



**TETRAS Technology Transfer in RAS for Business** 

Danish Bioeconomy Conference | 6 November 2025

Freya Robinson – SUBMARINER Network
Per Dolmer – Blue Research

Data collection & LCA Consumer - CO2 Impact? - No escapes? - Animal Welfare? Water usage/ Efficiency? Agriculture Investors WATER SOCIETIES Bio-filter Organic waste processing Sludgel Organic waste Greenhouses

interreg-baltic.eu/project/tetras

## **Budget** 3 Million EUR

(80% Financing)

# **Duration** 36 months

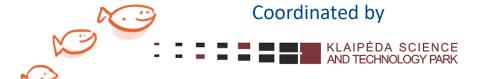
01.2023 - 12.2025

# **Consortium** 10 partners

LT • DE • DK • EE • PL

# **Solutions** 4 pilots LT • DK • EE





#### **Project Partners**





















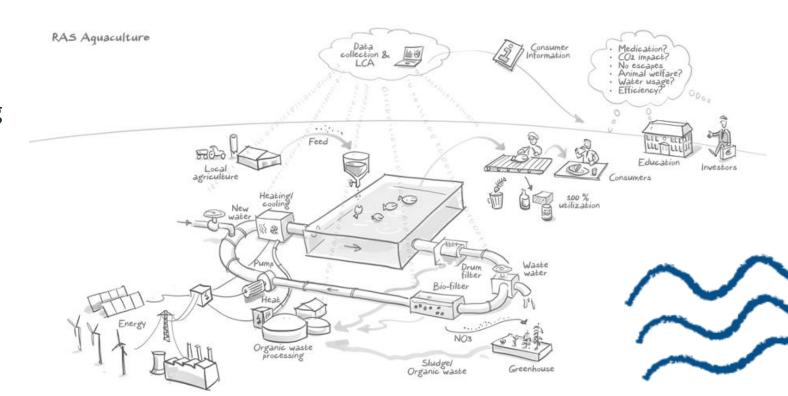


# **Overall Challenge**





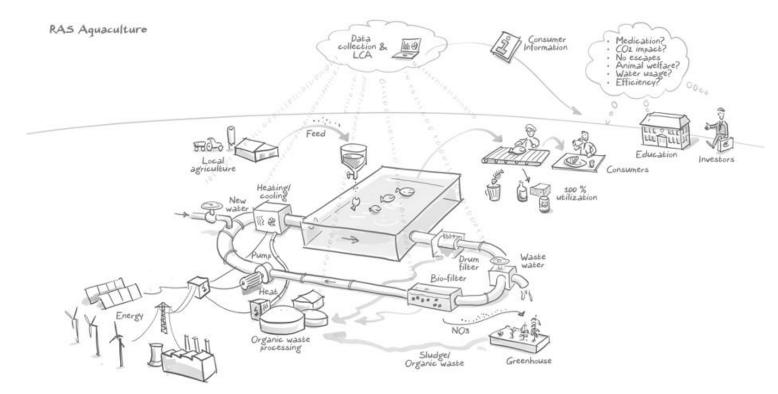
- RAS are a costly technology, with high investments for installation and operation. Setting new investments needs careful planning and good conditions to ensure their sustainability.
- Location, access and discharge of water, energy security, labor access, and consumer acceptance are key factors that determine the success criteria of a RAS farm.



# **Overall Challenge**



To support RAS, as a promising scalable sustainable food-producing sector, we need to understand how various settings and factors impact a RAS business model and its environmental footprint, and then showcase tools that can best be used to improve the sustainability of RAS industry in practice, also transfer knowledge to other regions/countries to promote new investments.







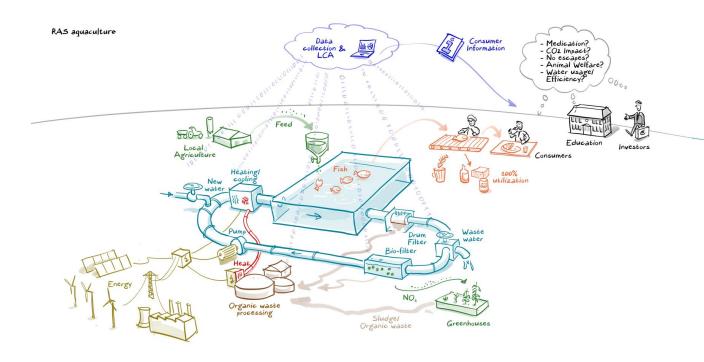




TETRAS aims to improve the economic and environmental sustainability of recirculating aquaculture systems (RAS) by demonstrating new concepts of industrial symbiosis where RAS systems are placed strategically or combined with industrial processes to increase resource efficiency (i.e. water, energy) while producing affordable and healthy food.

# One process's waste or residual is another process's resource.

Additionally, TETRAS will develop tools and standards to assess and monitor RAS and promote investment, implementation, and expansion of these food production systems.



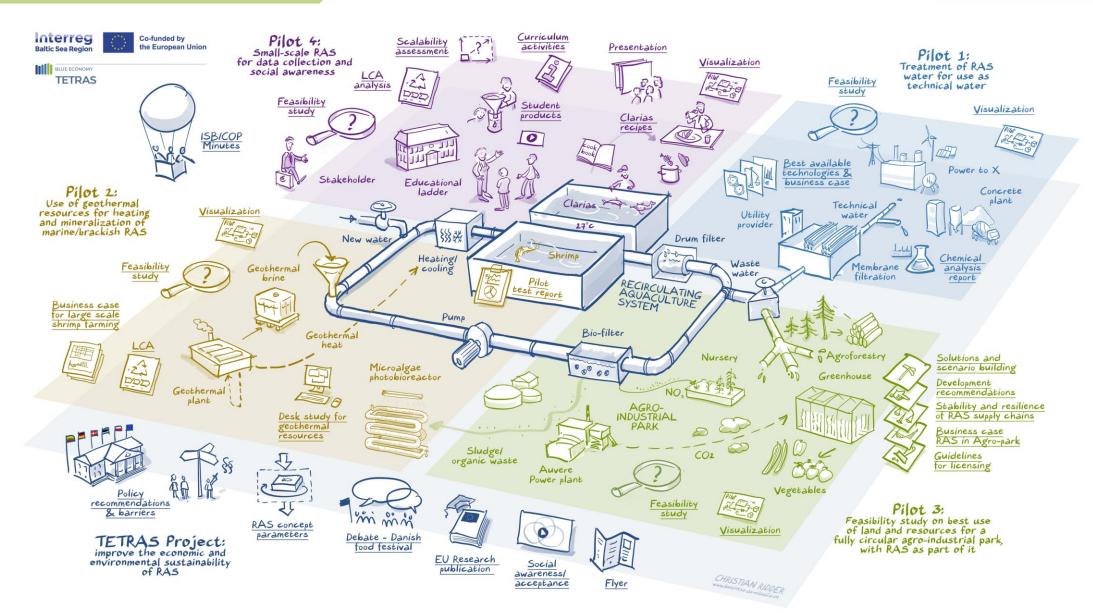




## **Portfolio of solutions**





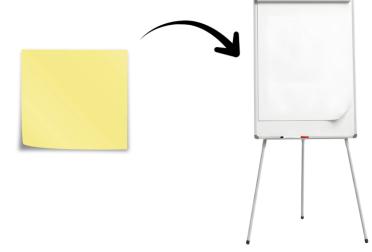








- Collect questions, thoughts, input on sticky notes
- Place on A3 paper







Think about what is needed going forward to support the RAS sector...







# **Contacts**





www.interreg-baltic.eu/project/tetras/



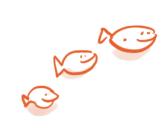
fr@submariner-network.eu

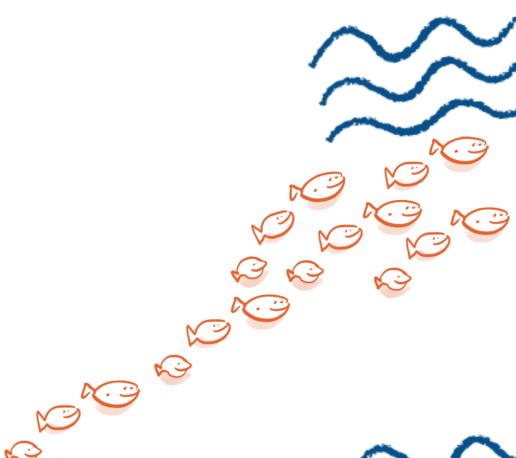


TETRAS BSR









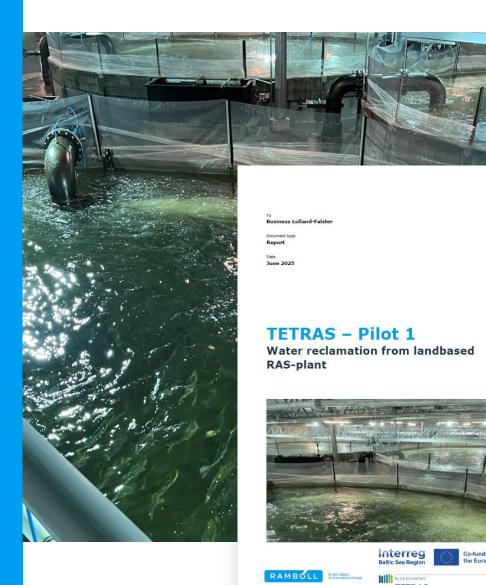


# TETRAS - PILOT 1

Water reclamation from landbased RAS-plant

06.11.2025
Final TETRAS Event
Danish Bio-Economy Conference

Sylvie Braekevelt Mie Højborg Thomsen Caroline Elisabeth Flyger



# **Introduction to Tetras Pilot 1**

#### **Pilot 1 Objectives**

- Demonstrate water reclamation from RAS (Recirculating Aquaculture Systems)
- Use membrane technology for purification
- Evaluate the reuse of RAS wastewater as technical water for other industries
- Examine economic feasibility of a full-scale RAS plant

#### **Key Technologies Tested**

- Ceramic Ultrafiltration (CUF)
- Reverse Osmosis (RO)
- Membrane Distillation (MD)

#### **Why This Matters (Business Drivers)**

- Stricter discharge regulations and water scarcity increase operational risk.
- Circular water solutions reduce freshwater intake, improve compliance, and strengthen ESG.
- RAS growth demands reliable non-potable technical water for industrial uses.





# The test set-up

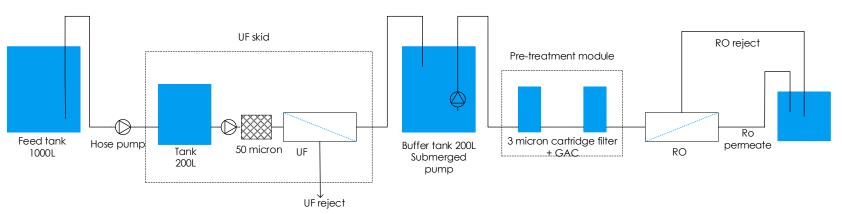
#### **Objective & Scope**

Produce technical water of near-drinking quality from RAS wastewater using membranes (CUF, RO, MD)

#### **Pilot Test Setup**

- •Step 1: Pretreatment Mechanical filtration & activated carbon
- Step 2: Ultrafiltration (UF) Ceramic membranes for suspended solids removal
- Step 3: Reverse Osmosis (RO) High-recovery desalination process
- •Step 4: Membrane Distillation (MD) [Additional Test] Evaluating alternative desalination







# **Test location: Skagen Salmon – RAS Facility**

#### **Overview of Skagen Salmon:**

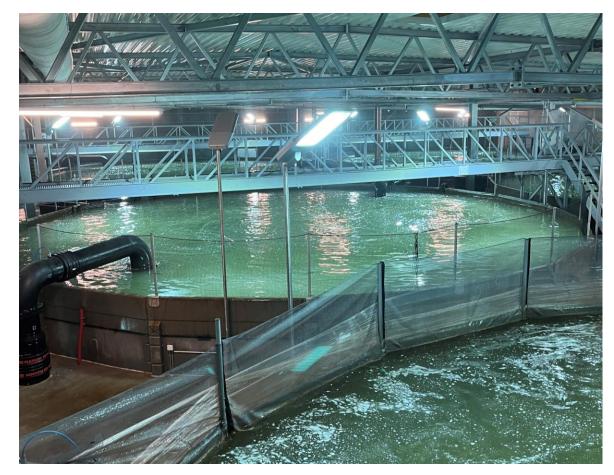
- Established in 2020, state of the art saltwater-based RAS facility
- Produces **3,800 tons of salmon per year** (~1 million fish)

#### **Water Management & Treatment:**

- Multi-step treatment process:
- Mechanical filtration (drum filter, 50 μm)
- o Biological filtration (MBBR) & fine polishing
- o **Deoxygenation & ozonation** for disinfection

#### **External wastewater treatment** before discharge to Skagerrak

- Discharges **150** m³ wastewater per hour
- 90% reduction in nitrogen & phosphorus discharge through treatment



# Results showing satisfying permeate water qualities

#### **Permeate Water Composition & Quality**

#### •RO Permeate (65% Recovery):

- Conductivity reduced from 1700 mS/m to 25 mS/m
- Chloride reduced from 14,000 mg/l to 55 mg/l (below drinking water limit)
- Ammonia < 1 mg/l, requiring further validation</li>

#### •Membrane Distillation (MD) Permeate:

- High purity water, low conductivity (0.26 mS/m)
- Chloride <1 mg/l, well within safe limits</li>

RAMBOLL

Ammonia (2.1 mg/l) exceeds drinking water standards



# High quality water offers plenty of opportunities for reuse

#### **Application Potential for Permeate Waters in Lolland-Falster**

#### 1.Industrial Use:

**1.Cooling Systems:** Prevents scaling & corrosion

**2.Cleaning & High-Pressure Cleaning:** Leaves no residues

**3.Concrete Production:** Ensures durability & strength

#### 2.Energy & PtX Technologies:

**Hydrogen Production:** Need further purification to meet ultrapure water (UPW) requirements

# The reuse water does not fully meet Danish drinking water standards

 Minor adjustments necessary to comply: ammonia stripping and pH adjustment



# **Reject Water: Risks and Reuse Pathways**

#### Limitations

- Not suitable for agriculture: can be used as fertilizer, rich in nutrients (nitrogen), but high salinity and chloride could harm soil health.
- Not suitable for biogas production: High salt levels and low biodegradable organic matter hinder anaerobic digestion.
- Cannot be discharge to sea: High chloride, nitrogen, and metals require additional treatment for compliance with environmental regulations
- Require treatment before discharge to local: High salinity, ammonia, and heavy metals disrupt treatment processes and require advanced technologies for regulatory compliance

#### **Potential Solutions:**

Dilution with fresh water to reduce salinity.
Use of salt-tolerant crops (halophytes) for specific regions.
Treatment technologies to remove heavy metals (e.g., filtration, adsorption).
Ammonia management strategies (e.g., volatilization).



# Perspectives to turn the pilot into commercial projects

• Conduct comprehensive technical and economic assessments for full-scale installation.

Include sensitivity to energy price, recovery rate,

and membrane life.

- Determine reject water strategy and manage risk
  - Map regulatory landscape for treatment & discharge in the Baltic Region
    Finalize realistic pathways for the reject water
    Quantify reject water treatment costs
- Water quality: validate ammonia removal to meet Danish drinking water limits



## What it takes to move on

- Continued coastal RAS **site access** for assessments and test validations.
- **Vendor engagement** for water treatment technology incl. ammonia stripping: partner with several to build integrated offers. Offer turnkey and quick-turn pilots to accelerate adoption.
- Joint workshops with regulators/utilities about reject water management: regulatory drivers to go hand in hand with engagements to improve regional water resilience in vulnerable regions with high potential (e.g. Lolland-Falster)
- Detailed design and **local business cases** including reject water



# Thank You!

06.11.2025
Final TETRAS Event
Danish Bio-Economy Conference

Sylvie Braekevelt - <a href="mailto:sybt@ramboll.dk">sybt@ramboll.dk</a>
Mie Højborg Thomsen
Caroline Elisabeth Flyger





# **Geothermal Water in RAS: Business Plan Perspectives (Shrimp)**

**Danish Bioeconomy Conference** 

6 November 2025

Matas Zubas – Akola Group

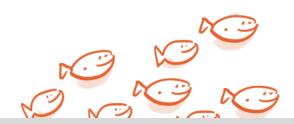
Nerijus Nika – Marine Research Institute of Klaipeda







# **Synopsis**





#### **Completed actions**

Analyzed geothermal heat & mineralization impacts; validated in Pilot-2; modeled 100/300/1000mt facilities.



#### **Results**

Potential economic impact; system stability maintained; ambiguities

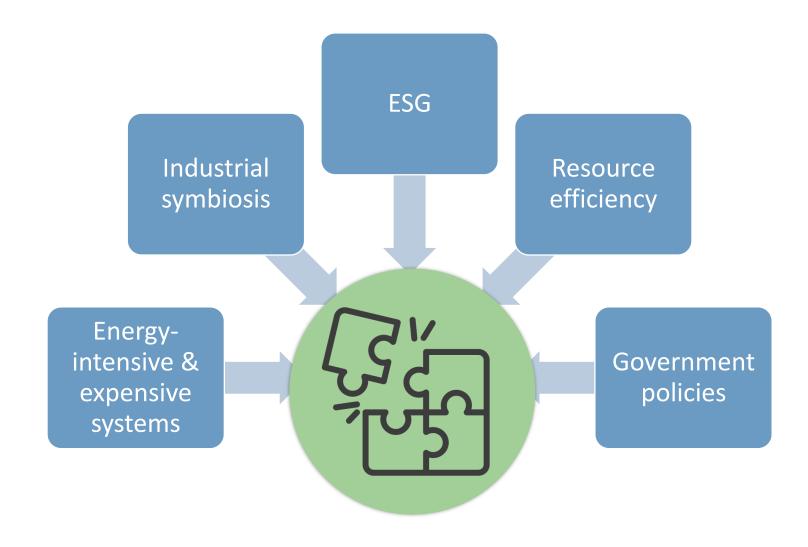


#### **Future prospects**

Geothermal availability; Integration potential; Estimates for go/ no-go gates.



# **Context: Why This Matters**



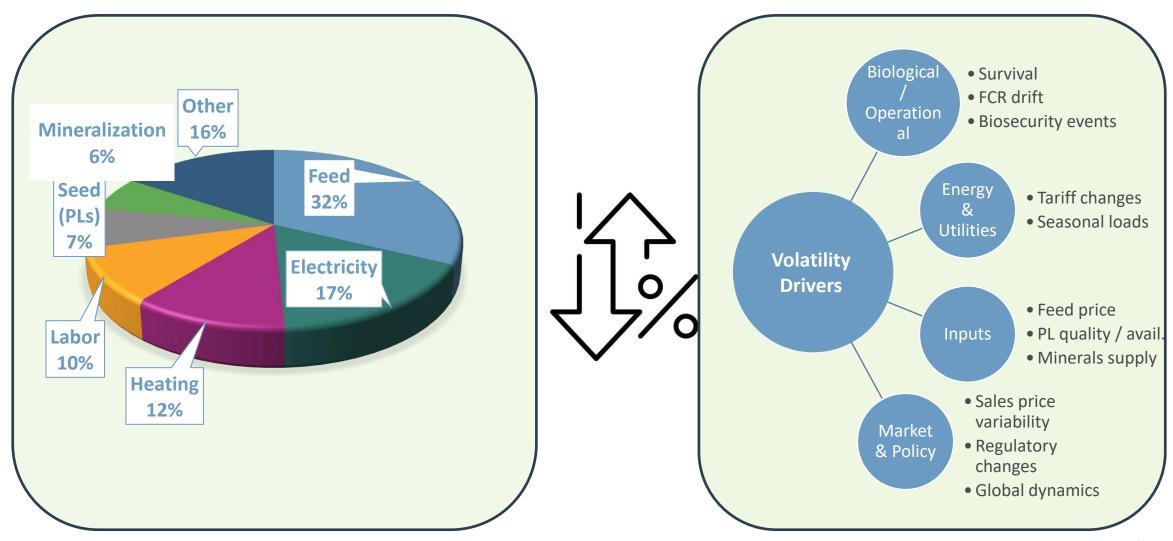
# **Shrimp RAS Basics - What Matters to Shrimp**

Stable physics = stable biology = stable economics.

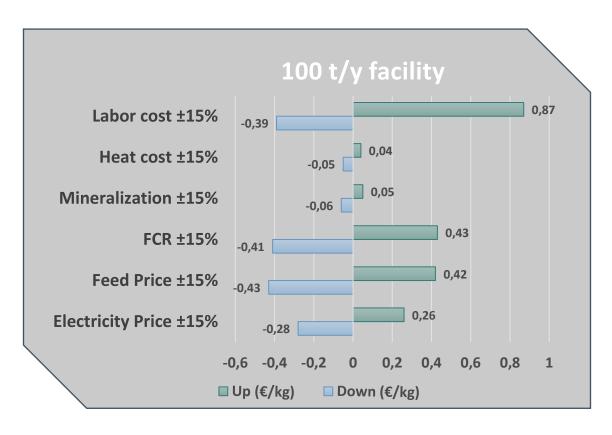
	Water Temperature (°C)	27-29
35	Salinity (ppt)	15-20
•	Dissolved O2 (mg/L)	5-7
	рН	7.5 – 8.5
<b>~</b>	Alkalinity (mg/L)	120-180
NH3	Ammonia (mg/L)	<5
	CO2 levels (mg/L)	50-100

	Growth Rate (g/week)	1.5 - 2.5
	FCR	1.5 – 1.7
: <b>%</b>	Survival Rate (%)	65 - 75

# **Shrimp RAS - Costs and Volatility Drivers**



# **Shrimp RAS - Cost Volatility Impact on COGS**







6 personnel total 17 (t / person)



18 personnel total 55 (t / person)

## **Geothermal Resources: Two Tracks**

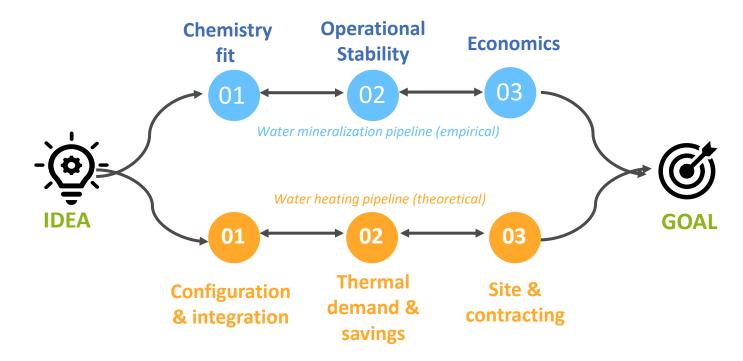


Blue track - Pilot 2 empirical data



Orange track – theoretical desk study

Utilize local geothermal resources to facilitate RAS shrimp economics



Scalable integration model that turns local geothermal resources into competitive advantage

# **Geothermal: How It Fits In**



# **Operational Targets**

- Salinity 15-20 ppt
- Alkalinity 120-180

## Potential Impact

 Net eur/m3 for new-water mineralization vs synthetic mix

KPIs to Watch

- Stability (ph/alk/N)
- Survivability
- eFCR

#### **Constraints**

- Site-specific chemistry
- Pretreatment SOP (if needed)

# Operational Targets

- Maintain 27-29 C
- Culture water + Building

# Potential Impact

- Effective eur/kWh
- Heat pumps, HEX losses, O&M, amortized tie-in CAPEX

- KPIs to watch
- Thermal kWh/kg
- Resource Stability

#### **Constraints**

- Source availability
- Source parameters
- Priority alignment (cascading)

# Pilot-2 Snapshot & Learnings



#### Goals

Evaluate biological, economical, technical aspects of geothermal brine use in RAS



#### **Hypothesis**

Positive economic impact by shared resource utilization; water parameter stability



#### Results

Stable growth metrics; suitable water quality; positive economic impact



#### Limitations

Control variables; small scale pilot; uncertain replication at scale



#### **Experimental Data**

Metrics / KPIs	Control (w. LCSM*)	Geothermal Brine 1	Geothermal Brine 2	
FCR	1.71	1.52	1.5	
Survivability (%)	33	63	42	
Growth Rate (g/day)	0.22	0.2	0.29	
Dissolved O2 (%)	70	70	93	
Salinity Average (PPT)	22	20.5	23	



#### Modular RAS Farm Model (Baseline) Grow-out Tanks Nurserv Tank Capacity / output (MT/y) 100 (3 modules) **Total System Volume (m3)** 2,85 1,57 3 2,52 2,1 2100 2,5 2,33 **Daily Water Intake (%)** (£/kg) 1,5 0,36 1.5 - 3 0,38 0,11 0,31 0,31 Water Pure O2 Other **Stocking Density (kg/m3)** Salt Heating Electricity Feed 0,5 **15** 0

PLs

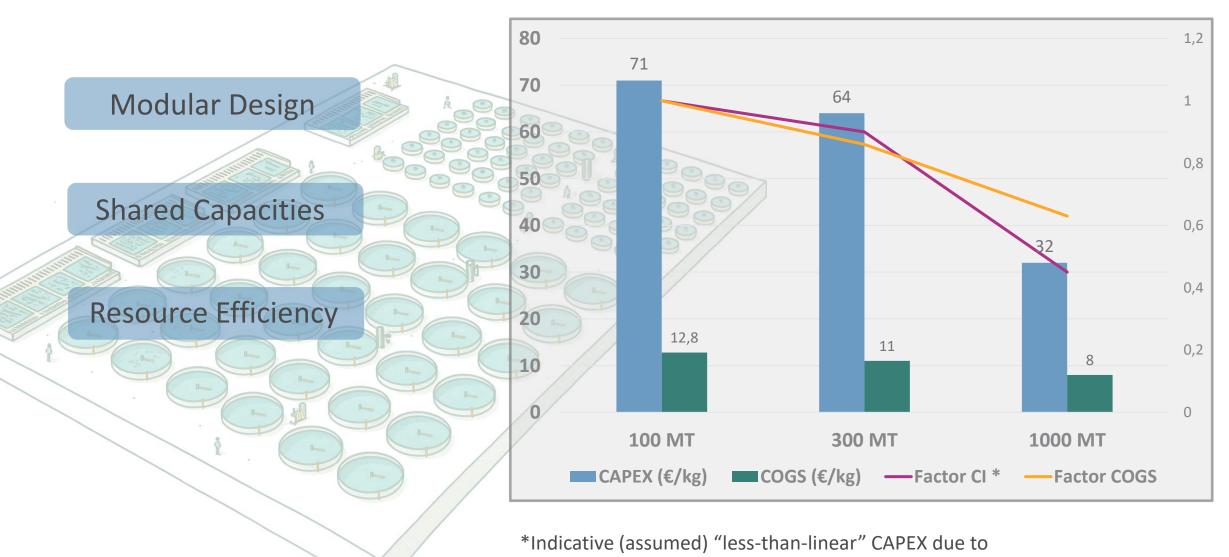
**COGS** 

**Recirculation rate (%)** 

95-98

Design and performance targets are based on commercially proven pilot RAS practices and Akola's engineering synthesis.

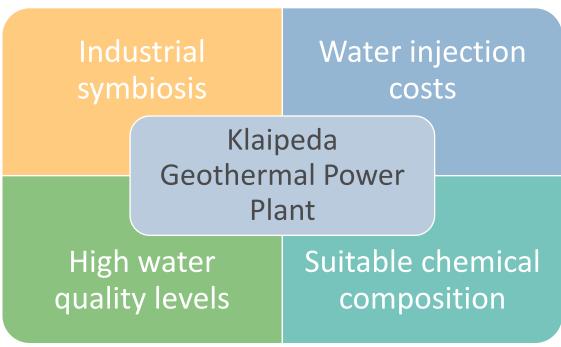
# **Favorable Scale Economies**

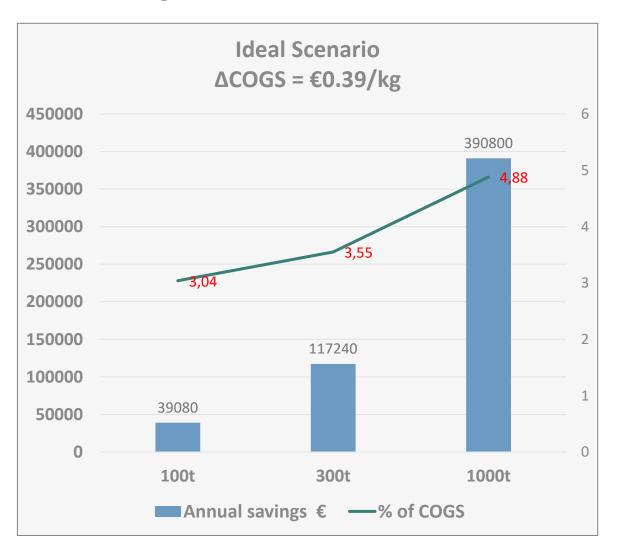


shared infrastructure, more efficient system design etc.

# **Economic Lever A - Mineralization Impact**

Source justification





# **Economic Lever B—Heat Impact (theoretical)**

## **Prerequisites**









Scenario	Tin>Tout (°C)	ΔΤ	Flow (L/s)	Availabili ty	Usable heat (MWh/y)	Pumping (MWh/y)
S1 Warm Well	55>35	20	0.5	0.95	282.4	1.89
S2 Plant effluent	45>30	15	0.8	0.95	338.9	3.02
S4 Low temp, high flow	35>28	7	2.0	0.95	395.4	7.55
S5 High temp, low flow	65>40	25	0.3	0.95	211.8	1.13
S6 Seasonal	45>30	15	1.0	0.70	313.2	2.78
S7 Ideah high- capacity	75>35	40	2.5	0.98	2.913	9.74

<sup>| 31</sup> 

# **Risks & Guardrails**

#### Mineralization

- Chemistry drift
- Trace contaminants
- QA SOPs



#### **Economics**

- Cost mitigation
- Payback rate





### Regulatory

- Brine handling
- Resource coupling

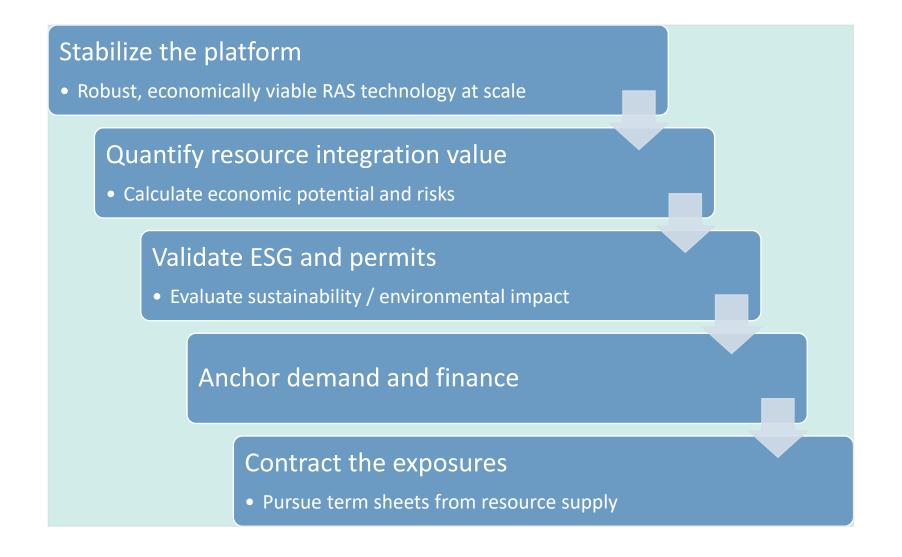


# Heating

- Availability & stability
- Seasonal load matching
- Redundancy systems
- CAPEX



## Recommendations









# **Contacts**



www.interreg-baltic.eu/project/tetras/



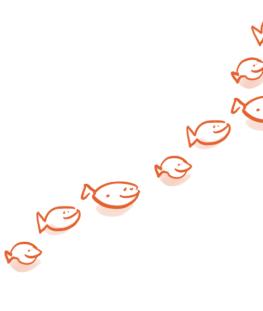
m.zubas@akolagroup.lt

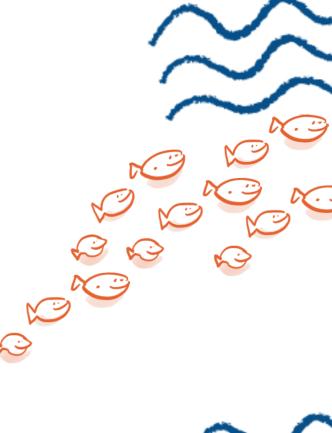


TETRAS BSR











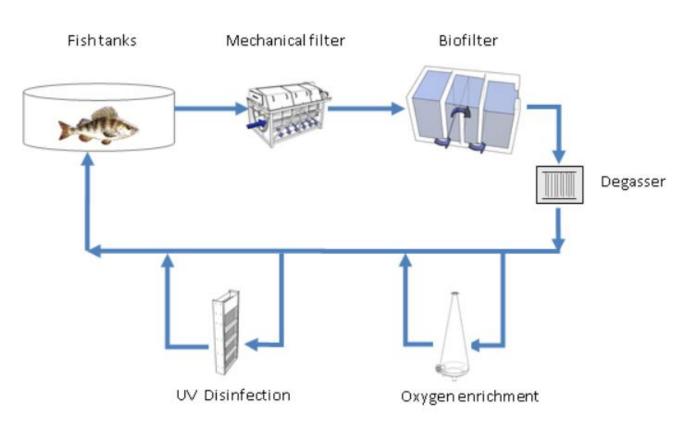
# RAS as an educational tool

Lisette Larsen, Teacher in Biology, Bioteknology and PLS, CELF



# RAS

Recirculation Aquaculture Systems
Fishfarming





## Clarias gariepinus

- no scales but bone plates instead
- They have sensitive whiskers
- Analyses of the fish meat
  - Fatty acids and protein
  - Fish and health



## Merkurs Plads

Technical High School

**Business High School** 

**EUX Business** 

**EUX Technic** 

**EUD** 

10.th grade



## Biology C

- Investigation of Clarias anatomi and Life cyklus
- Growth experiments with Fish Water



Af ShanKamley - Eget arbejde, CC BY-SA 4.0, <a href="https://commons.wikimedia.org/w/index.php?curid=97856065">https://commons.wikimedia.org/w/index.php?curid=97856065</a>, gills from Clarias



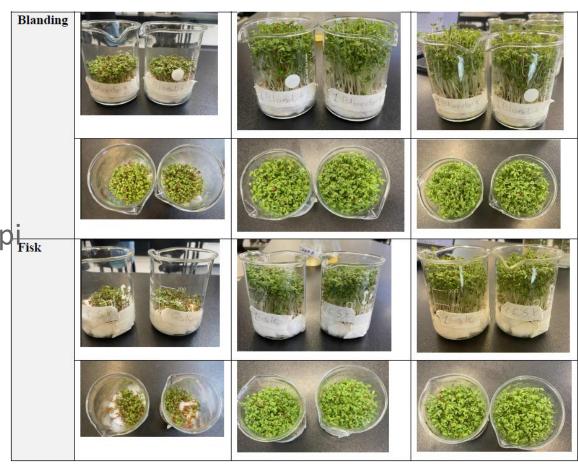
## Biotechnology A

Water quality

- Phosphat and nitrat
- ©pH, temperature
- evisuel Measurements and mikroskop

The environmental impact

- Produktion of food in general
- Sustainability





## PLS (Proces, food and Health)

Visit in Sweden October 2024



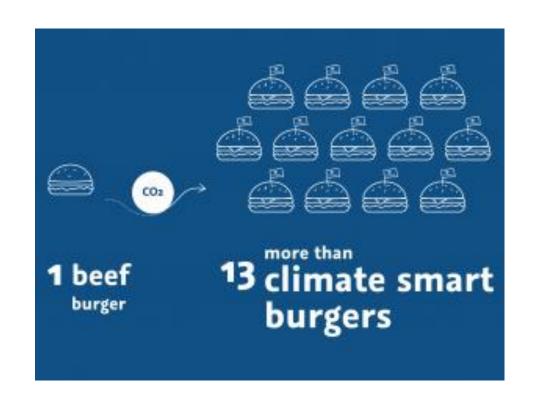


Gårdsfisk fish farming in sweden

## PLS (Proces, food and Health)

From Clairas "Caviar" to the diner table.

- The Farming proces.
- © Economic and sustainability
- Analyses of the fish meat
- Fatty acids and protein
- © Gelatin and leather
- Fish and health



https://denblaaplanet.dk/from-ocean-to-plate/

### Communication and IT

Investigating target groups and how to market Clarias.

Develop PR materials

Working with logo, competition.





## Kringelborg

Vocational education and training

- Retail, trade and office
- Food and service
- Construction and plant
- Mechanics, engines, transport and storage
- Engineering and energy



### **Nutrition assistants and Chefs**

This is not a Salmon, the meat is different Training of new fillet technics

Table 1. Chemical composition of catfish meat (wet weight bases)

Parameters	Catfish
Moisture %	71.30 ± 0.15
Protein %	19.03 ± 0.46
Fat %	$8.10 \pm 0.09$
Ash%	$1.05 \pm 0.14$
Carbohydrate %	0.52±0.12
Caloric value (kcal/100 g)	151.1±0.08

Nutritional Value of African Catfish (Clariasgariepinus) MeatH. E. Abdel- Mobdy1\*, H. A. Abdel-Aal2, S. L. Souzan2 and A. G. Nassar1



## **Nutrition assistants and Chefs**

Experimenting with the Meat and creation of new

dishes.





## Educational ladder



Knowledge growth
Experience Sharing



From delicacy to everyday food



From mammal farming to fish farming

## Thank you for your time

Questions?

### **Reflection Time and Discussion**





- Place Questions and thoughts on A3 paper
- Think about what is needed going forward to support the RAS sector...



























## Environmental performance of semicommercial RAS in Lithuania and Denmark

Nykøbing Falster | Novembre 6th 2025 Michele Zoli – University of Milan

interreg-baltic.eu/project/tetras



## Aim of this study

### **Environmental impact assessment**

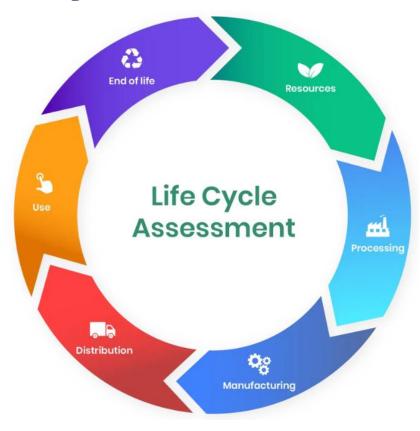
- Quantify the environmental impact of the RAS facility for shrimp production in Lithuania (University of Klaipeda);
- Quantify the environmental impact of the RAS facility for Clarias gariepinus production in Denmark;
- Identify the main hotspots of these two systems;
- Suggest mitigation strategies and provide guidance for future developments







## Life Cycle Assessment approach



LCA consists in the evaluation of mass (production factors, emissions of pollutants into the environment and waste production) and energy flows characterizing the analysed process.

### **LCA**

Life Cycle Assessment is the most used methodology to evaluate environmental performances of products (processes or services). It is standardized approach (ISO 14040/14044) and it considers the entire life cycle of products, from the extraction of raw materials to the management of waste.



### **LCA OUTPUTS:**



Quantification of different impact categories: carbon footprint, water footprint, etc.

## Goal and scope definition

Functional unit: Mass-based FU:

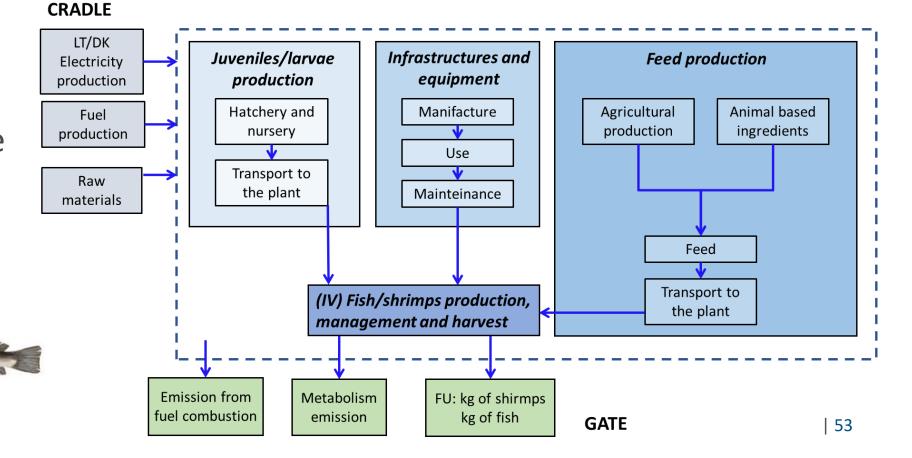


1 kg of live shrimps

1 kg of live *Clarias* 

## **System** boundaries:

From cradle to gate



## **Analysed system**

## **Shrimps rearing**

- Experimetal facilities in Klaipeda;
- Use of geothermal water;
- Electricity from Lithuanian network;
- Liquid oxygen supply
- From post larvae to commercial size
- 8 different feeds
- > 7 tanks





## **Clarias** rearing

- Municipality of Guldborgsund;
- Demostative plant
- Electricity from Denmark network;
- ➤ No liquid oxygen air blower
- From 100g to about 1.5kg;
- One feed
- 2 tanks





## **Life Cycle Inventory**

### **Primary data**

Primary data directly collected and related to the case studies analyzed. Measured data, experimental data. They refer to:

- Final production
- > FCR
- Mortality

- Feed provided
- Energy consumption > System set-up
- Liquid oxygen

- Consumption of other prod. factors

Secondary data

Secondary data collected from LCA database, scientific literature,

model estimation:

- Feed ingredient inclusions
- Background material > Metabolism
- Energy modelling
- Juveniles modelling

emission (mass balance model)





## Life Cycle Inventory Shrimps rearing



Parameters	unit	1st cycle	2nd cycle
Cycle duration	days	80	92
Juveniles	kg	0.6	0.24
Juveniles transport	km	1,474	1,474
Freshwater	m³	68	60
Geothermal water	m³	30	8
Liquid oxygen	kg	45.38	19.95
Electricity	kWh	578.39	252.23
Mortality	%	53	58
FCR	/	1.53	1.54
Emissions			
Ammonia	kg	2.49	1.19
N ureic	kg	1.34	0.64
N solid	kg	2.20	0.83
Phosphate	kg	1.90	1.02
P solid	kg	1.29	0.57
Biomass output			
Shrimps	kg	119.01	51.9

### **Clarias** rearing

Parameters	Unit	Value
Cycle duration	days	201
Juveniles	kg	60
Juveniles single weight	kg	0.1
Total plant volume	$m^3$	9.5
Water daily recirculation	$m^3$	9.025
Daily added freshwater	$m^3$	0.475
Oxygen concentration	mg/l	2.5
Disinfectants (H2O2 footbath)	1	1
Disinfectant - H2O2 hand pump	1	5
Bicarbonate of Soda	kg	107
Sea salt	kg	18
Electricity	kWh	10,275.9
Mortality	%	10
FCR	/	1.05
Emissions		
Ammonia	kg	0.39
N ammonium	kg	17.95
Nitrate	kg	10.89
N solid	kg	8.15
Phosphate	kg	1.62
P solid	kg	3.67
Biomass output		
Fish live weight	kg	842.5
Wastewater	$m^3$	104.9

In addition all the info related to feed composition and infrastructures

## Life Cycle Impact assessment





### EF3.1 Method

- Acidification (AC);
- Climate change(CC);
- Freshwater ecotoxicity (ECOTOX);
- Particulate matter formation (PM);
- > Eutrophication freshwater, Terrestrial and Marine (FE, TE, ME);
- Human toxicity carcinogenic effect (HT\_c);
- Human toxicity non carcinogenic effect (HT\_nc);
- > Ozone layer depletion (OD);
- Photochemical ozone formation (POF);
- > Fossil resources use (FRD);
- Mineral and metal resources use (MRD);
- Cumulative energy demand (CED);
- ➤ Net Primary Production Use (NNPU).

## Results - 1 kg of shrimps

	Unit	1st	2nd
AC	mol H+ eq	0.06	0.08
CC	kg CO2 eq	8.91	10.82
FEx	CTUe	176.85	204.93
PM	disease inc.*10-5	0.07	0.09
ME	kg N eq	0.03	0.04
FE	kg P eq	0.02	0.02
TE	mol N eq	0.14	0.16
HT-c	CTUh*10-6	0.01	0.01
HT-nc	CTUh*10-6	0.39	0.26
OD	mg CFC11 eq	0.69	0.75
POF	kg NMVOC eq	0.04	0.04
RU-f	MJ	125.51	159.67
RU-mm	g Sb eq	0.11	0.23
WU	m3 depriv.	32.58	32.04
CED	MJ eq	165.19	203.23
NPPU	kg C	3,11	3.82



compared to literature:

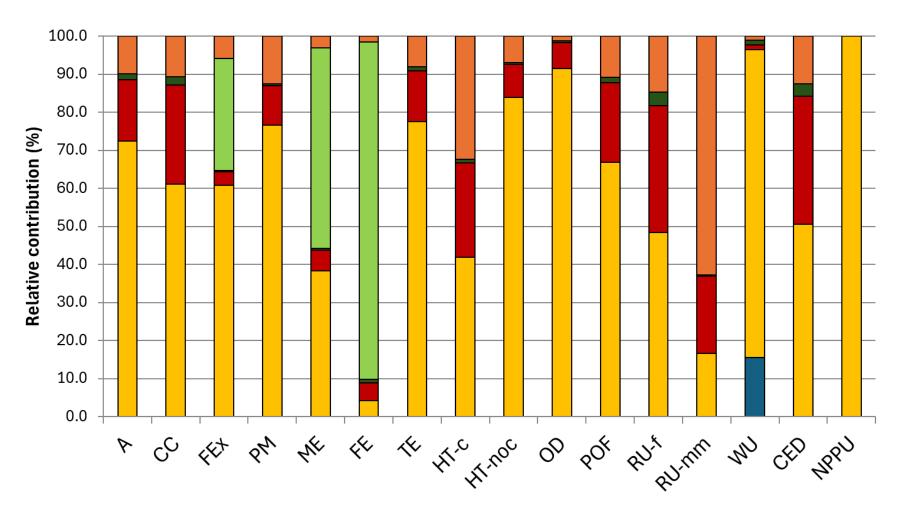


First cycle better than second one Carbon footprint slightly high

- Cao et al., 2011: 2.7-5.3 kg CO<sub>2</sub> eq;
- ➤ Al Eissa et al., 2022: 4 kg CO<sub>2</sub> eq;
- Sun et al., 2023: 4.41-4.97 kg CO<sub>2</sub> eq.

A: Acidification; CC: Climate change; FEx: Freshwater ecotoxicity; PM: Particulate matter formation; ME: Marine eutrophication; FE: Freshwater eutrophication; TE: Terrestrial eutrophication; HT-c: Human toxicity, cancer effects; HT-nc: Human toxicity, non-cancer effects; OD: Ozone depletion; POF: Photochemical ozone formation; RU-f: Resource use, fossils; RU-mm: Resource use, minerals and metals; CED: Cumulative energy demand; NPPU: Net Primary Production Use.

## **Contribution analysis**



Feed is the main hotspot in most categories: 72% A, 62% CC, 76%PM, 50% CED

Electricity impacts for 26% del CC, 33% RU-f, 33.6% CED

Infrastructures are main responsibles for RU-mm (63%) and HT-c (33%)

N and P emissions impact on FEx (30%), ME (53%) and FE (87%).

## Results – 1 kg of *Clarias*

	Unit	1st
AC	mol H+ eq	0.03
CC	kg CO2 eq	4.50
FEx	CTUe	131.85
PM	disease inc.*10-5	0.27
ME	kg N eq	0.03
FE	kg P eq	0.01
TE	mol N eq	0.09
НТ-с	CTUh*10-6	0.35
HT-nc	CTUh*10-6	0.12
OD	mg CFC11 eq	0.31
POF	kg NMVOC eq	0.31
RU-f	MJ	0.02
RU-mm	g Sb eq	65.54
WU	m3 depriv.	9.21
CED	MJ eq	3.36
NPPU	kg C	1.01

### Results are in line with previous studies

### Carbon footprint from literature:

- > Cao et al., 2011: 2.7-5.3 kg CO<sub>2</sub> eq;
- ➤ Al Eissa et al., 2022: 4 kg CO₂ eq;
- > Sun et al., 2023: 4.41-4.97 kg CO<sub>2</sub> eq.

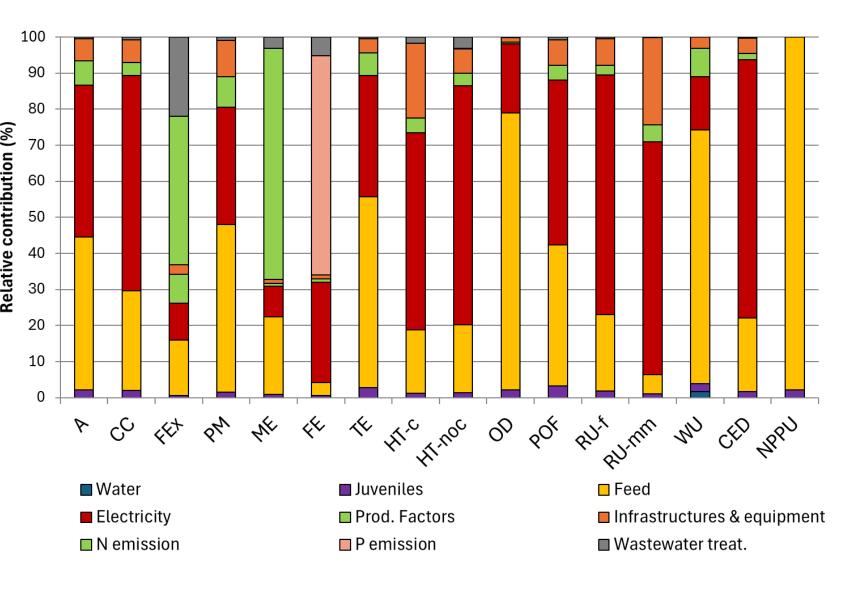






A: Acidification; CC: Climate change; FEx: Freshwater ecotoxicity; PM: Particulate matter formation; ME: Marine eutrophication; FE: Freshwater eutrophication; TE: Terrestrial eutrophication; HT-c: Human toxicity, cancer effects; HT-nc: Human toxicity, non-cancer effects; OD: Ozone depletion; POF: Photochemical ozone formation; RU-f: Resource use, fossils; RU-mm: Resource use, minerals and metals; CED: Cumulative energy demand.

## **Contribution analysis**



Electricity is the main hotspot in most categories: 43% A, 60% CC, 66% RU-f OD, 66% RU-mm, 72% CED.

Feed represents the total of NPPU (98%), the 77% (OD) and «only» 28% of CC.

Infrastructures mainly affect PM (10%), HT-c (20%), RU-mm (24%).

N and P emissions impacts on FEx (42%), ME (64%) and FE (61%).

### **Discussion & conclusions**

### **Shrimps rearing**

- > There is definitely a production scale effect;
- In any case, the percentage results of the contribution analysis are consistent with the literature;
- > Room of improvements > electricity, oxygen, feed.

### **Clarias rearing**

- Overall good environmental performance;
- The analysis can be extended to the fillet and all co-products (although data on their economic value would be required);
- $\rightarrow$  Room of improvements  $\rightarrow$  electricity, system expansion.







BLUE ECONOMY

**TETRAS** 















### THANK YOU FOR YOUR ATTENTION

Michele Zoli michele.zoli@unimi.it











## GARDSFISK

MEVER









### The Gårdsfisk way



### Fish fry

The fish is hatched on our farm in Skåne and later on moved to the farmer where they live in pools inside the barn.



### At the farm

The farmer now has a new animal that provides nourishment to the fields outside.



### **Closed-loop**

The fish pool water is used for watering the crops. Fish excrement is the perfect manure - making it an almost closed-loop system.





### Fresh

We have chosen freshwater species to be able to use the waste water on the fields. And all fish excrement turns into manure.



### **Robust**

Our fishes thrive in shoal and can live together without getting sick. They have never required medication.

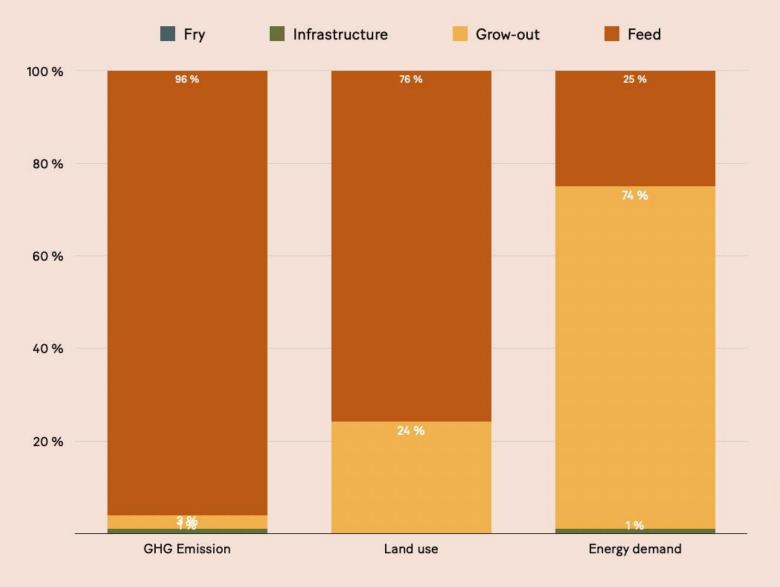


### **Omnivore**

They can to a large extent be fed with vegetables and don't need to eat as much fish as other fish species.

#### GÅRDSFISK LCA - 2017





#### **Possible Improvements**

#### **FEED**

A vegetarian feed would lower the cO2e with ≈28%.

Also, removing soy would decrease it further.

#### BY PRODUCTS

The result is only calculated on fillets (50%). When we can use by-products (now converted to bio-gas), the overall CO2e, land use and Energy demand will decrease with 50%.

#### ENERGY (done)

Used in the calculation is the Swedish energy mix. Swapping to renewable energy would decrease everything further.



## Thank You!

### **ANDREAS GRANATH**

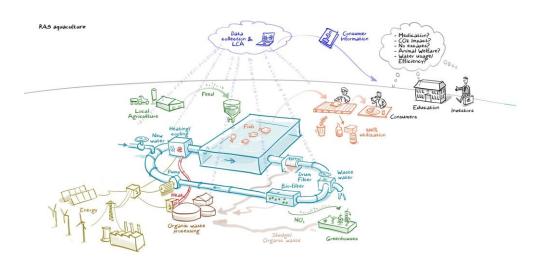
andreas@gardsfisk.se



# Big Data Transformation in Aquaculture

### How Big Data Drives Technological Innovation

Dr Monika Klein & Dr Laima Gerlitz WISMAR



CHRISTIAN RIDDER









**Big data** refers to large and complex sets of data that are difficult to collect, store, process, and analyze using traditional data management tools or methods.

It's not just about size — big data is defined by several key characteristics often summarized as the "5 Vs":

**Volume** – The sheer amount of data being generated (e.g., terabytes or petabytes from social media, sensors, transactions, etc.).

**Velocity** – The speed at which data is created and needs to be processed (e.g., real-time streams from IoT devices).

**Variety** – The different types of data: structured (databases), semi-structured (JSON, XML), and unstructured (text, video, images).

**Veracity** – The reliability and accuracy of data; big data often includes "noisy" or uncertain information.

**Value** – The potential of the data to generate insights or business benefits once analyzed.



## Introduction to Big Data in Aquaculture



Big Data in aquaculture refers to collecting, analyzing, and applying large volumes of data from sensors, IoT devices, feeding systems, and environmental monitoring.





Enables better management, sustainability, and decisionmaking in fish farming operations.

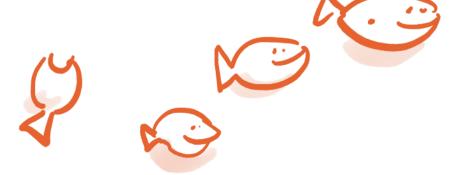




- Smart Farming (Precision Aquaculture)
- Using **IoT devices** and **AI analytics**, farmers can monitor realtime conditions in ponds or cages.
- Data-driven automation adjusts **feeding rates**, oxygenation, and water flow automatically.
- This reduces waste and improves growth rates.

### • Example:

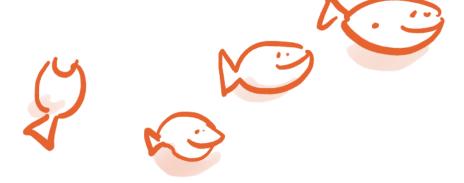
If oxygen levels drop, a smart system activates aerators before fish are stressed – minimizing mortality.





- Predictive Analytics for Fish Health
- Big data models can **predict disease outbreaks** by analyzing environmental changes, feeding behavior, and historical trends.
- Early warnings enable preventive actions, reducing the need for antibiotics and saving stock.
- Example: Example:

Al systems in salmon farms detect early signs of sea lice infestations using image data from underwater cameras.



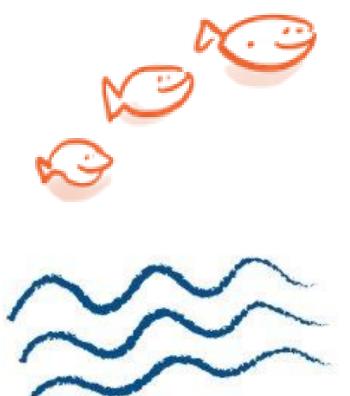


- Sustainable Resource Management
- Data helps optimize water and feed use, improving resource efficiency.
- Analyzing patterns across farms reveals best practices for sustainability
- and reduces environmental impact.
- Example:

Comparing data across regions can show which farms use less feed per kilogram of fish,

• promoting eco-friendly operations.

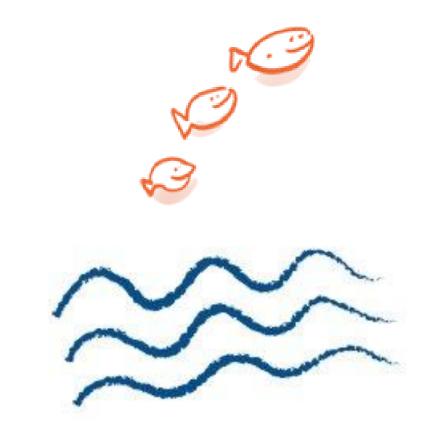




- Supply Chain and Market Intelligence
- Big data integrates production with **supply chain and market data**, improving logistics and pricing.
- Predictive analytics forecast **demand trends**, helping producers time harvests for higher profits.
- Example:

Retail and consumption data can guide when to harvest shrimp or tilapia to match

• peak demand in export markets.







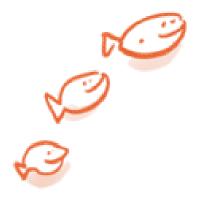


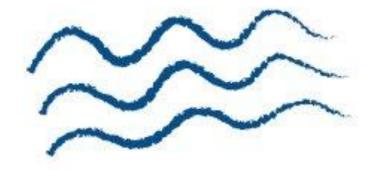
## Technological Transformation Through Big Data

- 1. Smart Farming (Precision Aquaculture): Real-time monitoring and automated feeding.
- 2. Predictive Analytics: Early detection of diseases and stress conditions.
- 3. Sustainable Resource Management: Optimizing feed and water use for eco-friendly operations.
- 4. Supply Chain Integration: Data-driven logistics and market alignment.









## Big Data and Business Innovation

#### **New Business Models**

Data-as-a-Service: Companies can sell or share data insights (e.g., environmental monitoring platforms).

Subscription-based analytics platforms for small-scale fish farmers.

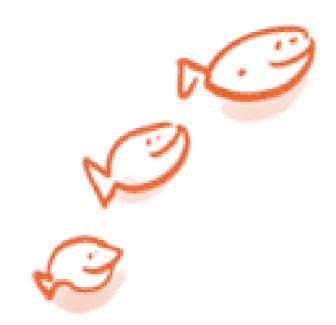
**Enhanced Product Traceability** 

Blockchain + big data ensure full traceability from hatchery to plate.

Builds consumer trust and meets global sustainability standards.

#### **Personalized Nutrition and Breeding**

Using genetic and feed intake data, companies can create custom feed formulas and optimized breeding programs, improving productivity and quality.







## Benefits of Big Data in Aquaculture



Improved productivity and reduced losses.



Enhanced sustainability and reduced environmental impact.



Better disease management and animal welfare.



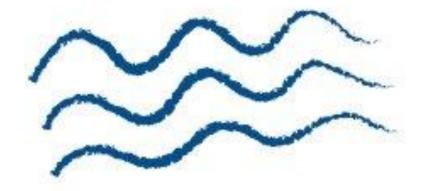
Increased profitability and competitive advantage.



**TETRAS** 

## Conclusion

Big Data transforms aquaculture from traditional farming into a smart, connected industry. It fosters technological innovation, sustainable growth, and data-driven business models, ensuring long-term profitability and environmental stewardship.











### **Contacts**





www.interreg-baltic.eu/project/tetras/



monika.klein@hs-wismar.de

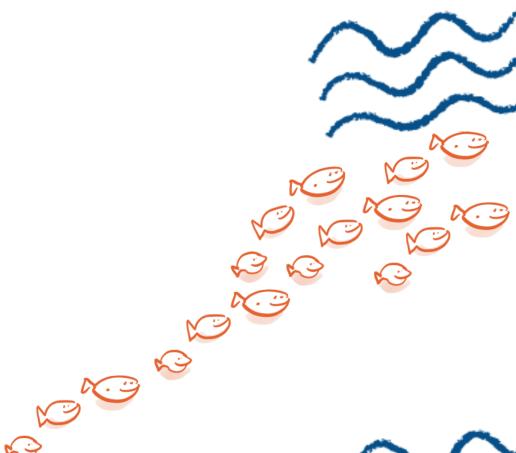


TETRAS BSR













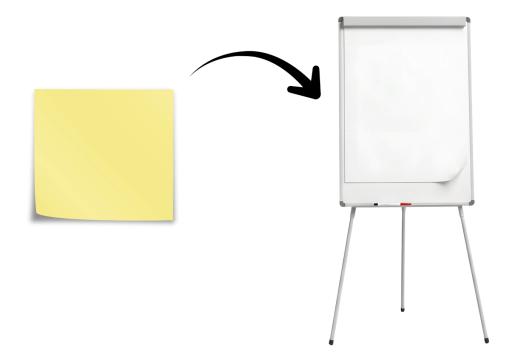
## **Q&A** and Discussion





- Place Questions and thoughts on A3 paper
- Conclusions
- Barriers







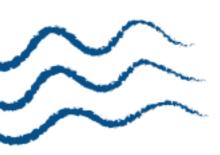
## **Capacity Survey**







Please complete our survey











### **Contacts**





www.interreg-baltic.eu/project/tetras/



fr@submariner-network.eu



**TETRAS BSR** 

