GAIN Green Aquaculture Intensification

SUMMER SCHOOL

IMPAQT

Intelligent Management System for Integrated Multi-trophic Aquaculture

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 774109

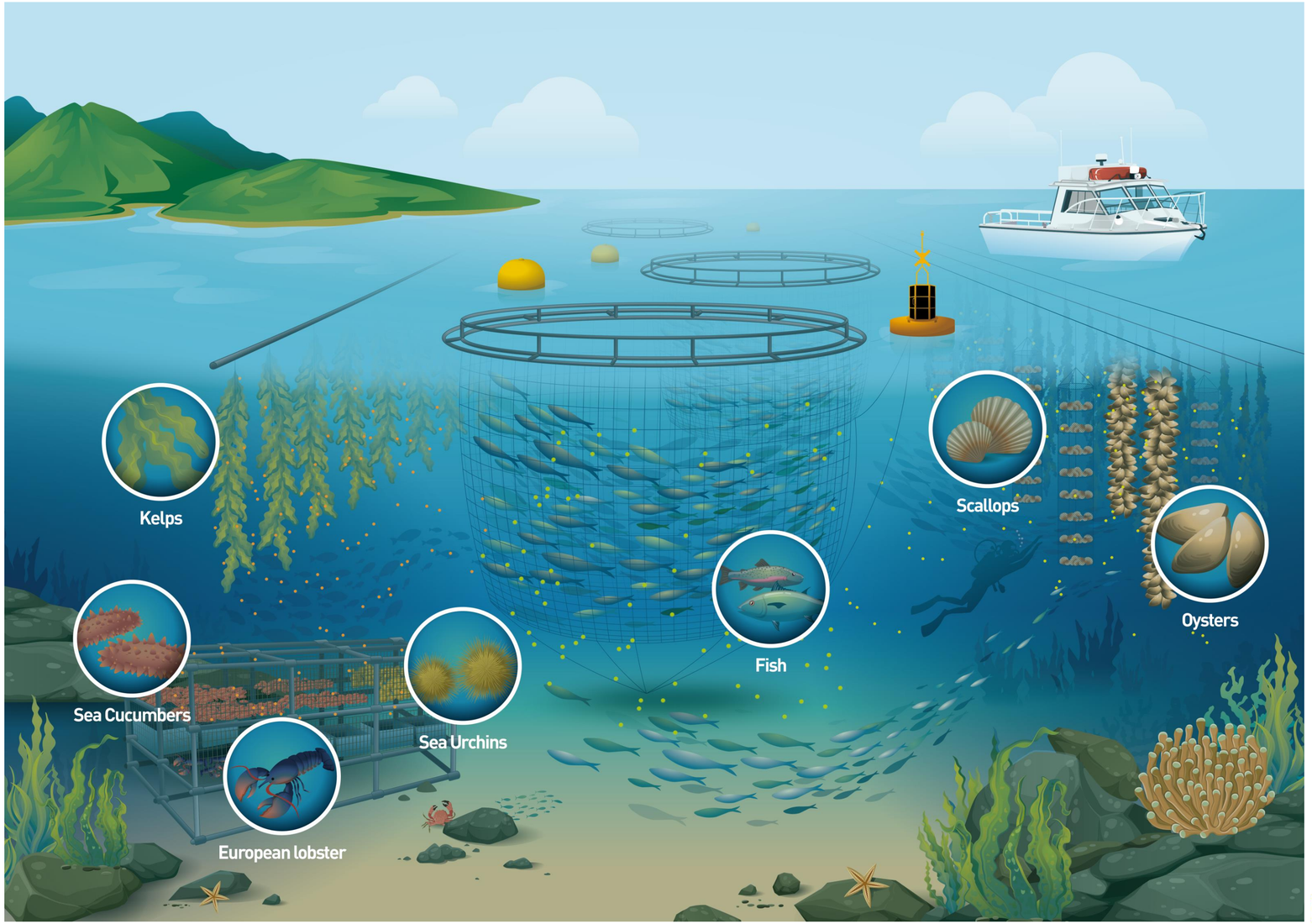
IMPAQT

An intelligent management system for integrated multi-trophic aquaculture

Frank Kane

This project receives funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 773330 (GAIN)

Integrated Multi-Trophic Aquaculture - IMTA



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IMTA

- IMTA or ‘imta’ = Integrated Multi-Trophic Aquaculture.
- A term to describe a specific concept in aquaculture – not new.
- Acronym was coined in 2004 by Thierry Chopin at a conference in Canada.
- Current aquaculture practices involve single species mono-culture.
- Additional species to that area known as polyculture.
- IMTA is a specific type of polyculture – it required growing 2 or more species, and for those species grown to be complementary to each other in some way.
- Concept with 3 elements…

IMTA - 3 elements

The Aquaculture element

is the farming of aquatic organisms (marine & FW) - interventions in the rearing process to enhance production.

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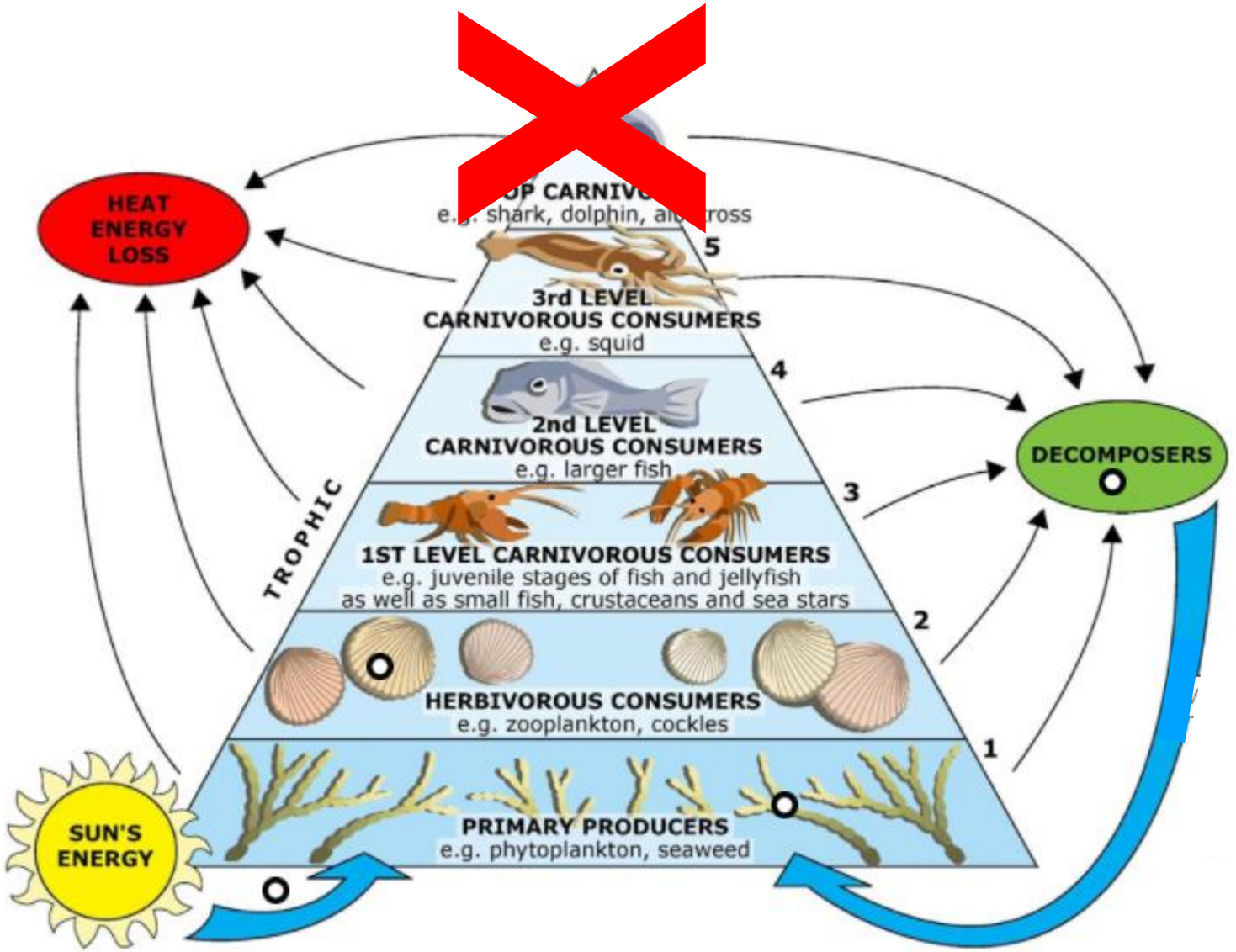
IMTA - 3 elements

The Multi-Trophic element

- the species must come from different levels on the food chain.



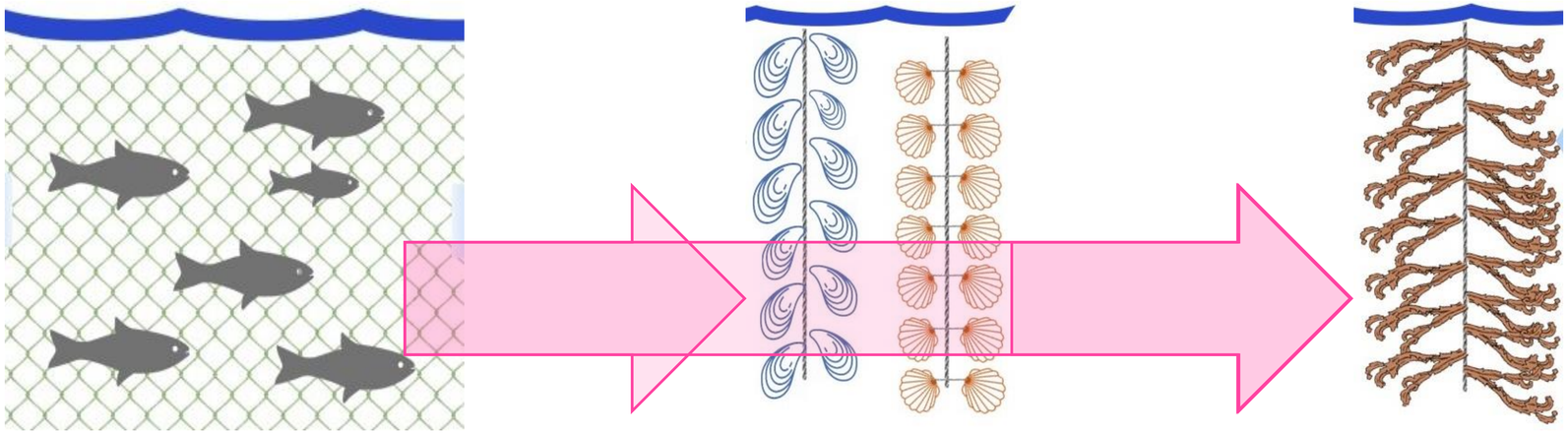
IMTA - 3 elements

The ‘Integrated’ element – Key!

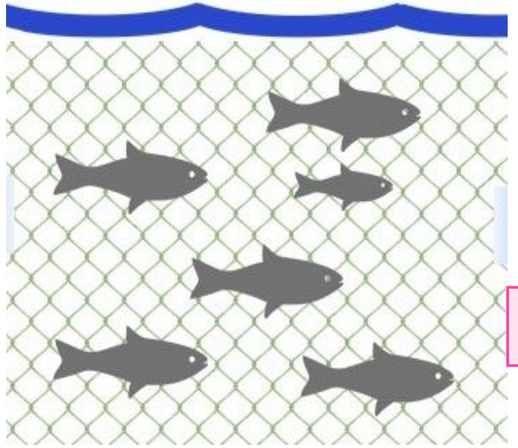
The species farmed are linked - serving complementary functions within the ecosystem.

Organic and inorganic waste serves as nutritional inputs

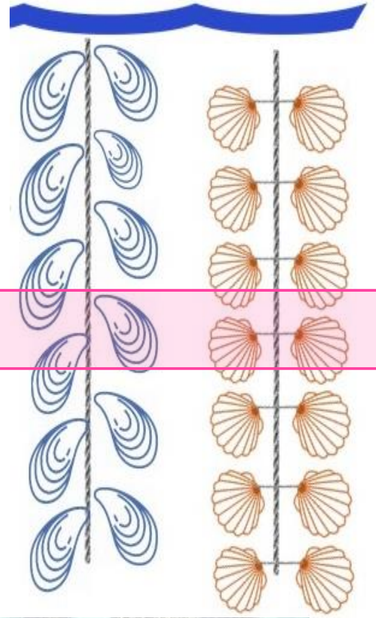
Waste reused as nutritional inputs, becoming a useful by-product.



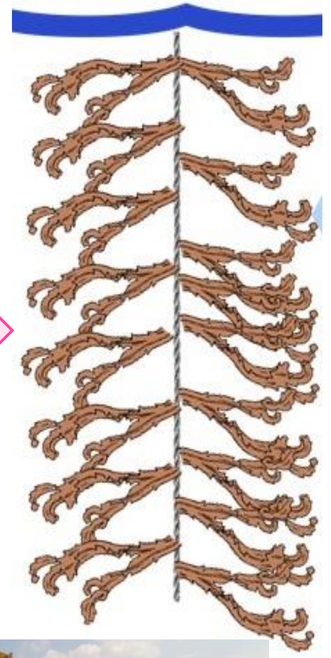
IMTA - Typical



Nitrogenous waste (Nitrogen (N) in the form of ammonia and ammonia ions (NH3 and NH4+)



Phosphorous waste (phosphorus (P) in the form phosphate (PO43-), and waste carbon.



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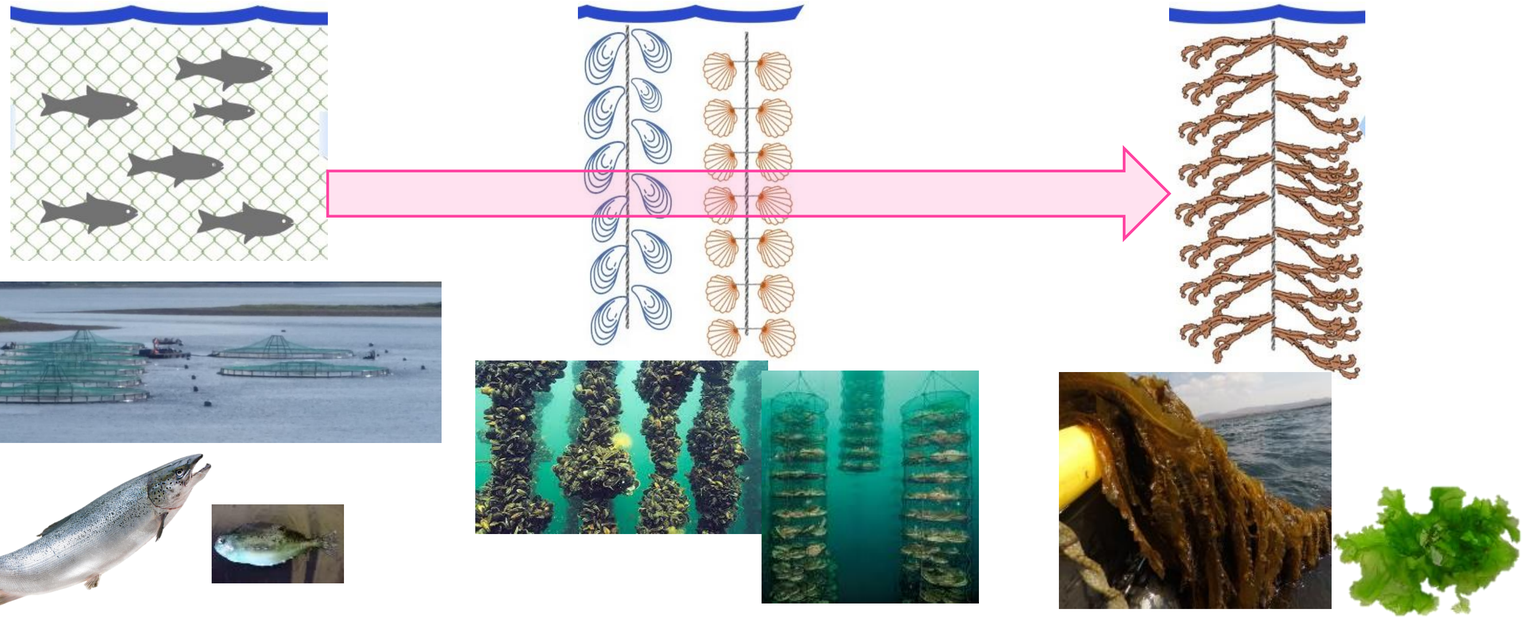
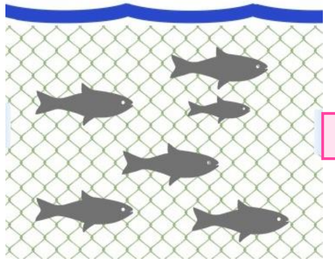
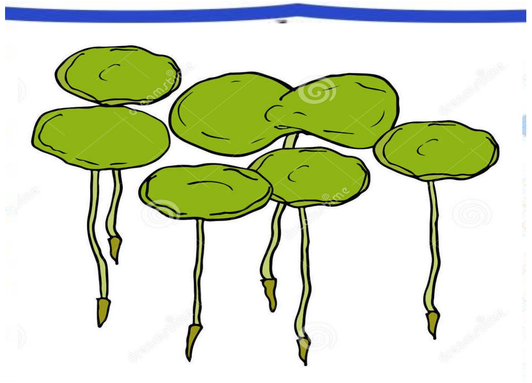
IMTA - Less Typical

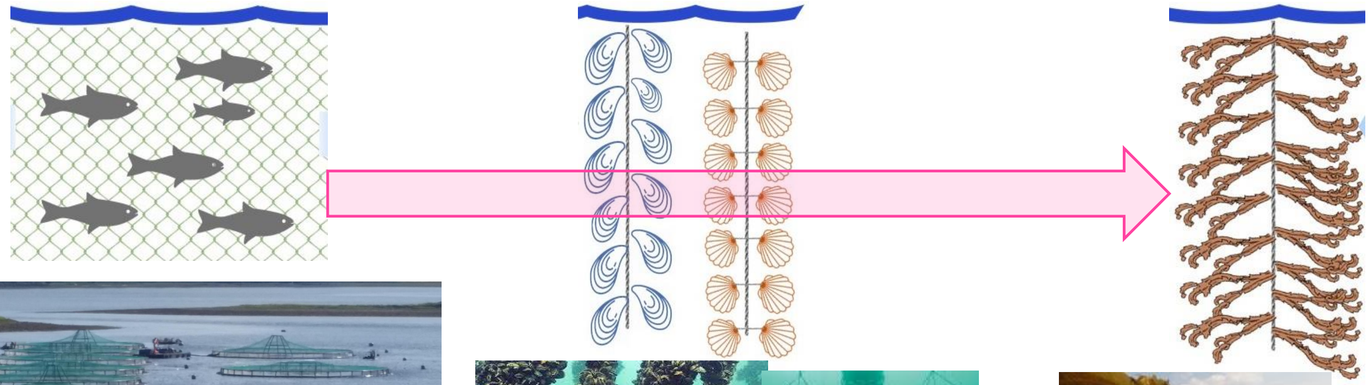


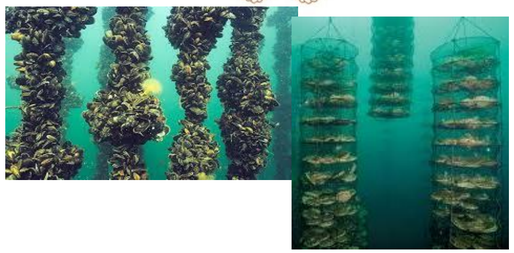
IMTA - Less Typical





IMTA - Less Typical





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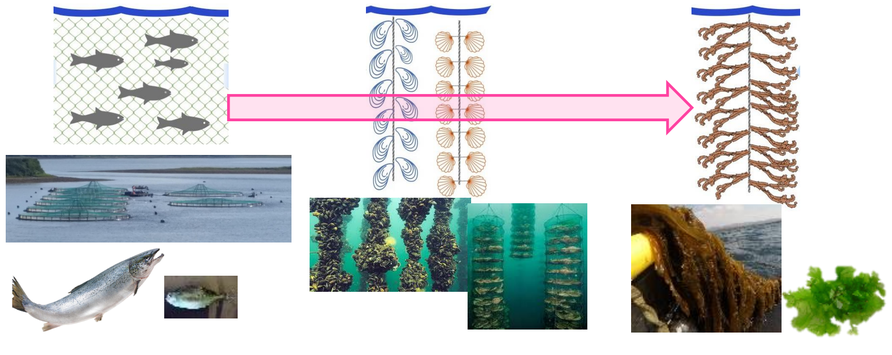
IMTA - Broader



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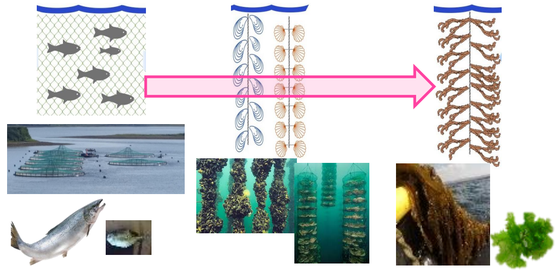
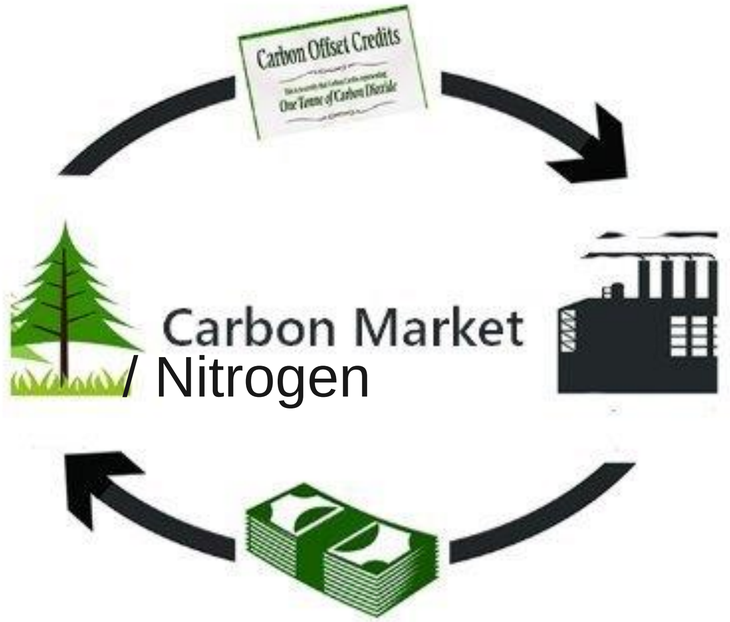
IMTA - Wide scale?





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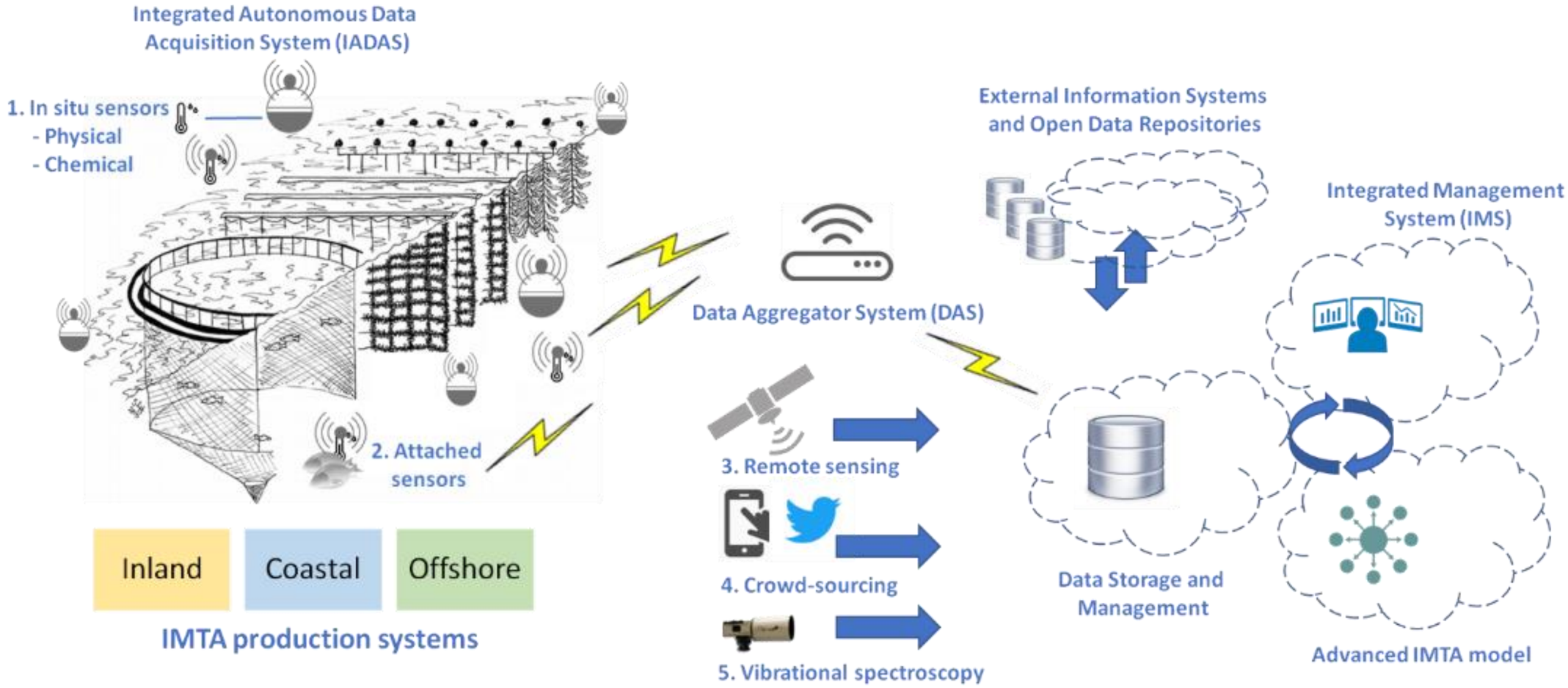
The IMPAQT Project



Semantic aquaculture data interoperability and harmonization

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The IMPAQT Project

- Sensors (Tyndall, UNITOV, UI, EGM, LEITAT, WINGS)
- Remote sensing based on satellite observation (IOPAN, ARGANS)
- Data analytics (WINGS)
- Modelling tools (Deltares)
- Crowd-sourcing applications (ARGANS)
- Management systems (INTRA, WINGS, NETAS)
- Food safety and biofouling (AUA)
- Communication systems (EGM, NETAS, UI, WINGS, LEITAT)
- Semantic interoperability (OU, EGM, UI, WINGS)
- System integration (INTRA, NETAS, WINGS)
- Environmental-socio-economic sustainability (LEITAT, Deltares, HUA)
- Exploitation management and ecosystem building (FEUGA)
- Integrated aquaculture (SAMS, MI, NSF, Camli, YSFRI, DEU)

IMPAQT
Intelligent Management System for Integrated Multi-trophic Aquaculture

IMPAQT Pilot sites

SAMS, UK

NSF, The Netherlands

Keywater Fisheries, Ireland

YSFRI, China

MI, Ireland

Camli, Turkey

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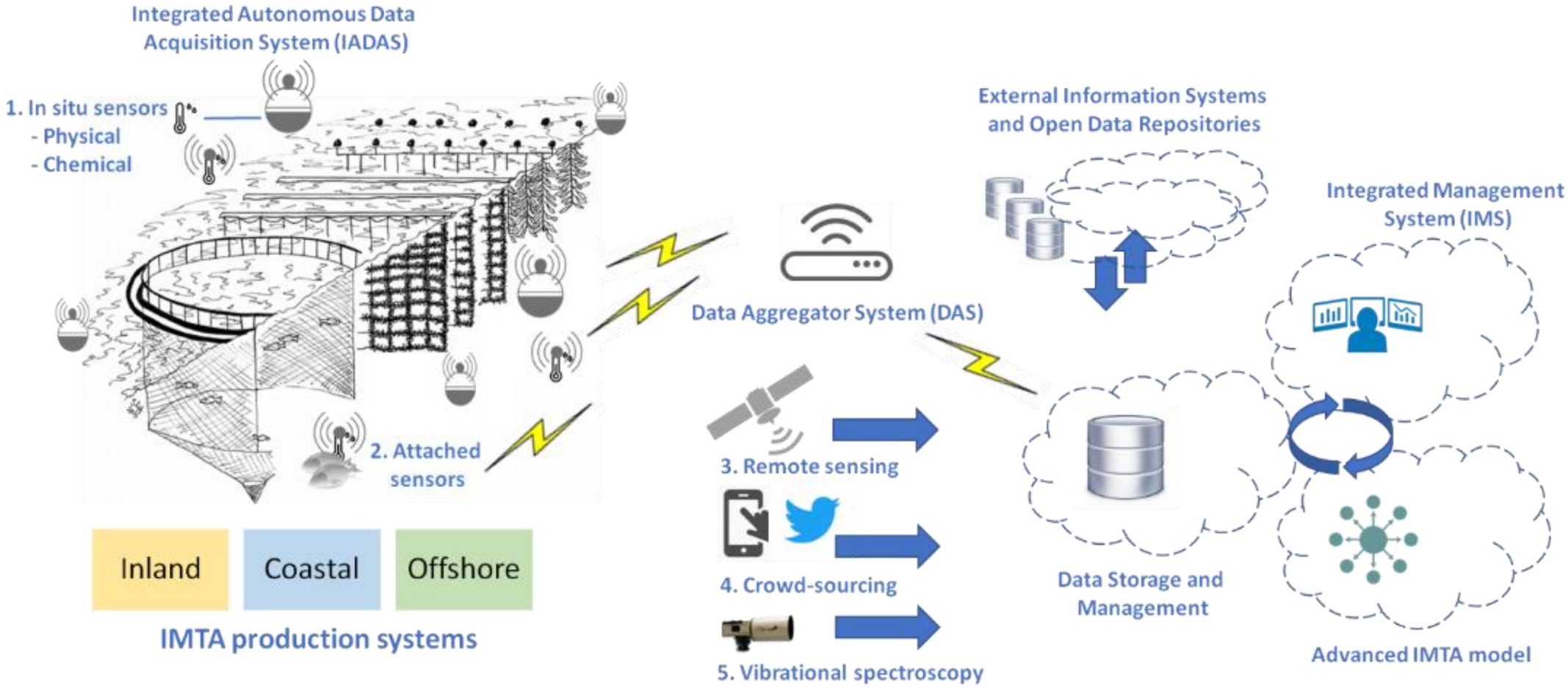
The Technology

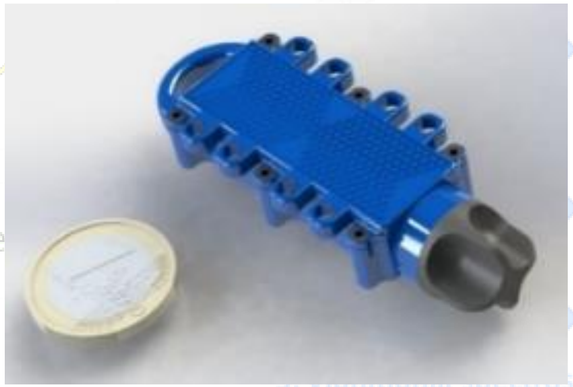


Semantic aquaculture data interoperability and harmonization

Autonomous data acquisition and communication system
Sensors & sources

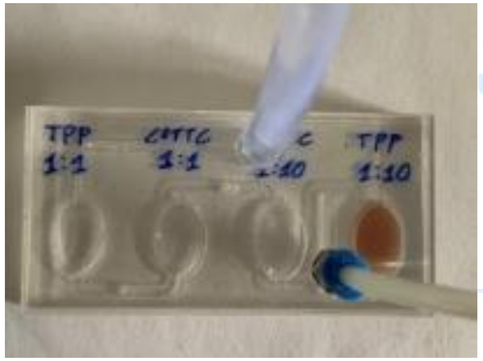
- Nitrite and phosphate sensors

- Databuoy



- Attached sensors

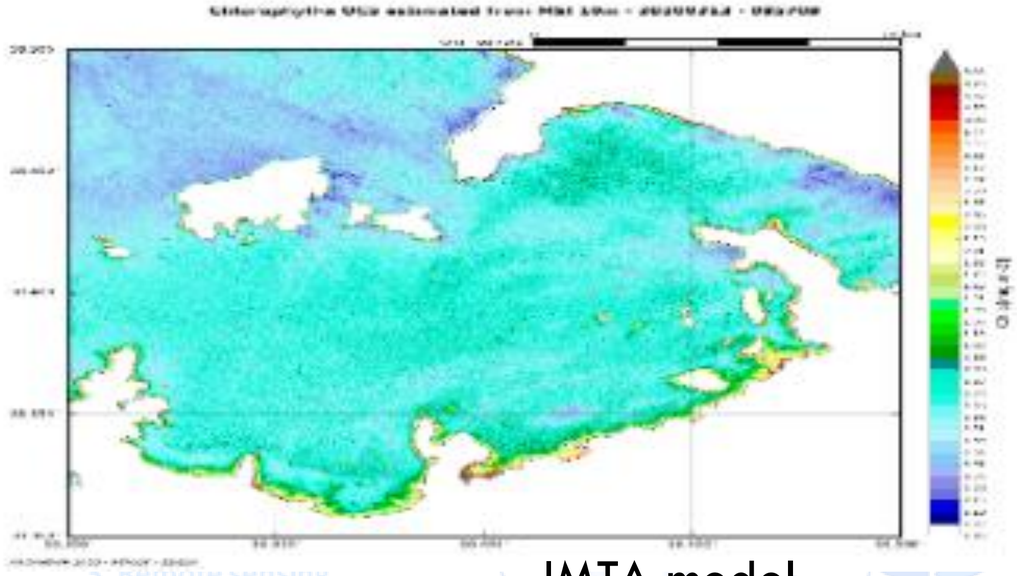
- Conventional sensors



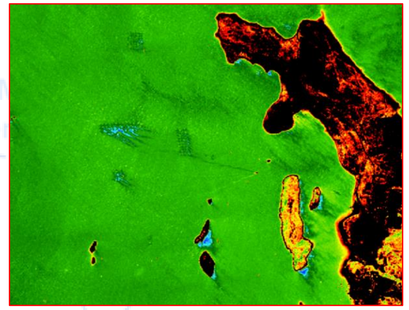
- Electronic ‘tongue’

Autonomous data acquisition and communication system
Sensors & sources

- SIMPLEX app



- IMTA model



- Satellite

Seaweed (%)	Moisture	Ash	Protein	Fat	Carbohydrates
Alaria fresh	80,55	2,92	1,99	0,13	14,41
sterr	0,81	0,18	0,08	0,08	
Alaria dried	10,64	26,34	9,13	0,60	53,28
sterr	0,01	0,46	0,35	0,09	

Fat composition	%
Total Saturated	73,97
Total Monounsaturated (MUFA)	13,60
Total Polyunsaturated (PUFA)	12,43
Total n-3 Polyunsaturated (PUFA)	3,53
Total n-6 Polyunsaturated (PUFA)	8,00
Omega-3/Omega-6	0,43

- Manual data

- Food safety lab data

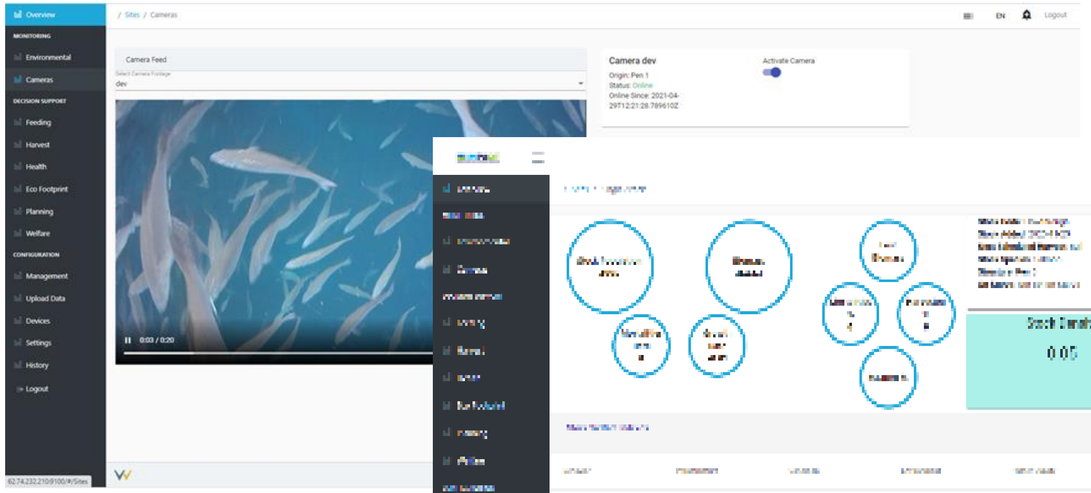
Autonomous data acquisition and communication system
Communications

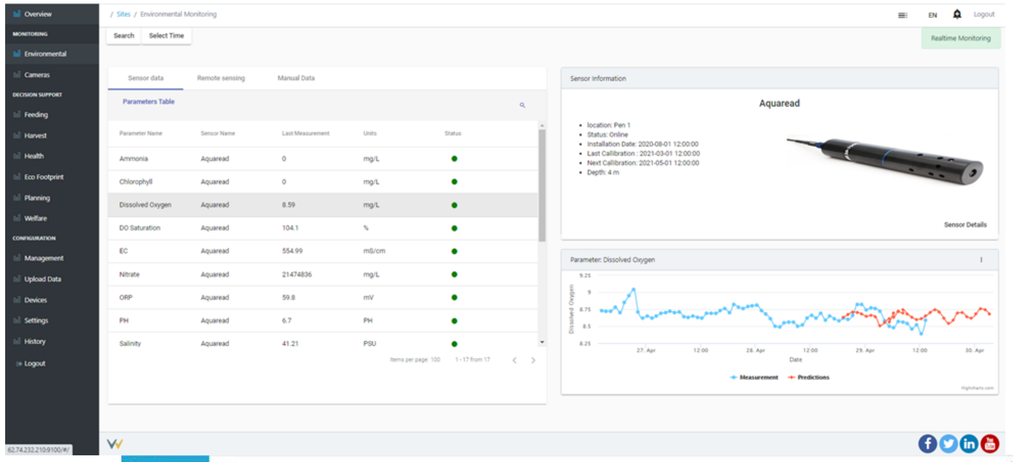
- DAS
- Data aggregator System

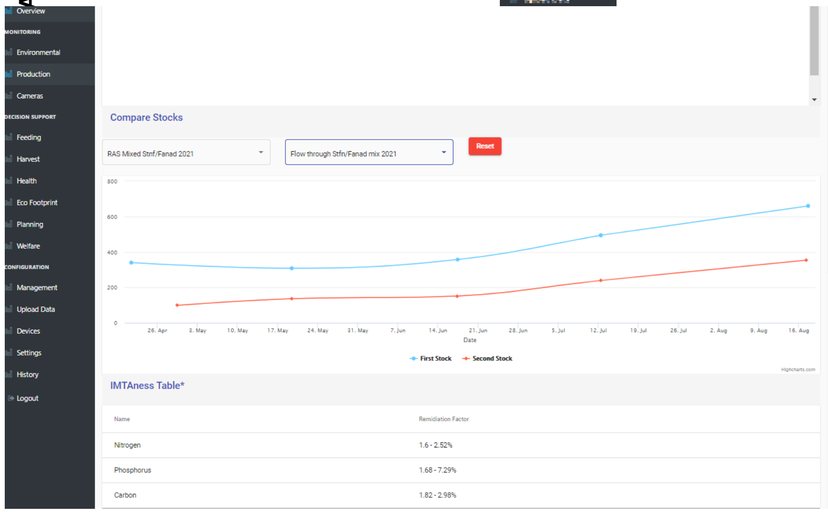
- IADAS
– Integrated autonomous data acquisition system

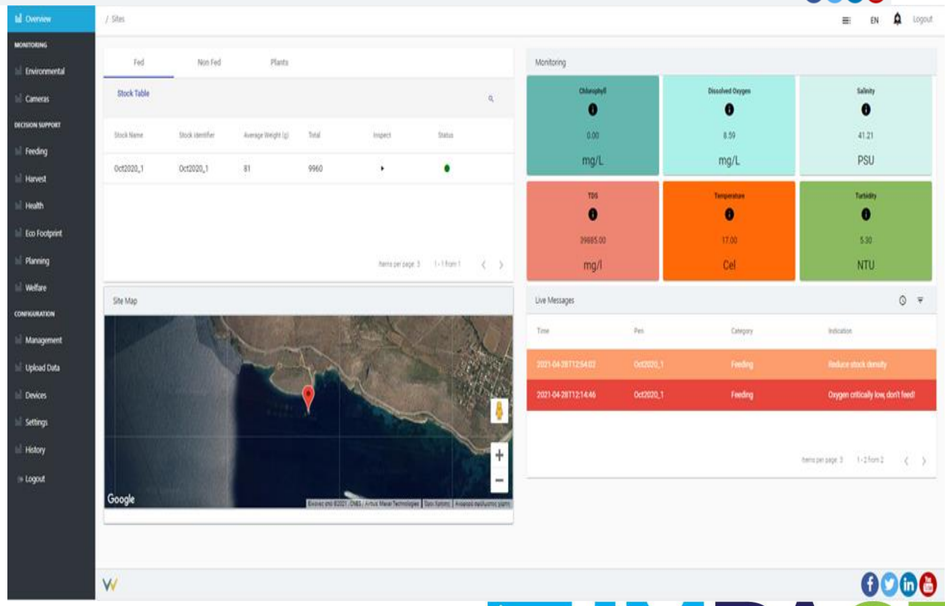
- EMS - Energy Management system

Autonomous data acquisition and communication system IMS









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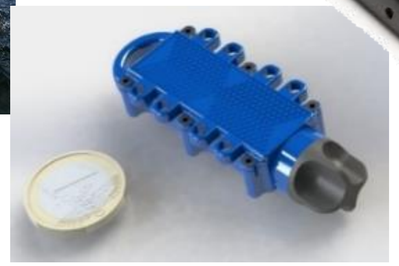
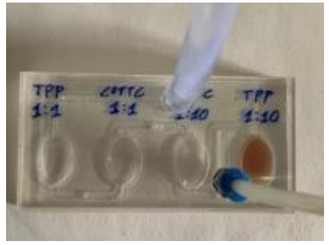
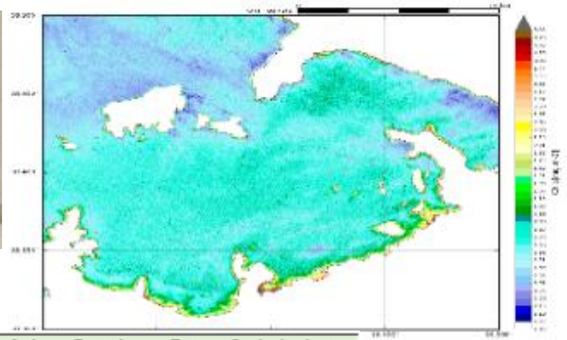
The IMPAQT platform







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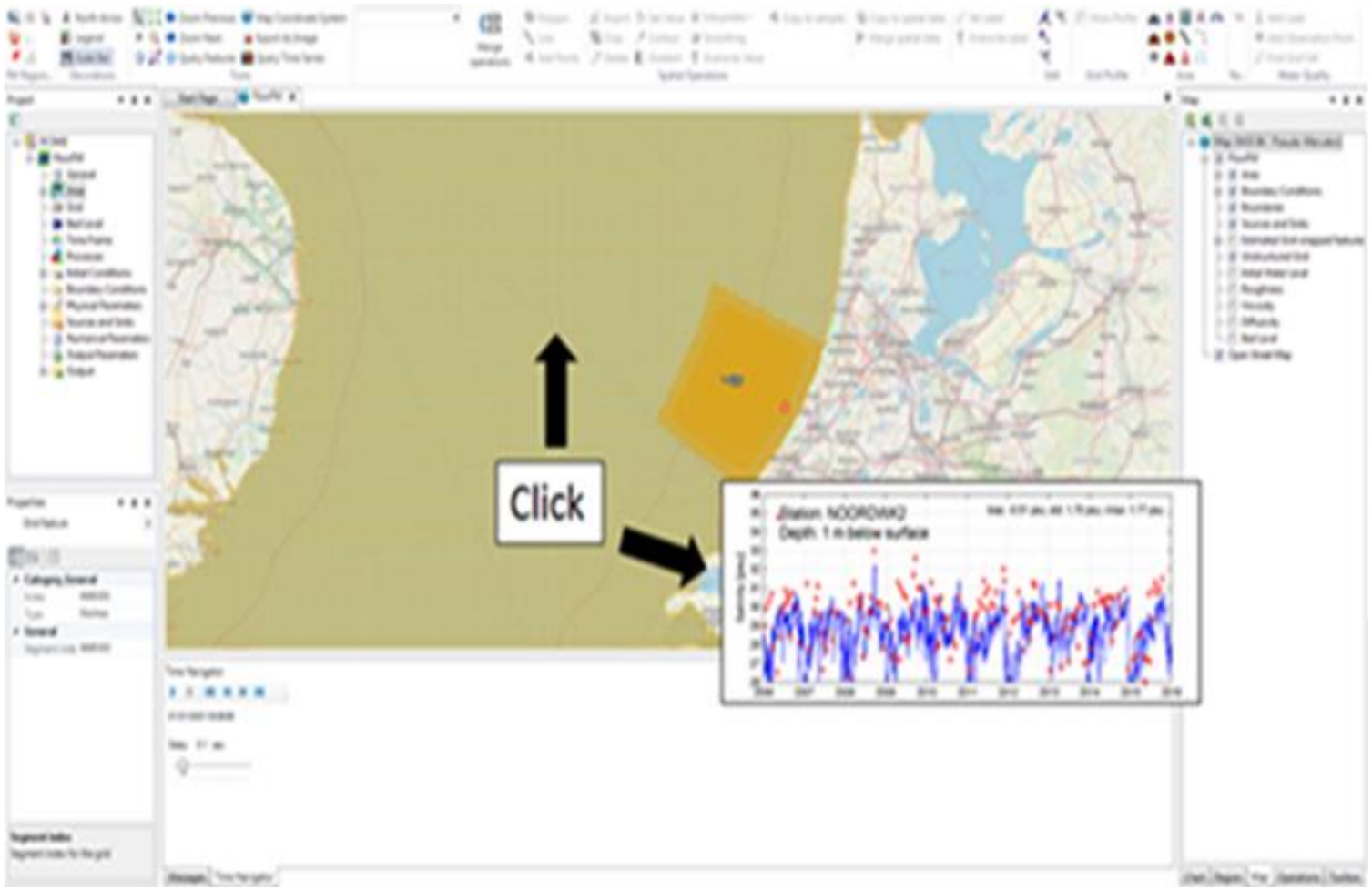
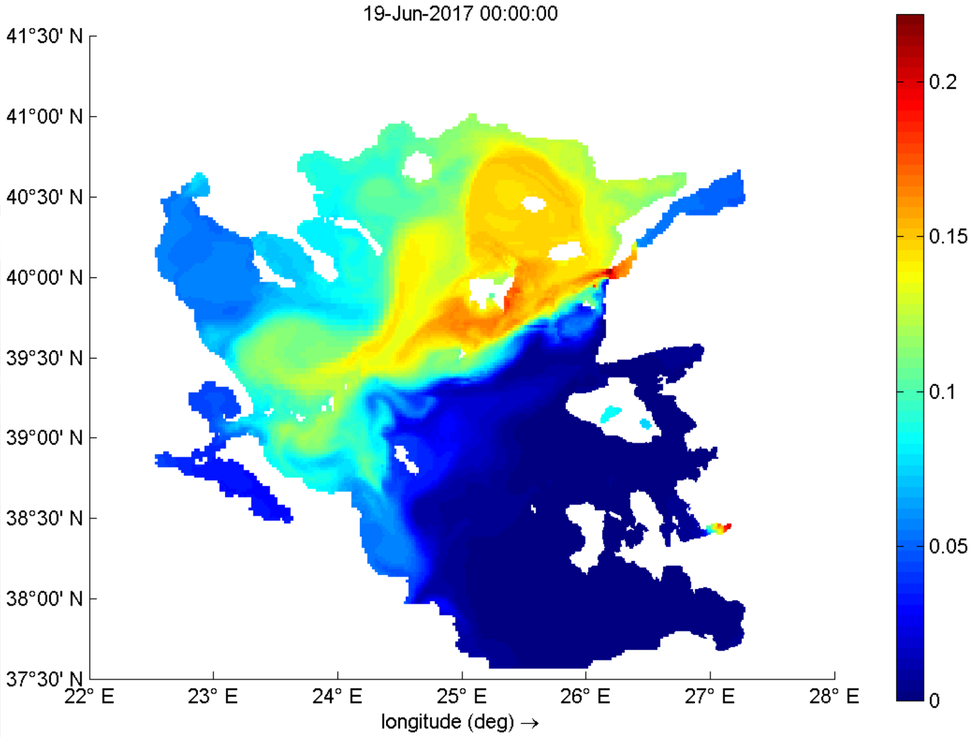
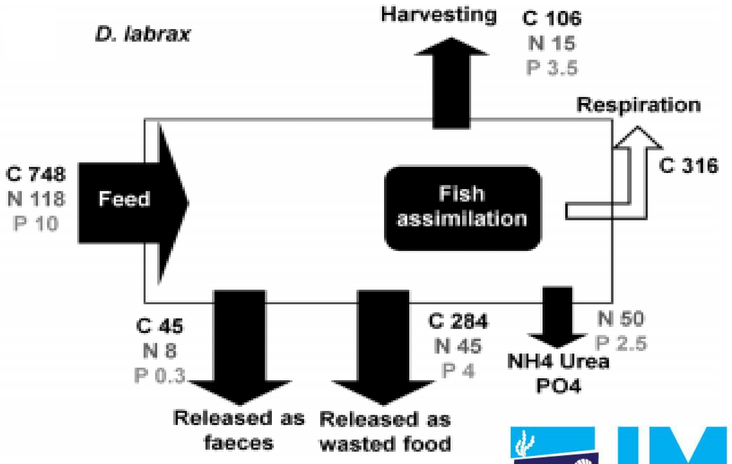
IMTA Model







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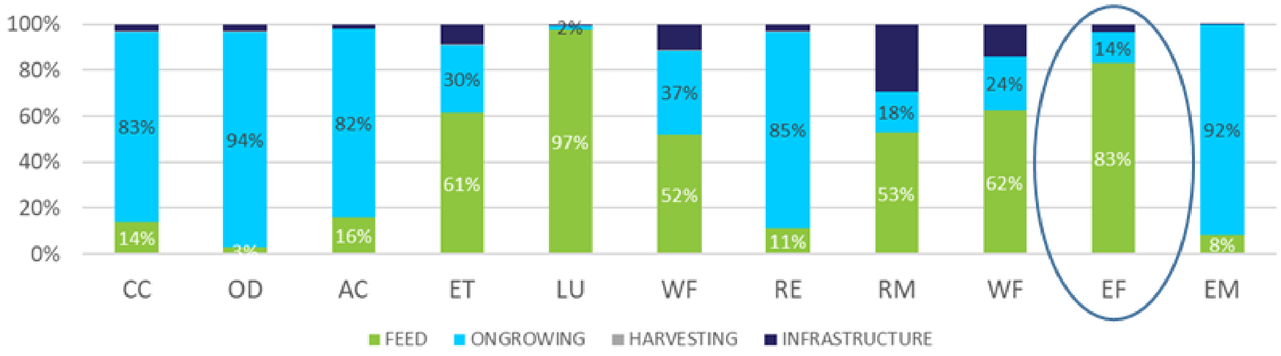
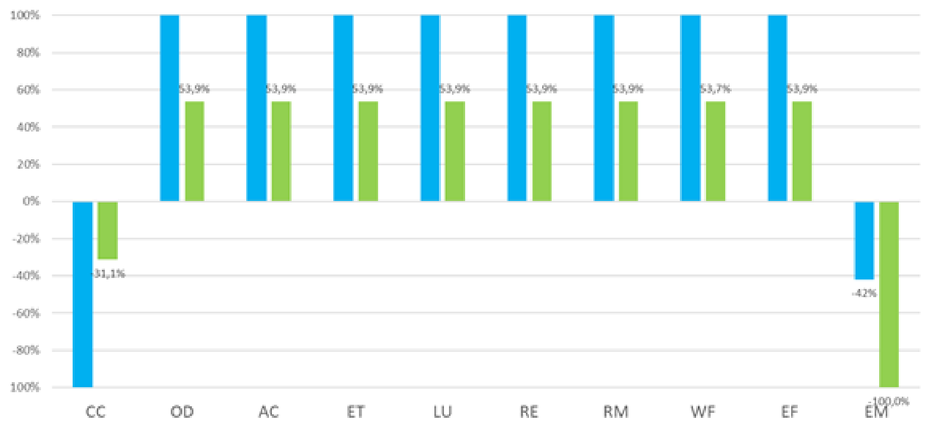
Sustainability and Circular Economy

Environmental impacts: Outcomes



Environmental profile of Monoculture (fish).
Marine eutrophication would be reduced during the on-growing phase due to the introduction of extractive species (IMTA Conditions)



Environmental benefits associated with more efficient use of infrastructure when growing multiple species

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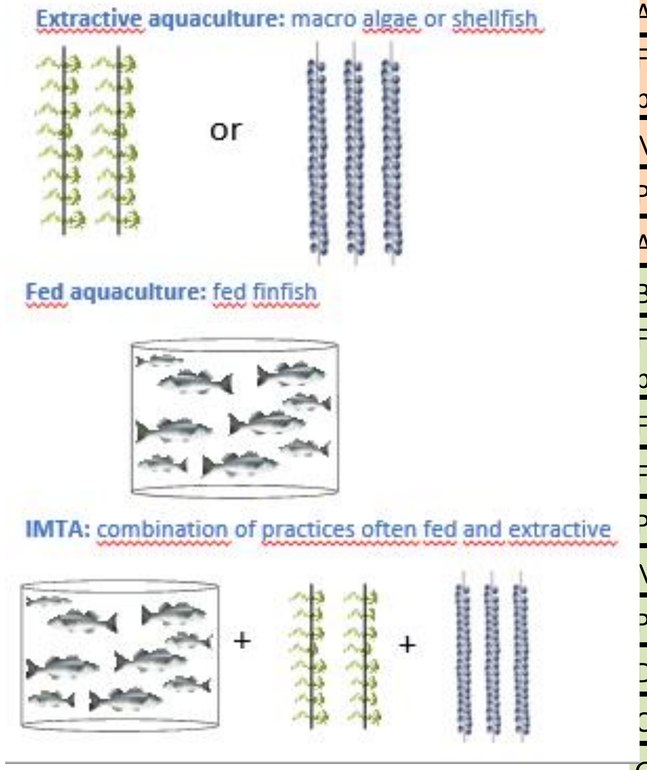
Sustainability and Circular Economy

Ecosystem services : Outcomes



Marine Ecosystem Service Working Name	Extractive aquaculture	Fed aquaculture	IMTA
Plants and algae from in-situ aquaculture	+		+
Animals from in-situ aquaculture		+	+
Fibres and other materials from plants, algae and animals for direct use or processing	+		
Materials from plants, algae and animals for agricultural use	+	+	+ +
Plant-based resources	+		+
Animal-based resources		+	+
Bio-remediation by micro-organisms, algae, plants, and animals	+		+
Filtration/sequestration/storage/accumulation by micro-organisms, algae, plants, and animals	+		+
Filtration/sequestration/storage/accumulation by ecosystems	+		+
Flood protection			
Pollination and seed dispersal	+		
Maintaining Nursery Populations and Habitats			
Pest control			+ −
Disease control		−	+ −
Chemical condition of salt waters	+ −	−	−
Global climate regulation by reduction of greenhouse gas concentrations	+	−	−
Scientific	+	+	+ +
Educational	+	+	+

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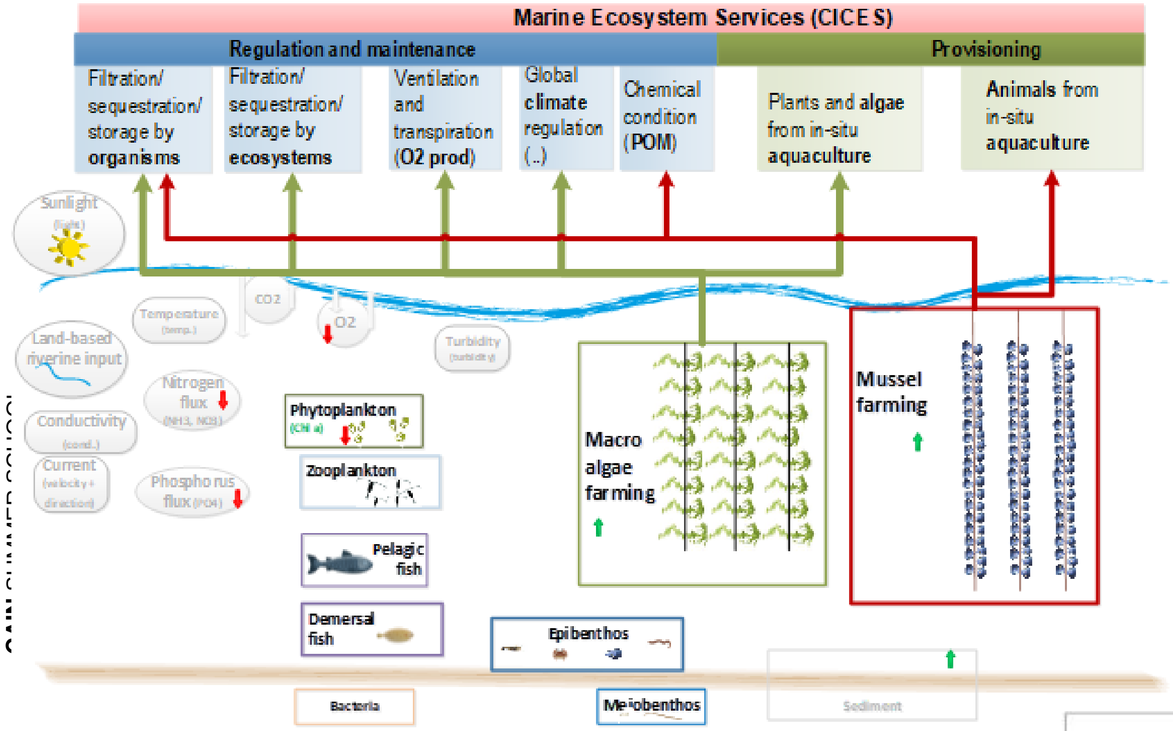
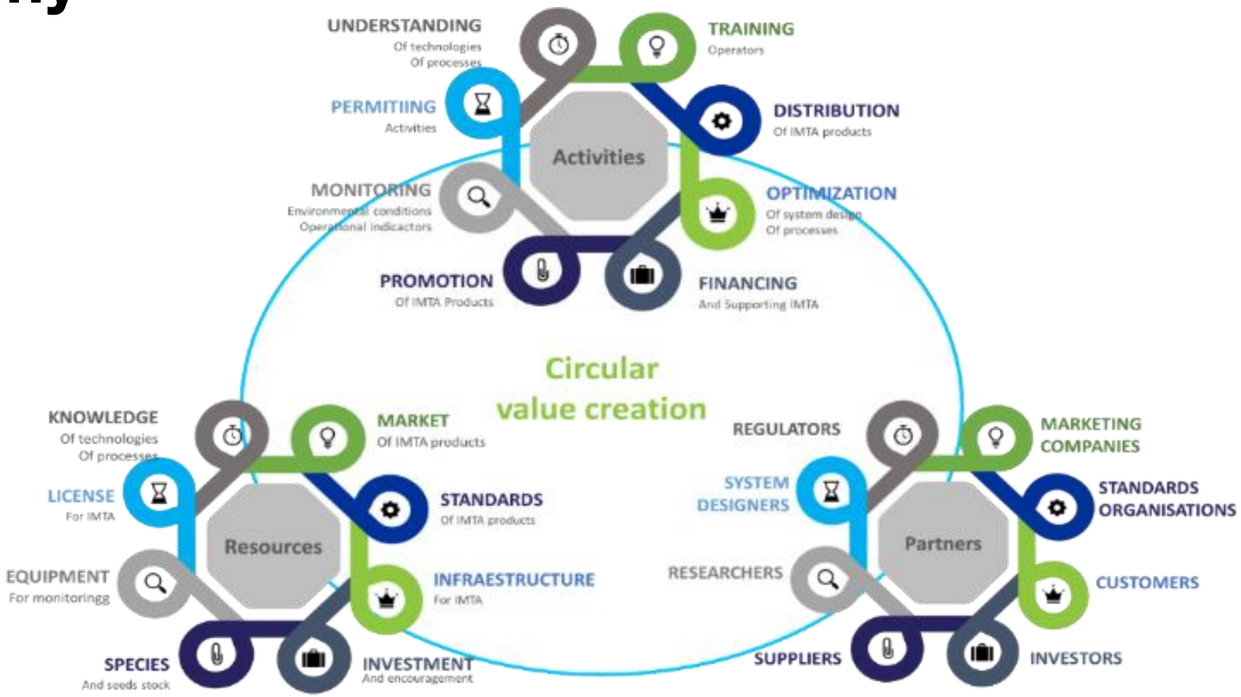
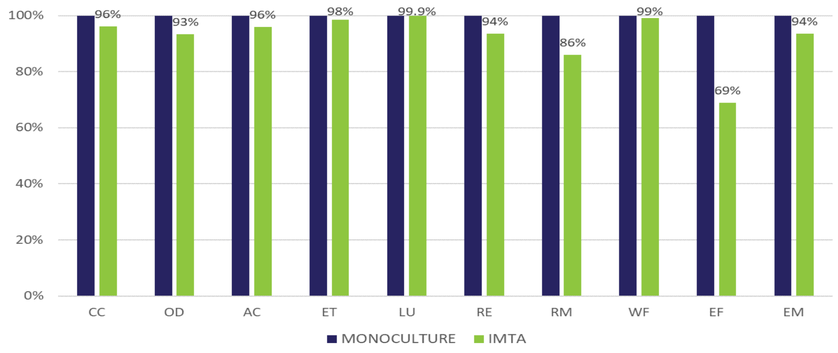
Sustainability and Circular Economy







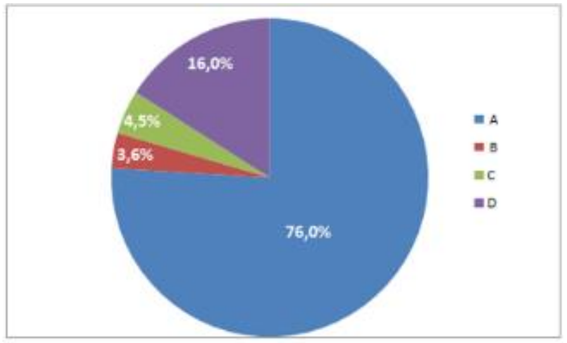
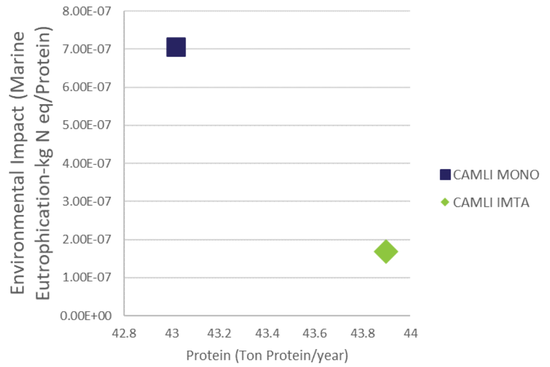


Figure 16. OPEX per species and IMPAQT platform (CAMLI)



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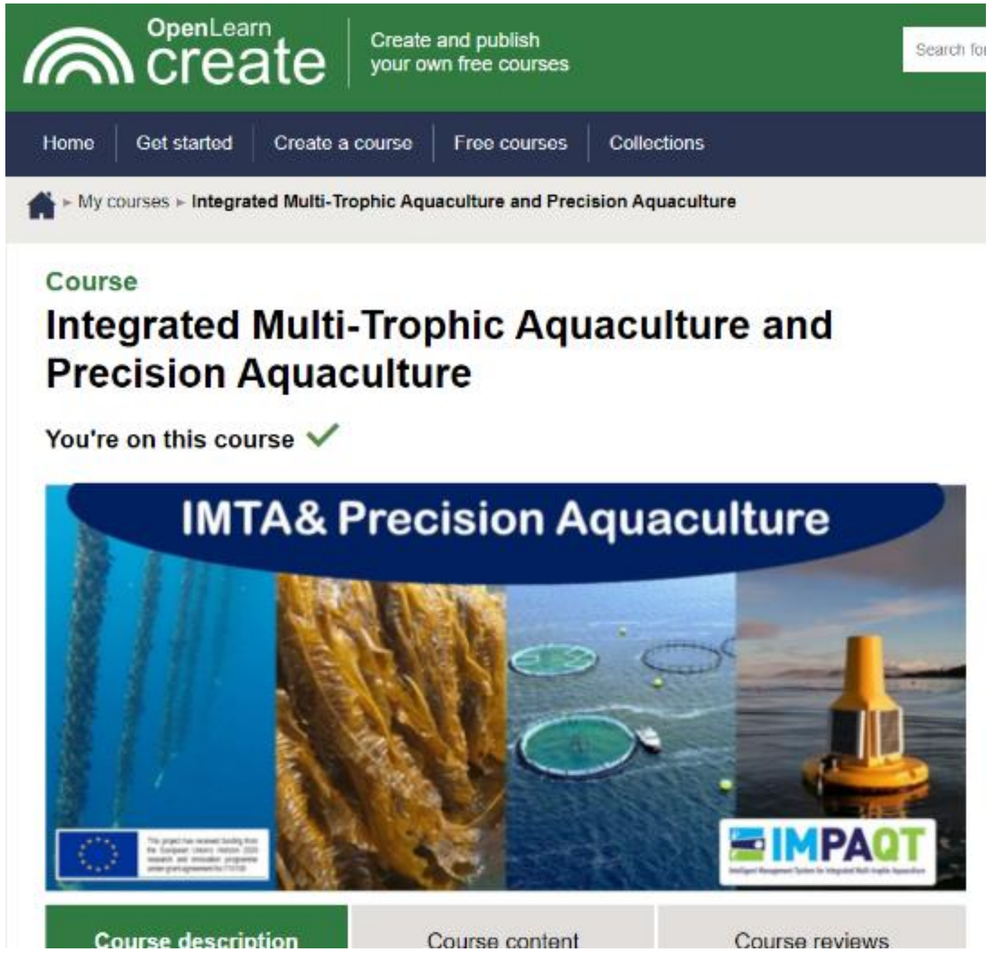
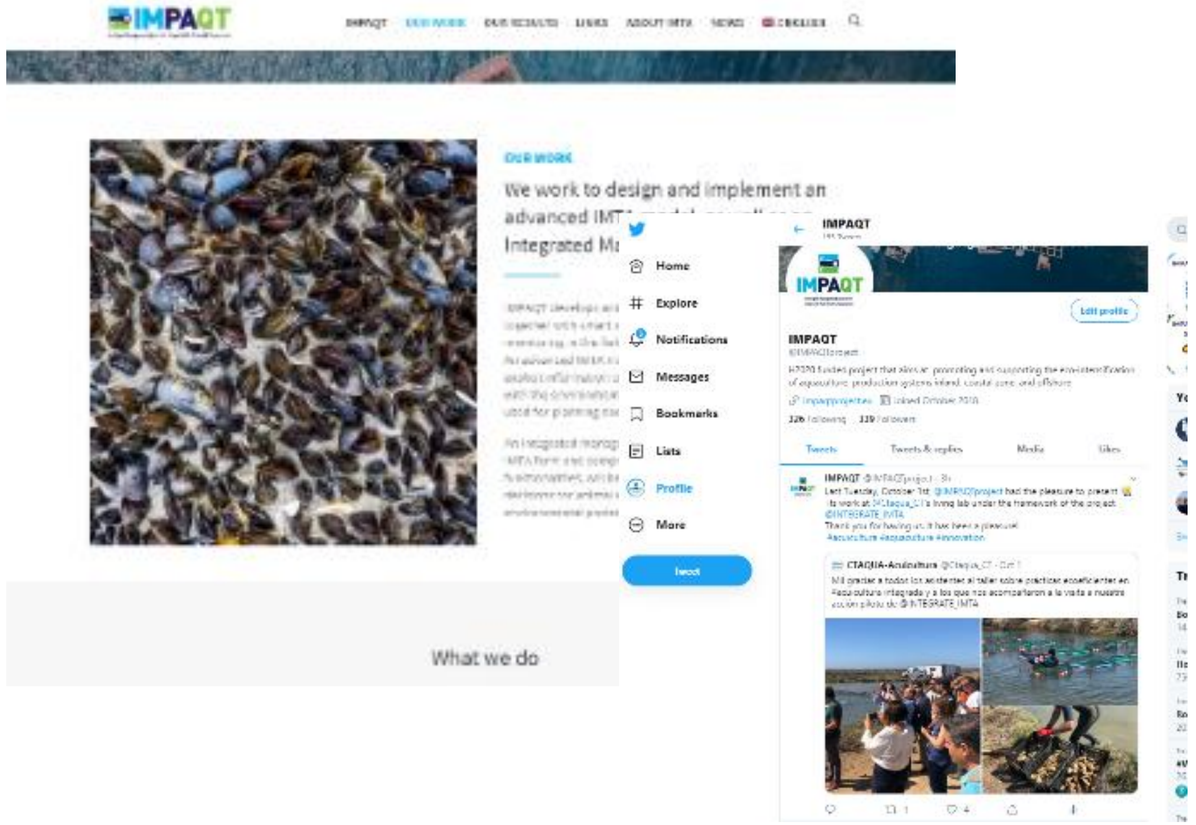
IMTA MOOC





Project website
https://impaqtproject.eu/

Online course link
https://www.open.edu/openlearncreate/course/view.php?id=7116