



Life cycle assessment of multi circular value chains Project HUB-360



Partners: SINTEF Ocean, CSIC, AWI, NOFIMA, CIIMAR, Project HUB-360, Bielefeld University, Biokraft AS, Skretting



Performance and Sustainability by Design

Project HUB360 role in **Sidestream** project was Work Package n.4 leader for environmental and economic sustainability assessment studies









Outline

- 1. System Boundaries
- 2. Functional Unit & Technical unit
- 3. Products & Production Complexity: addressing hot spots
- 4. Scope Differences and decision making







SIDESTREAM

Secondary bio-production of low trophic organisms utilizing side streams from the Blue and Green sectors to produce novel feed ingredients for **European aquaculture**







Life Cycle Assessment and Waste Management

...LCA is an essential tool for consideration of both the direct and indirect impacts of waste management technologies and policies (Thorneloe et al., 2002; 2005; WRAP, 2006). Climate Change 2007: Working Group III: Mitigation of Climate Change

The use of LCA in order to analyze waste management systems appeared for the first time in the early 1990s.

T. Christensen, Solid waste technology and management. John Wiley & Sons, (2011)

LCA as a tool plays an important role 🟓

Quantification of the environmental impacts that derive from the system













1 Linear vs. circular models Functional System & System boundaries





Conventional systems



1 Linear vs. circular models - Functional System & System boundaries





Sidestream – Circular system



1 Linear vs. circular models -Functional System & System boundaries







1 Linear vs. circular models -Functional System & System boundaries





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2 Technical and functional units

Pathway #1: from polycaetes to seabass juveniles & Pathway #3: from polychaetes & gammarids to shrimps post larvae to seabass juveniles







Pathway #1: from polycaetes to seabass juveniles

Technical unit (100kg diet)









Pathway #1: from polycaetes to seabass juveniles

Functional unit (referred to % Nretention efficiency)





Looking for indications to obtain optimal diet formulation

PROJECT

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Title: "Towards sustainable aquaculture: Assessing polychaete meal (Alitta virens)as an effective fishmeal alternative in European seabass (Dicentrarchuslabrax) diets." Authors: Monteiro, M.; Costa, R.S.; Sousa, V.; Marques, A.; Sa´, T.; Thoresen, L.; Aldaghi, S.A.; Costamagna, M.; Perucca, M.; Kousoulaki, K.; Valente, L.M.P., Journal: Aquaculture, Volume 579, 2024, 740257, ISSN 0044-8486. Link: https://doi.org/10.1016/j.aquaculture.2023.740257



COFUNI





Pathway #3: from polychaetes & gammarids to shrimps post larvae

Technical unit (100kg diet)







Pathway #3: from polychaetes & gammarids to shrimps post larvae

Functional unit (referred to FCR & growth data)











3 Production Complexity and hotspots Production pathway #4: from bacteria to trout juvenile (through Astanxanthin)



N





Bacteria growth for Astaxanthin and dried biomass

Technical unit (100kg diet)







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Functional unit (referred to SalmoFan Card scores)

(a) =<20 = 20 = 21 = 22 = 23 = 24 = 25 = 26



Control Haemato COCCUS Coryneb acterium

Pink









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Addressing hot-spots: direct energy requirement

From standard energy mix to renewable energy: impacts reduction



Title: "Life Cycle Assessment of Bacterial, Algal, and Synthetic Approaches for Astaxanthin Production at a Laboratory Scale: Comparative Environmental Analysis and Sensitivity of Energy Sources" Authors: Aldaghi, S.A.; Ubais, R.; Schmitt, I.; Wendisch, V.F.; Costamagna, M.; Perucca, M. Journal: Processes 2023, 11, 2911. Link: https://doi.org/10.3390/pr11102911









4 Scope differences Pathway #2: from polychaetes to shrimps broodstock





Pathway #2: from polychaetes to shrimps broodstock

Scope: Addressing Climate change

VS.

a broader environmental profile



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Takeaways

- 1. System **Boundaries**: to be carefully set when comparing circular and linear systems
- 2. Functional Unit & Technical unit: substantial differences are found; functionality must be addressed in order to avoid misinterpretations and getting misleading indications
- 3. Products & Production Complexity: addressing **hot spots** is necessary to address relevant improvement points
- 4. Scope differences and decision making: the comparative picture is not always trivial, and it may strongly depend on goal and scope definitions. Multiple indicators for a broader perspective should be addressed





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