

Combating internal leakage and recycling of phosphorus

Baltic Sea



“The project will demonstrate the technical capabilities of the method and how its revenue stream will enable a continued restoration of the Baltic Sea.”

TechMarket

TechMarket is a **spin-off** from the
Royal Institute of Technology
Stockholm

System integrator for new technology
Neutral, independent



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2016

Municipal solar parks



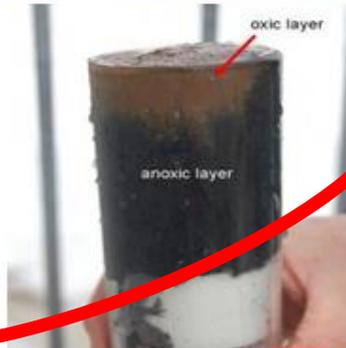
Rock caverns for heat storage



Phosphorus / Nitrogen neutral municipality

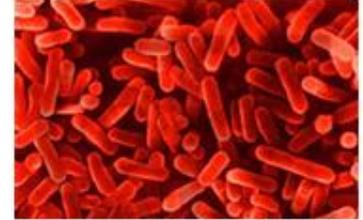


Low flow dredging of shallow lagoons



Downstream

Legionella control for lowered tap water temp



Future swimming pools



Elimination of medical residues upstream



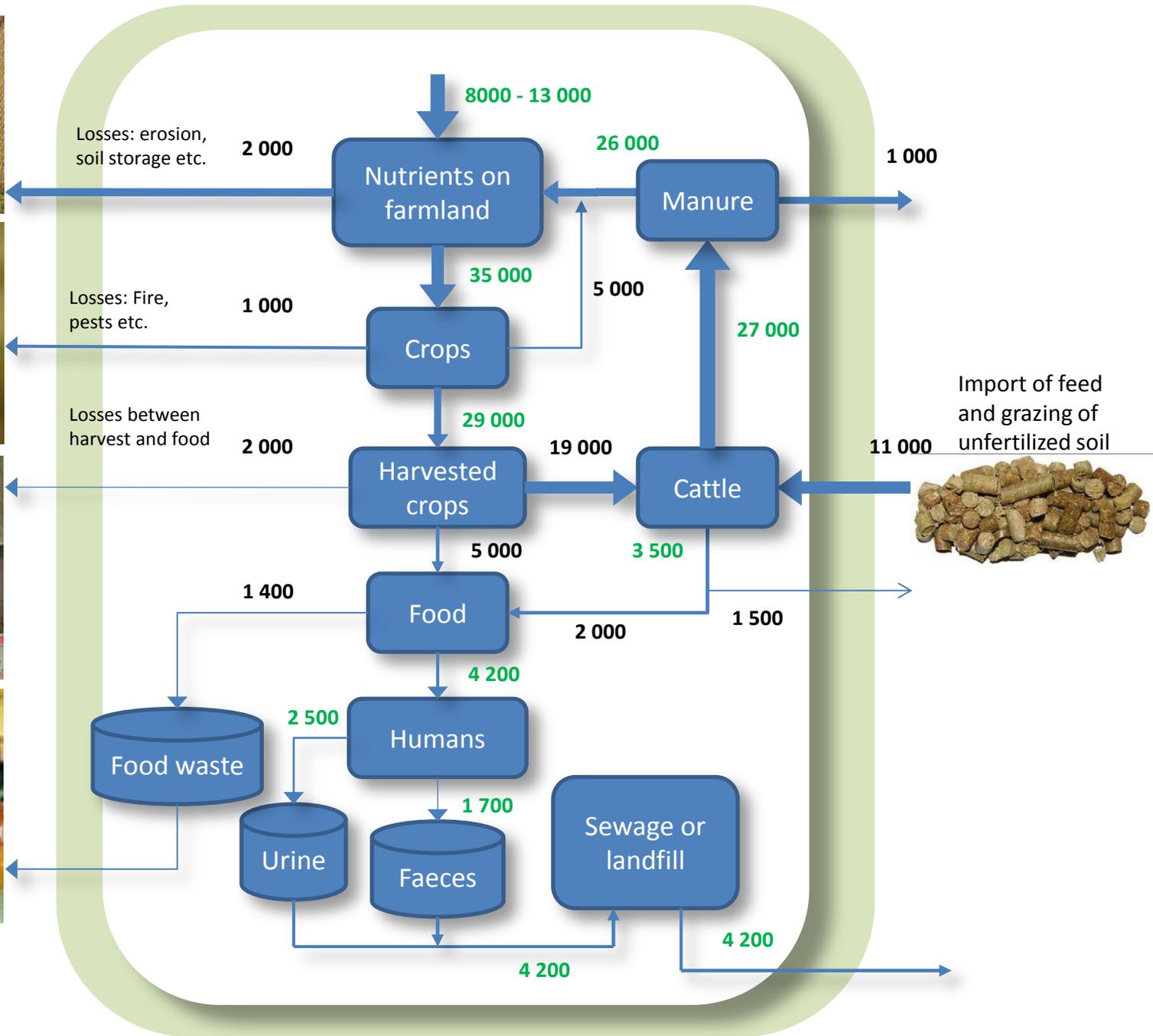
New single household sewage systems

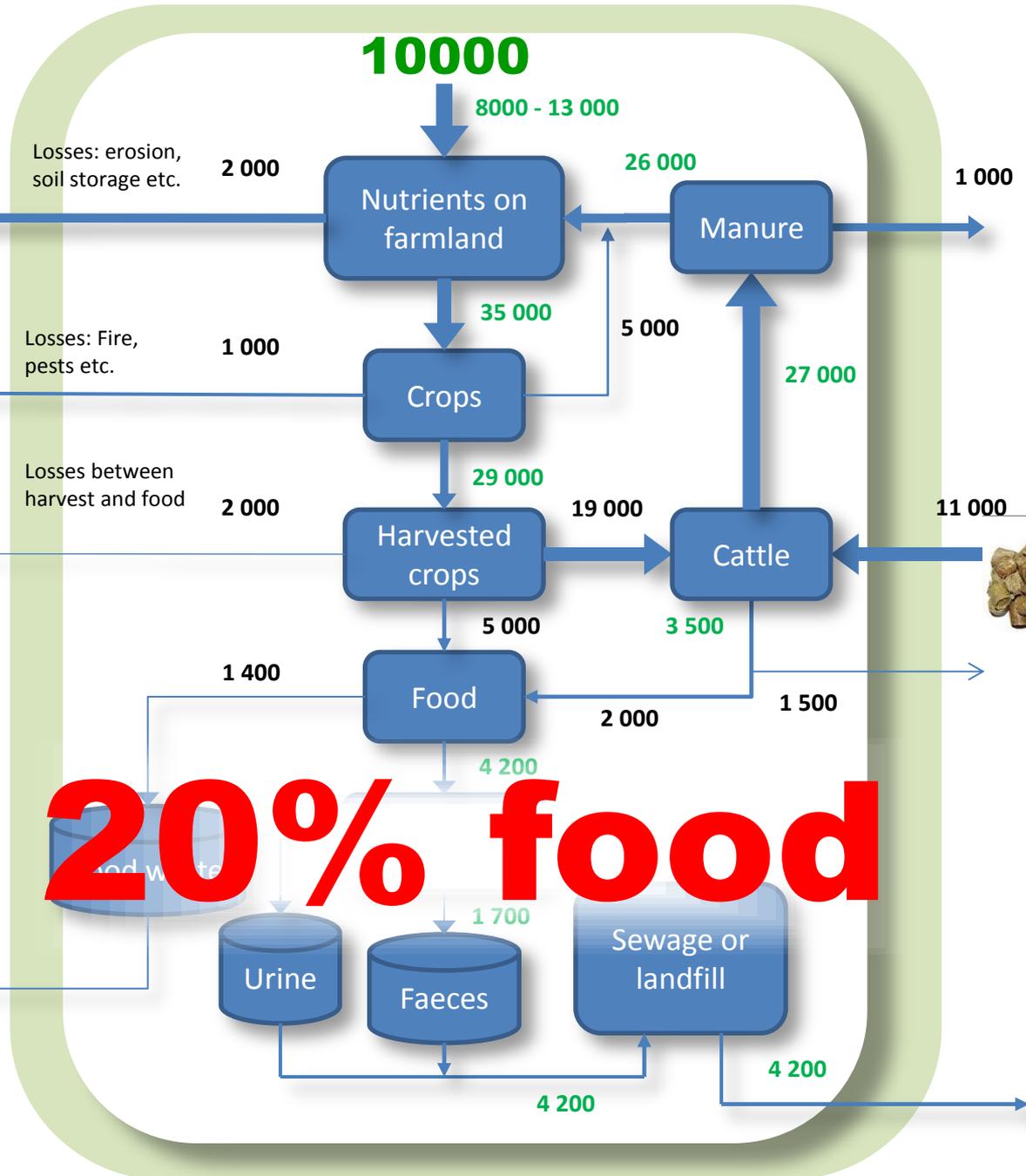


Upstream

The aim

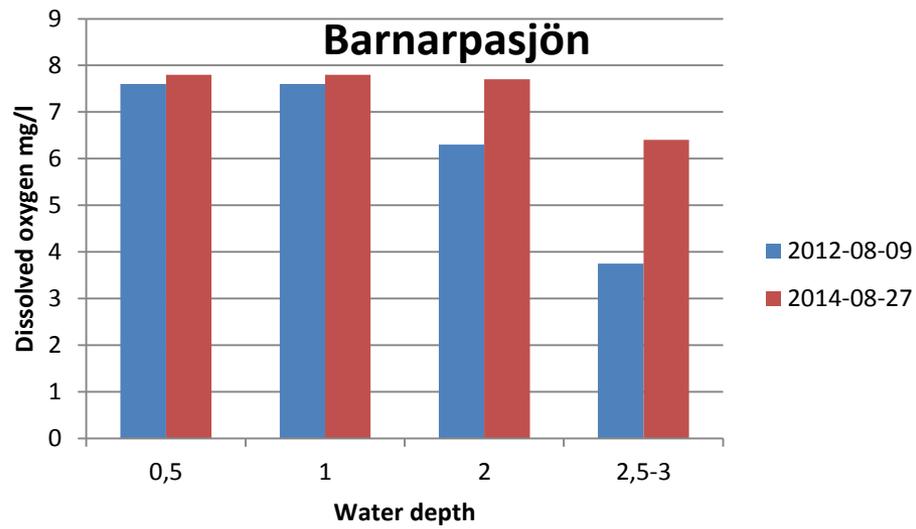
*Combating internal leakage and recycling of phosphorus
in the Baltic Sea*





20% food



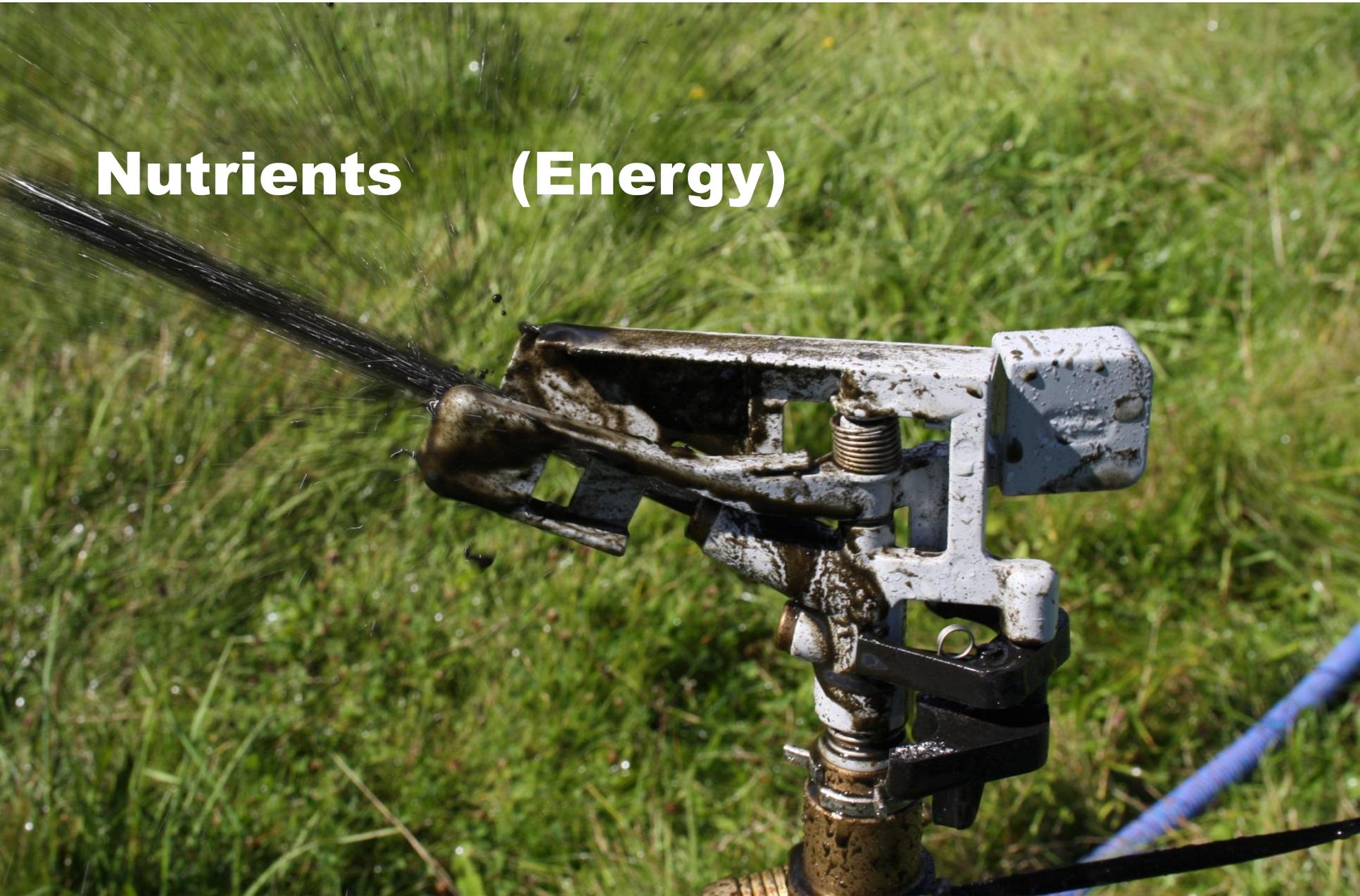


Before

After

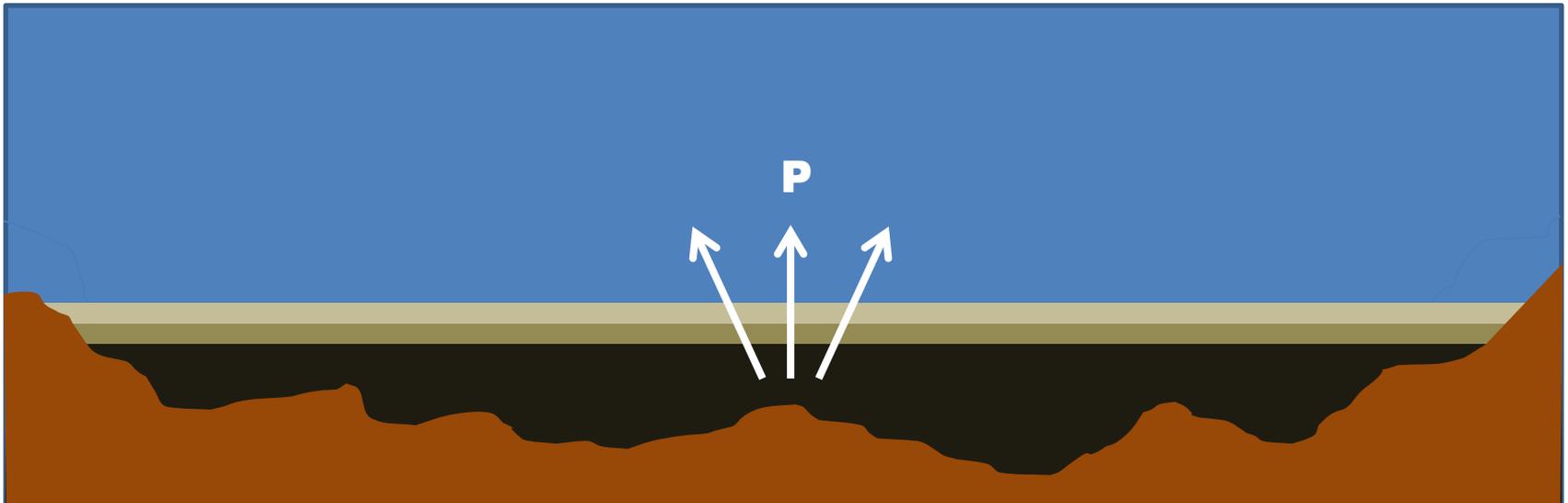


Nutrients (Energy)



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Recent sediments – internal leakage of Phosphorus



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Recent sediments – retrieval



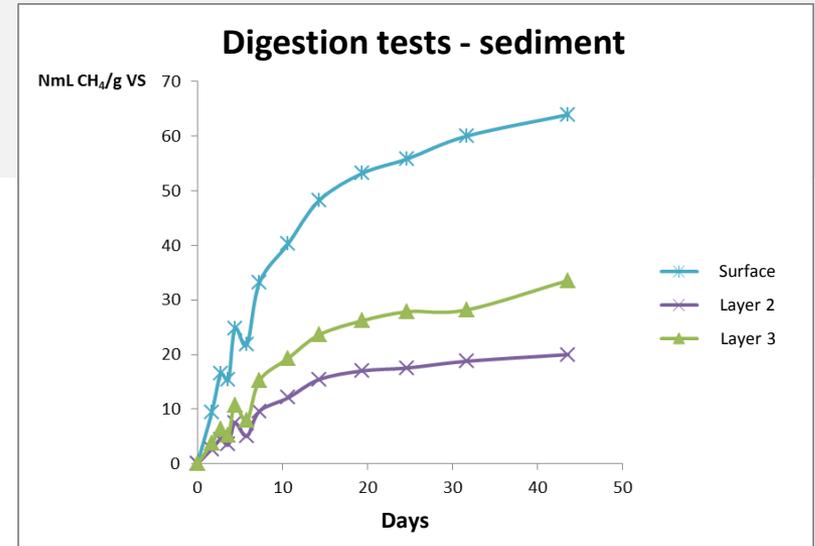
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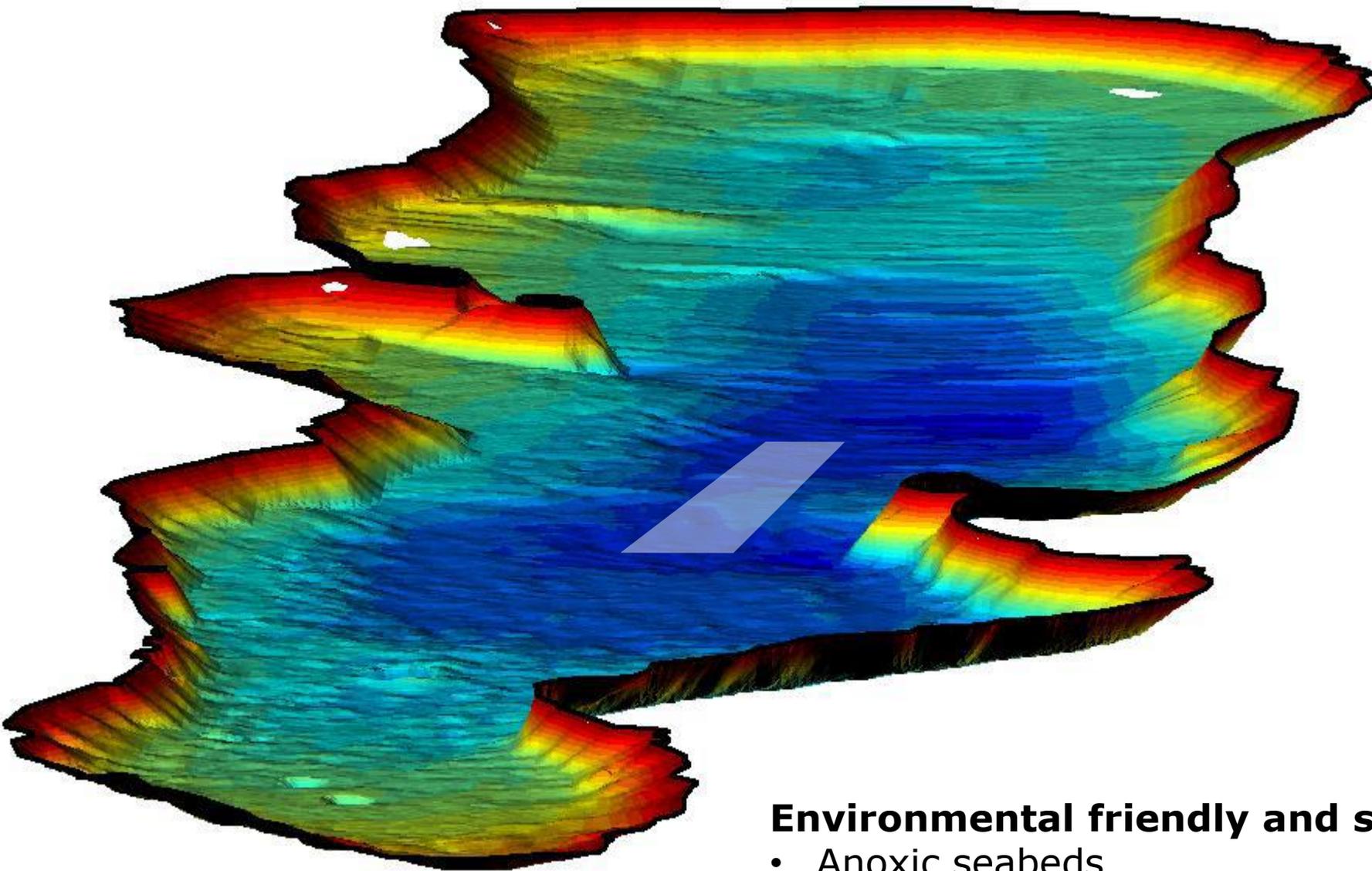
Recent sediments – retrieval



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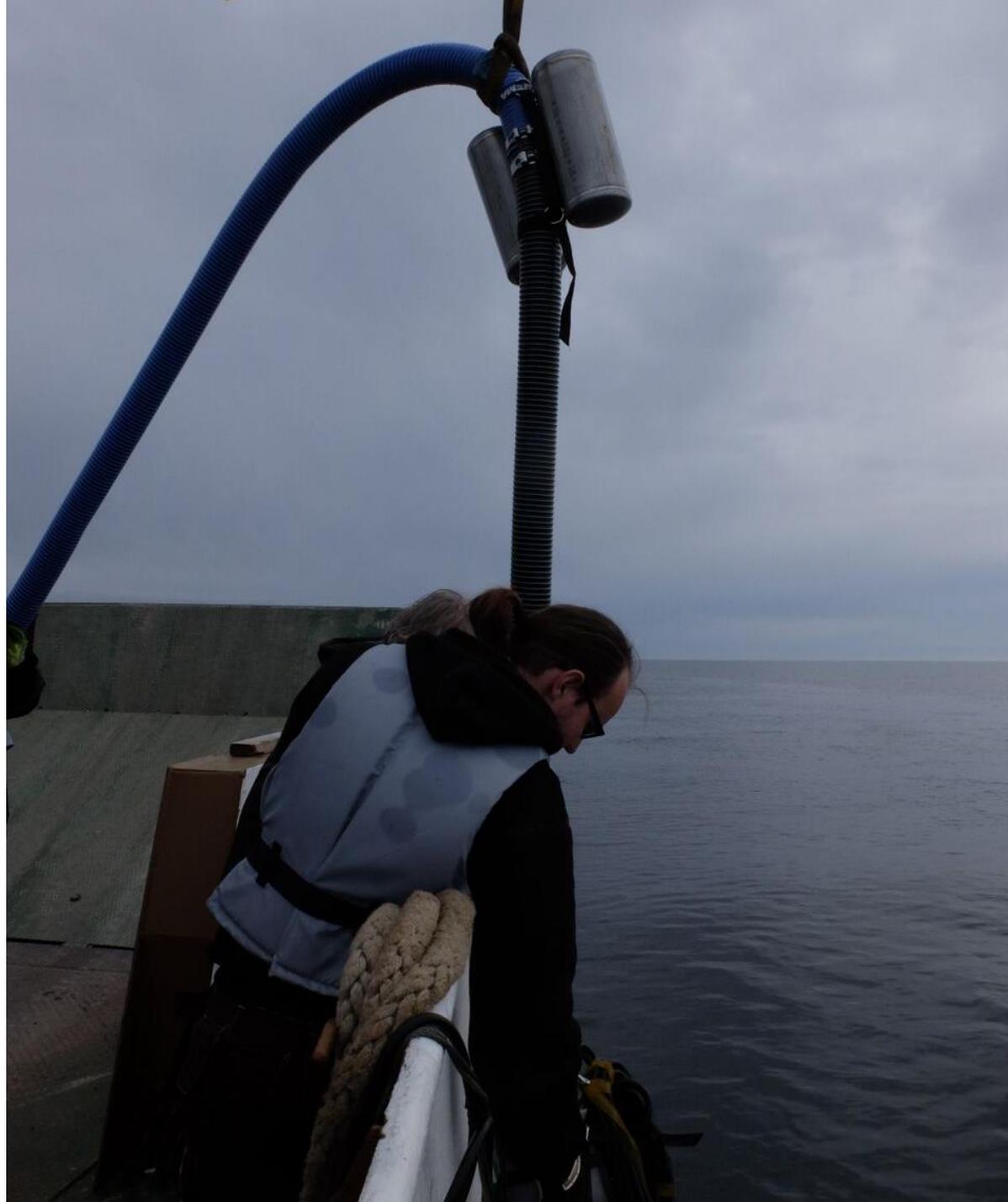
Recent sediments – retrieval

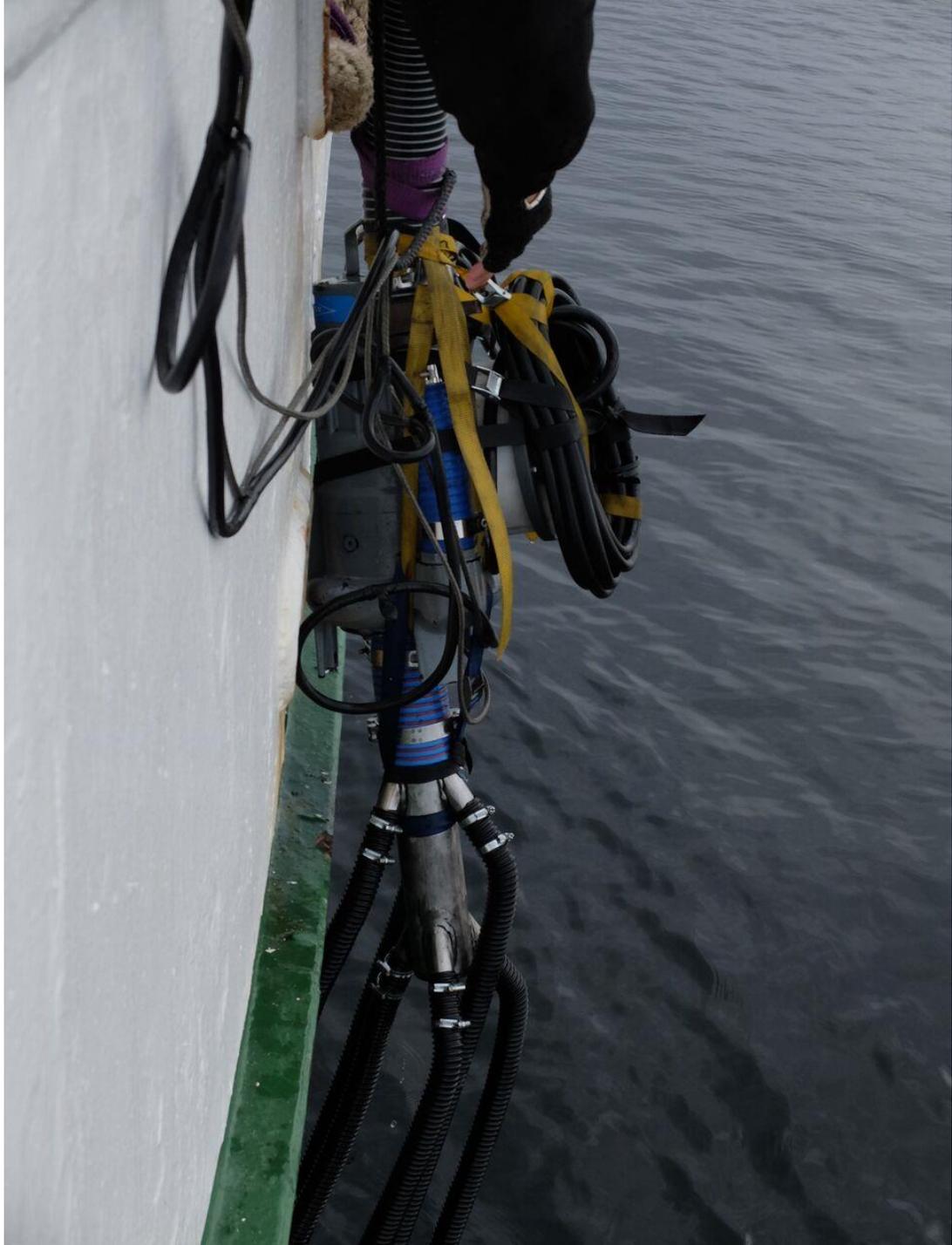




Environmental friendly and safe

- Anoxic seabeds
- Limited eco system
- No particle dispersion





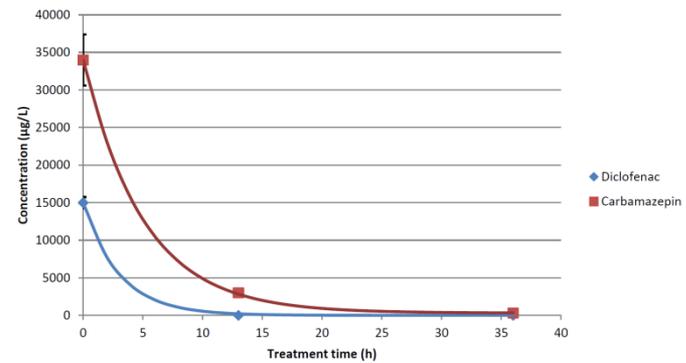
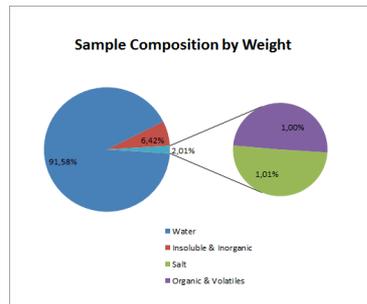




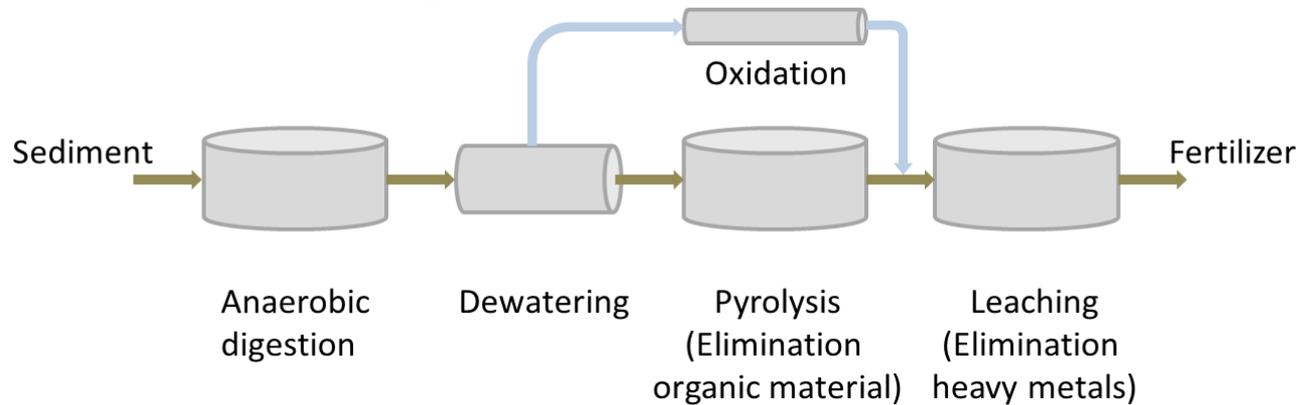
Decanter centrifuge



- > HTC > CHP > fertilizer
- > HTC > CHP > P-extraction > fertilizer
- > HTC > leaching > fertilizer
- > Cover material



Land based system integration





Upstream (land based)

Decrease import of phosphorus

Imported phosphorus:

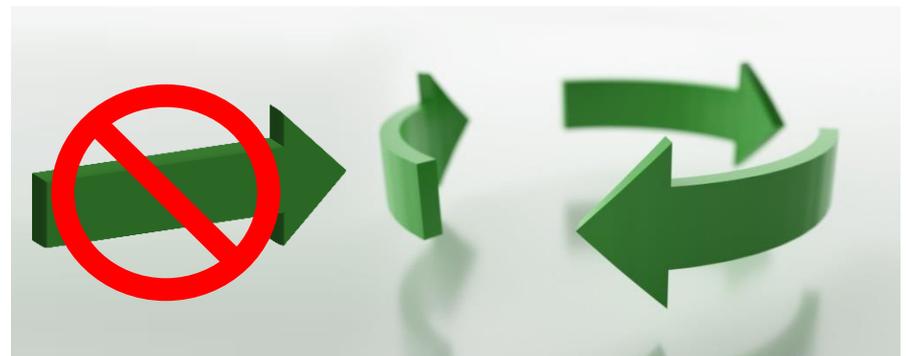
- **20%** into produced food
- **80%** losses (mainly widespread systems)

Downstream (sea based)

Decrease oxygen demanding sediment volumes

Retrieved phosphorus:

- 10000 tonnes retrieved
- 10000 tonnes reduced internal leakage



Solubility

	TSP	struvite	FePO ₄ sludge	digestate	pig manure
Total P (g kg⁻¹ FW)	430 ± 5	294 ± 3	0.50 ± 0.02	2.9 ± 0.0	3.3 ± 0.0
P soluble in H₂O	96%	1.7%	4.0%	79%	85%
P soluble in AC	95%	96%	100%	93%	91%
P soluble in MA	93%	98%	92%	100%	97%

Struvite

- slow release, mixed nutrient fertilizer
- high P-availability in the beginning of the growing season
- stock for later release

FePO₄-sludge

- not interesting as start fertilizer
- potential to increase the capacity of P-deficient soils

Digestate vs. animal manure

- higher yield and P-uptake
- slower P-release => less leaching
- higher release of difficult available soil phosphate

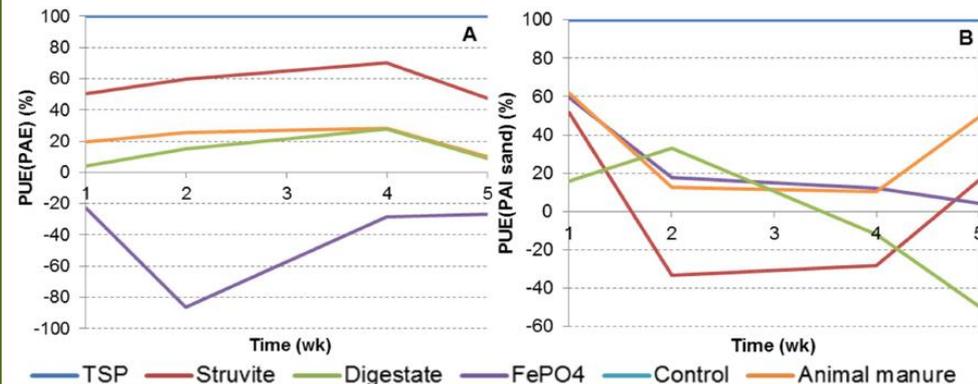


Phosphorus use efficiency

	PUE _{FW-yield} (%) Sand	PUE _{FW-yield} (%) Rheinsand	PUE _{DW-yield} (%) Sand	PUE _{DW-yield} (%) Rheinsand	PUE _{P-uptake} (%) Sand	PUE _{P-uptake} (%) Rheinsand
Struvite	-21 ^a	75	10 ^a	67	22	42
FePO ₄	-68^a	159	-16 ^a	233	16	3.3
Pig manure	-46 ^a	8.9	-8.5 ^a	-67 ^b	37	80
Digestate	-67^a	-45^b	-90^a	-100^b	80	63

	PUE _{PAE} Sand	PUE _{Pw} Sand	PUE _{PAI} Sand	PUE _{PAI} Rheinsand	PUE _{sol} Sand	PUE _{sol} Rheinsand
Struvite	57	374	1.6	-94 ^c	145	60
FePO ₄	-41 ^b	-46 ^b	23	-606 ^c	-131 ^b	3.2
Pig manure	21	24	34	-215 ^c	130	114
Digestate	14	212	-3.0	453^c	71	81

* TSP < blank, ^b substitute < blank, ^c not significantly different with the control and TSP

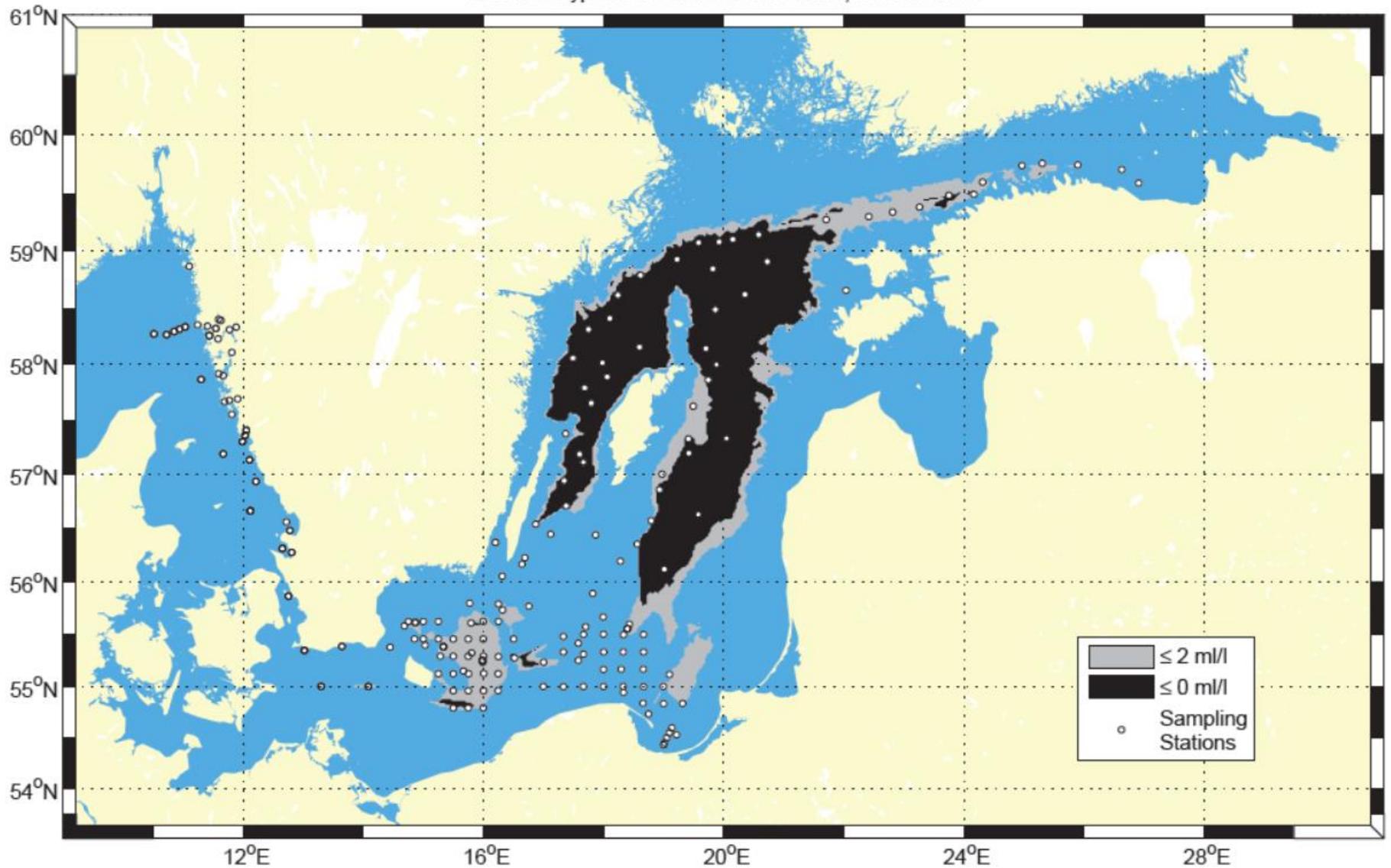


Planned main activities





Extent of hypoxic & anoxic bottom water, Autumn 2014



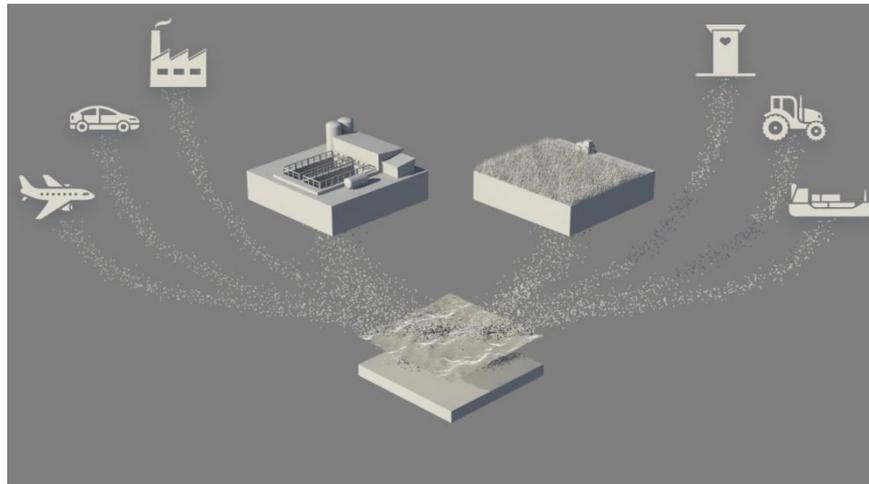
Created:
October 2014

Concrete results (nutrient reduction potential)



The reduction potential is closely linked to the area which can be prevented from becoming anoxic. Calculations indicate that **10 mobile dredging units** could achieve a reduction of somewhere between **60-600 tonnes of phosphorus per year**.

Financing plans 36 million households, 0,015 Euro/month



The preliminary calculations show that the 36 million households in the Baltic Sea catchment area, which are major contributors of nutrients through the sewage system, would only need to pay **0.015 Euro per household and month** to cover their part of the emissions. Polluting companies would be required to pay 0.30 Euro per kilogram of phosphorus they release.

Thank you

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