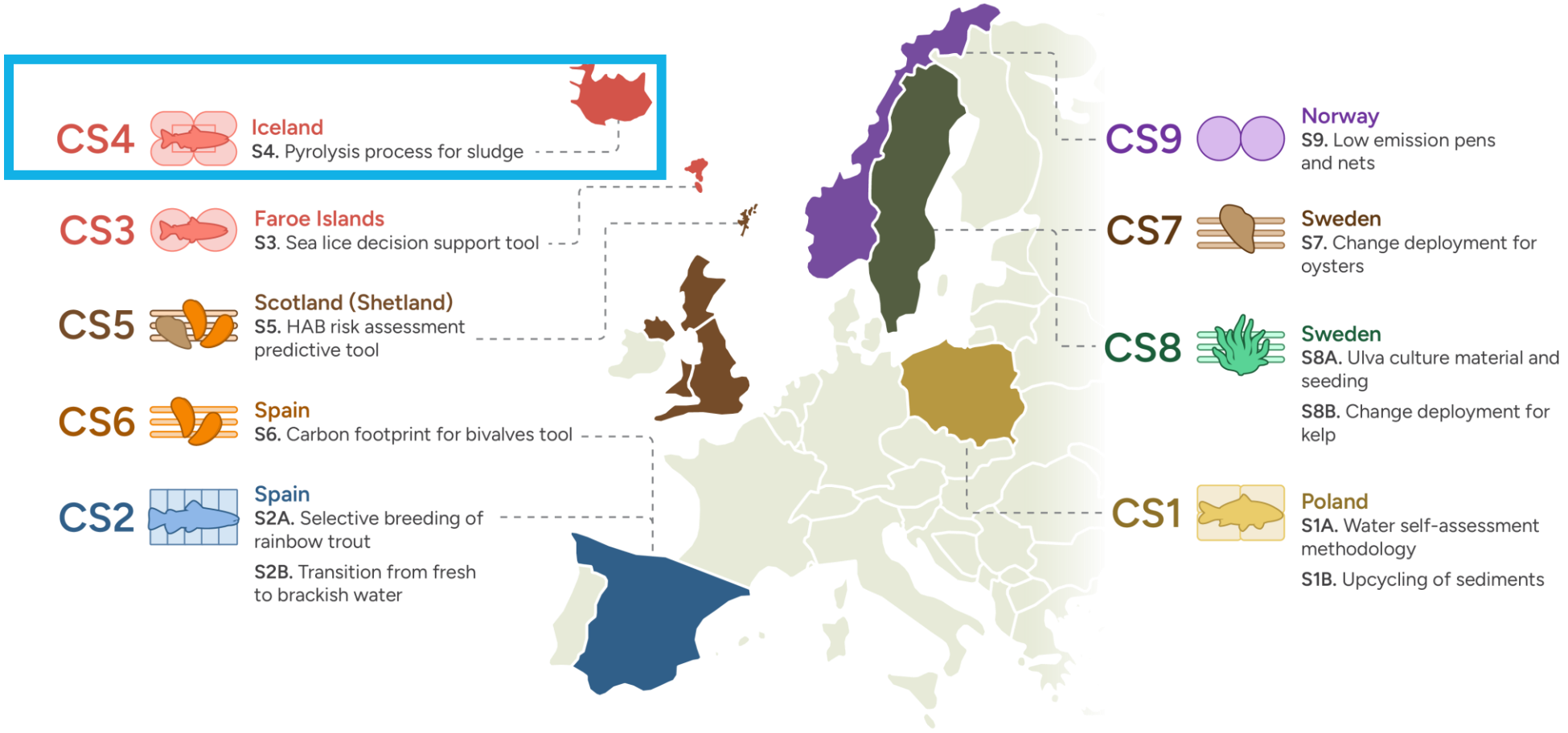
Next steps and pathways towards circularity



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Next steps and pathways towards circularity

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As long as the primary nutrients (substrate) remain cheap, the circular solution will remain underutilised.

Thank you!

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