



Integrate Aquaculture:
an eco-innovative solution to foster
sustainability in the Atlantic Area

INTERREG Atlantic Area 2014-2020 Project EAPA_232/2016

Report of the INTEGRATE IMTA Definition Event

CCDR-N, Porto

May 9th, 2019

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www.integrate-imta.eu

Target audience

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|----------------------|---|
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| Partnership | X |
| Associated partners | X |
| Media | X |
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1 INTRODUCTION

A series of expert roundtables were held as a part of WP4, Action 2 (Deliverable 4.2a). These aimed to identify IMTA best-practice, as it currently stands within the Atlantic Area, and to find commonalities in approach between countries, as well as identifying areas in which they diverged, mainly due to differences in IMTA systems used or species cultured. From these roundtables a common problem emerged: although the conceptual definition of IMTA was clear, even intuitive, a more utilitarian definition making some of the details explicit was necessary, for instance for regulatory purposes.

It was envisaged by IMTA stakeholders and producers that by addressing this need IMTA could be better regulated and commercialised, facilitating for instance the development of an IMTA technical standard (WP5, Action 3). This standard might later form the basis of an IMTA specific eco-label, further promoting the IMTA sustainable aquaculture 'brand', thus enabling the social and economic potential of IMTA in a series of steps.

To inform the development of a definition, opinions from experts within and outside of the Atlantic Area (AA) were sought. In December 2018, a questionnaire was launched with a specific target audience of those with direct knowledge or experience of IMTA, both academics and producers. The questions were derived from analysis of the thematic roundtables within each country and were devised in order to outline how much consensus existed within the IMTA community about what IMTA is. The full questionnaire can be found in Appendix 1, and a summary of the analysis of the questionnaire results is presented in Section 2 below.

Analysis of the questionnaire identified areas about which there was consensus versus areas in which there was a polarised split, and others with more diverse range of opinions. These areas of discordance became the focus of the questions that were used in the facilitated discussion sessions of a focused 'IMTA definition event' (CDRN, Porto, 9th May 2019) which brought together about 40 IMTA experts from within and outside the AA. During this event it was intended to work towards finding consensus, or a way around a lack of consensus, with regards to what should be included in a definition of IMTA (and how).

Although within the IMTA community there are diverse opinions about the appropriateness of 'defining' IMTA, within the INTEGRATE community of IMTA stakeholders there was a clear consensus that it is an essential step in furthering the development of the industry. The starting point of the event was therefore that the need for a definition exists, and what the event aimed to achieve further to this was twofold:



- To operationalise the conceptual definition of IMTA;
 - To decide and agree on what is and what is not IMTA.
- It is important to stress that this is not a fundamental definition, but one that will be useful in policy terms, to facilitate funding and to enable national governments to be better able to direct licensing and appeals etc. Additionally, a longer-term view sees the definition as the basis of development of an IMTA eco-label.

The process described above is shown schematically in Figure 1.

2 PROCESS

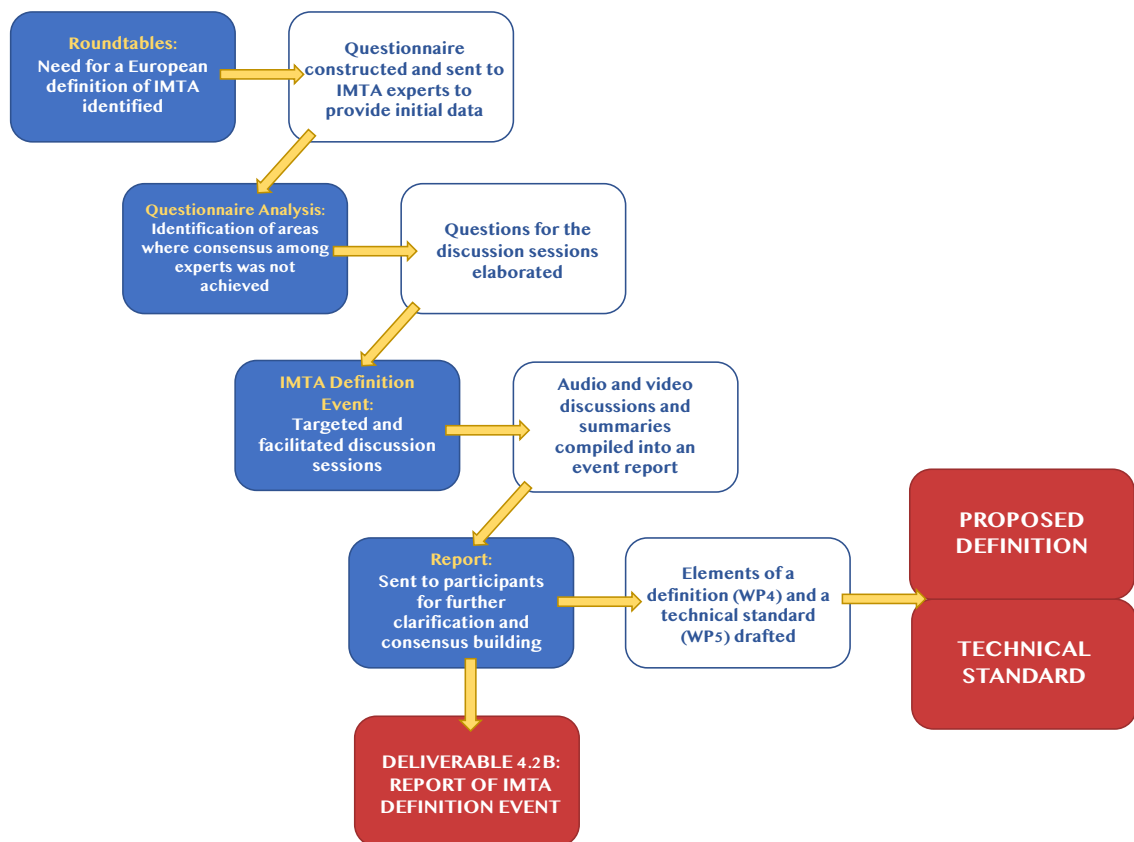


Figure 1. Schematic representation of the process involved in the development of a European definition of IMTA.

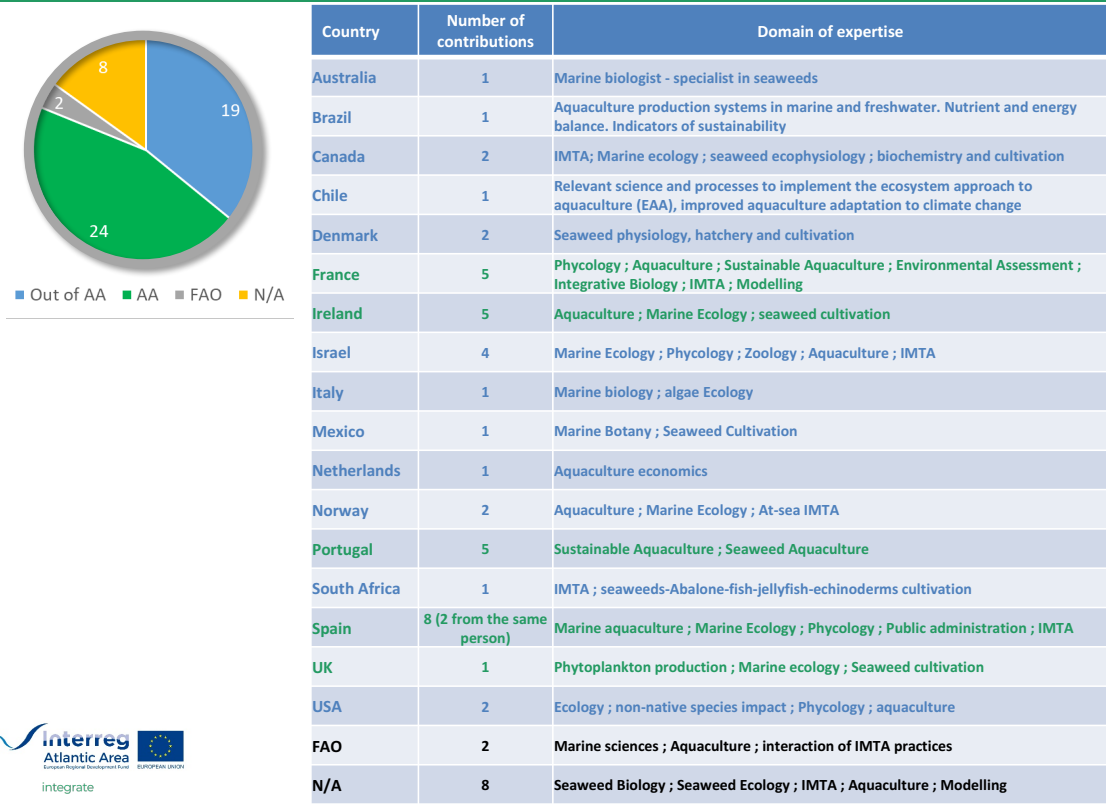
3 QUESTIONNAIRE: Results and Analysis

The full questionnaire, developed by partners of the INTEGRATE project, can be found in Appendix 2, and the following provides a brief synopsis of the results. Consensus was arbitrarily defined as > 66% agreement amongst respondents.

3.1 About the Respondents

Slide 1 shows the geographical origin and domain of expertise of the 53 contributors. This reveals a significant multidisciplinary and international interest for IMTA; indicating a very large and diverse scale of applications and perspectives.

Distribution of the 53 contributions per countries (AA and non-AA)



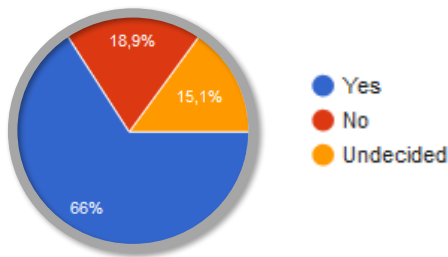
SLIDE 1



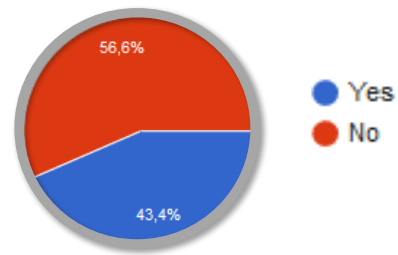
3.2 About the Concept of IMTA

Do we need a definition of IMTA? The 53 contributions have answered this question. Considering only those who answered from within the AA, 18 people answered YES (75%), 4 were UNDECIDED and only 2 answered NO (8.3%). For the global answers the values are different but still the majority of the participants/respondents believe IMTA needs to be defined (66%). There was a preference for the term IMTA despite acknowledgement of its technical nature (Slide 2).

Does IMTA need to be defined?



Do you use other terms to describe IMTA?



Terms normally used to refer to IMTA

- | | |
|--|--------------------------|
| Eco-aquaculture | 3-D aquaculture |
| Integrated Aquaculture | Multispatial Aquaculture |
| Mixed farming (when talking to the public) | Multitrophic Aquaculture |
| Compensation cultures | Sustainable aquaculture |
| Polyculture | MIMTA, FIMTA, etc. |



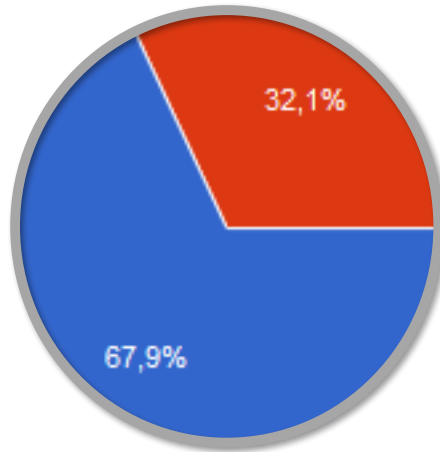
SLIDE 2



What is the most central concept to IMTA? The 53 contributions have answered this question. This relates to the focus of IMTA and showed that a narrow consensus (67.9%) thinks that the defining concept of IMTA is 'multi-trophic' rather than 'aquatic' - i.e. excluding terrestrial organisms (Slide 3).

Are combinations of terrestrial farming operations and aquaculture a type of IMTA?

Key point of IMTA is « Aquaculture »



Key point of IMTA is « Multi-trophic»



3.3 Interactions between co-cultured species

Most important interactions? Of the total responses given (22) they can be grouped as follows (Slide 4):

| | |
|--------------------------------------|---|
| Nutrient remediation | 9 |
| Resource/production efficiency | 4 |
| Ecosystem effects e.g. stabilisation | 3 |
| Disease mitigation | 1 |
| Infrastructural compatibility | 1 |

(Individual components – 4) * not specific enough

What do you consider to be the most important interaction(s) in an IMTA system ?

Maximisation of resources ; **nutrient fluxes recycling** (dissolved and solid nutrient)
The **efficient transfer** of nutrients between **trophic levels**.
Complementary **functions in the ecosystem** ; ecosystem stabilisation ; Bioremediation
Nutrients / waste produced by a **fed species** are used by a **non fed species**
Organic compounds recollection can be addressed as the most important
Extraction of wastes
Disease mitigation
Energy transfer
Potentially **mutual infrastructure** or feedback in growth
Compatibility, resilience/stability
Fish-seaweed component
Seaweeds with animals
Fish and sea cucumber
Fed fish, filter feeders, detritivores and algae
Nutrient amelioration and **benthic recovery**
The recycling of waste products into **valuable resources**
Nutrient **sequestration**
Productivity enhancement



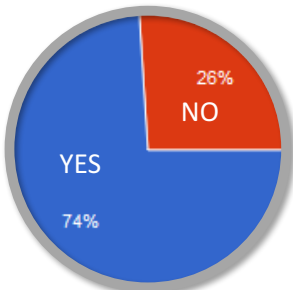
SLIDE 4



Negative interactions? There is a reasonable consensus (74 %) that negative interactions, as well as positive, can take place in IMTA systems. Of the total responses, there was a more even spread between the categories than in the 'most important interactions' question. Responses can be divided as follows (Slide 5):

| | |
|-----------------------------------|---|
| Transfer of pests and pathogens | 3 |
| Ecosystem effects | 3 |
| Incompatibility of species | 2 |
| Incompatibility of infrastructure | 2 |
| Transfer of contaminants | 1 |
| Decreased product quality | 1 |
| Decreased water quality | 1 |

Do you think there are interactions that can have a negative effect on aquaculture in an IMTA system?



- Competition between species by space, oxygen, feed or even show agonistic behaviour.
- The High nutrient flow can stimulate undesired organisms too.
- If the system is too intense : oxygen depletion / decrease the water quality.
- Antibiotics/chemical inputs
- Less phytoplankton for the natural beds
- The time spent to grow the co-cultures must be well-balanced in view of the cost/benefits it provides to the whole farm
- Life cycles that do not overlap
- Transfer of disease/pathogen
- Pollution or over exploitation of resources
- Biosecurity.
- taste or smell of the algae because of the mussels (maybe?)
- Hinder of water currents in open sea-based sites.
- Challenges with mooring of the installations
- Collisions of vessels against hardware could be a great concern.



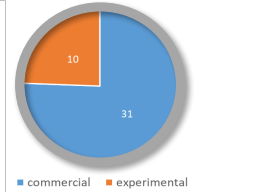
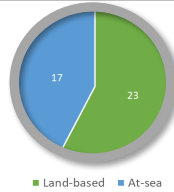
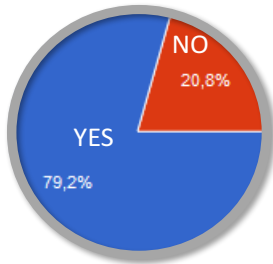
SLIDE 5



3.4 Technical, Environmental, Social and Economic Aspects of IMTA

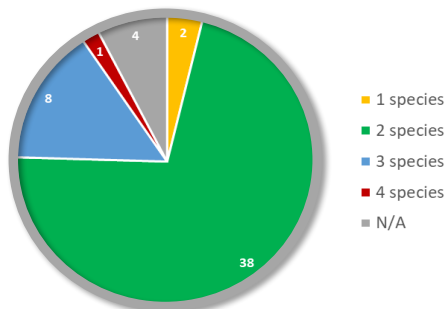
Minimum number of species in an IMTA system: From the 53 contributions, 52 have answered this question. There is consensus that two should be the minimum number of 'species' – but the point was made that it would be better to refer to trophic levels rather than species (Slide 6).

Are you aware of a successful IMTA operation (land-based or at sea)?



Main tested combinations are :
[Fish + macroalgae] and [Shellfish + macroalgae]

What is the minimum number of co-cultured species in an IMTA system ?



We should talk about trophic levels better than species



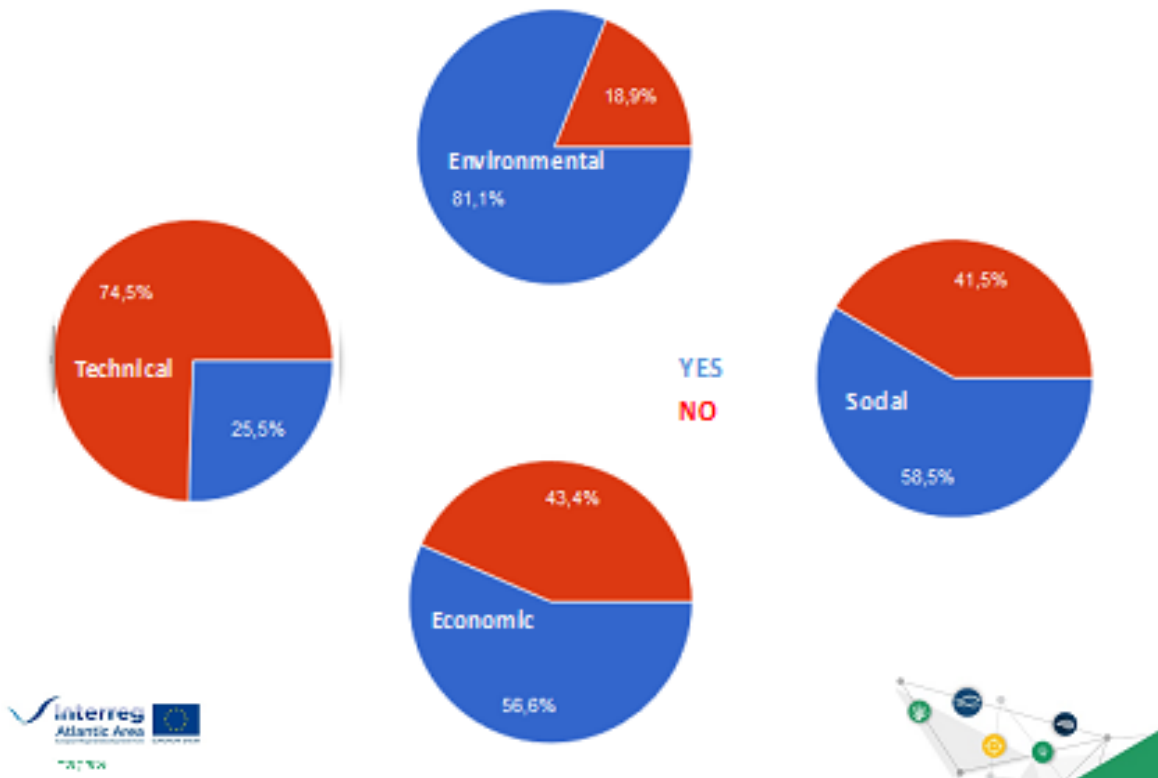
SLIDE 6



Types of benefit of IMTA: 81 % of respondents (N=53) considered IMTA to imply environmental benefits in the form of nutrient remediation (no other environmental benefits were specified), while there was a split around the 60:40 mark, in favour of social (31 YES ; 22 NO) and/or economic (30 YES : 23 NO) benefits being implicit, but without reaching a clear consensus.

For 38 contributors, technical benefits (i.e. shared infrastructure; disease mitigation etc.) were not considered important (Slide 7).

Does IMTA necessarily imply benefits?

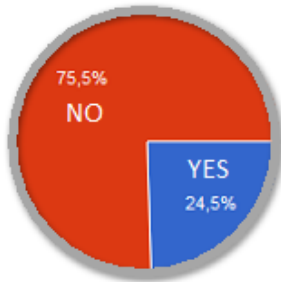


SLIDE 7



Revenue generation: All the 53 contributors have answered this question. While it was agreed that a direct revenue from each component in the system was not necessary (76 %), the overall system should be economically viable. Some components could provide indirect revenue through ecosystem services/taxes etc. (Slide 8).

Must producers generate revenue on all components of their farming operation for it to be considered IMTA ?



- Preferably, if you want to convince the aquaculture industry. Otherwise they won't take it seriously.
- The selection of co-species will consider its market value
- The activity must generate income. All levels must be profitable.
- Even if some parts will be more lucrative than others
- An increased economical profit in total is needed
- Maybe not all of them directly (reduction costs or taxes of emission).

Direct versus indirect revenue / benefit must be clarified

- Some components of the IMTA system may be needed for the actual system to function efficiently.
- If all the component are managed by one single structure/company.
- Some species could be included just for their environmental / social purposes creating a benefit in this sense but not a direct revenue.
- One component can be produced only for an internal use or for waste minimization.
- It is the overall system which has to be economically sustainable, not each component
- It may be just cost neutral to utilize some elements of IMTA
- IMTA defines the type of production system. Whether that system is economically viable or profitable is a whole other subject and should not be considered as part of the definition
- One of the components may pay for the whole system while the other can be seen just as a valuable input.
- But this would be the ideal scenario



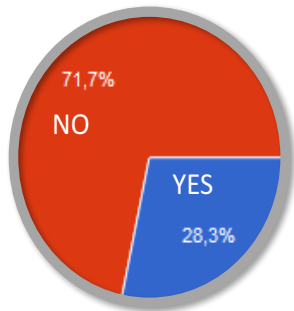
SLIDE 8



3.5 Geographic Scale

Co-management/ownership: All the 53 contributors have answered this question. While there is consensus single management of IMTA facilities is NOT necessary (72 %, Slide 9), nor ownership of all functional groups (91 %, Slide 10), in the case of multi-party ownership questions arose regarding the management of remediation; life-cycle overlap; equilibrium of trophic levels etc. – and how these would be managed, for example in incidental IMTA.

Must producers manage all components of the combined farming operation for it to be considered IMTA ?



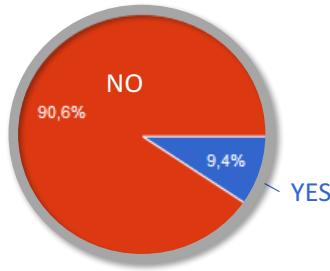
| | YES | NO |
|---|---|---|
| Single structures (centralized IMTA) | To keep equilibrium of the trophic levels | <ul style="list-style-type: none"> - Different farmers can work together depending on their own skills - « Passive » components with limited management |
| Different structures (dissociated IMTA) | Each producer has to manage its own production. | |



SLIDE 9



Must all functional groups in an IMTA system be owned by the same company or person?



- Separated species could be contracted out to a specialist
- Joint of experts to produce different organisms
- It is very difficult to find a company that would be good with all components.
- This is the key to success
- Co-cultures are often as or even more labor demanding.
- IMTA might be managed in its productive phases by different actors.
- A system is not necessarily linked to a company or a person
- In the case of large scale systems, may be managed by several actors
- It could be different operators operating in close proximity to each other
- IMTA is more a functional concept than an operational one
- Association among different companies could be an strength in the business

- At least the production components
- To be considered as a whole farm, it seems necessary to have one juridical identity
- An IMTA system should be single-owned and single-managed
- By the same company or to be on the same site, IMTA on larger scale will not solve nutrient emission issues otherwise

**Cooperation of different experts to combine and value their own skills
better than
Multi-skills single producers**

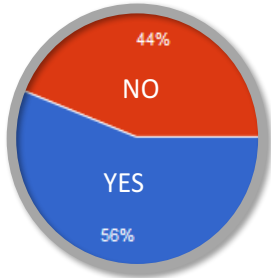


SLIDE 10



Energy/nutrient transfer & co-location of organisms: 51 people from the 53 contributors answered this question. There was no consensus about whether co-cultured species have to be located at the same farming site and no consensus about a minimum threshold of nutrient/energy remediation being necessary.

Does IMTA have to prove a minimum threshold of direct nutrient or energy flow irrespective of the geographic location of the different co-cultured species within the system?



What the threshold might be and how nutrient or energy flow be proved ?

- Otherwise, can we speak about IMTA anymore ?
- Any reduction in nutrient outflow is good.
- It depends of many factors : at-sea or land-based systems ; Species ; Scales of production...
- Economical relevant threshold
- Depending on the water quality thresholds from regulation
- Answers propose threshold from 10% to 50 %.

Why a minimum threshold is not needed ?

- To be managed on an ecosystem level.
- IMTA is a concept, not a formula. Giving numbers in regulations will make them extremely difficult to change or remove.
- There is no need to prove the direct link of nutrients between co cultures.
- This is very much site-dependent.

What could be an acceptable distance between the co-cultured species ?

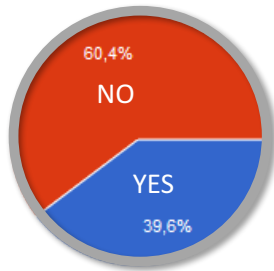
- Species must be cultured in very close proximity
- It will depend on the system (land-based or at-sea) and the combined species.



SLIDE 11



Do all co-cultured species in an IMTA system have to be located at the same farming site?



- Ecosystem management in ocean
- It depends on the nutrients recollection strategy.
- It depends of the site and of the location of the site.
- The most important is the global connection between the compartments
- Waste could be collected and move onshore.
- It will inhibit development of IMTA.
- Species may be located strategically in other to meet IMTA requirements.
- They just need to be contiguous
- De-coupled IMTA models may be possible and even easier to manage.
- But the flow of nutrients must be correct.

- Some countries regulate in water body level and not site level
- This is the idea of multi-trophic comes from.
- How explain exchange between species of there are not in the same location ?
- Exports of material to different locations can be considered as coproducts management more than integration
- It doesn't make sense to me if they are not ; Otherwise, it's not IMTA
- Need to be integration between the components of the system and with distance, the integration dissolves
- Otherwise we are talking about Area Based Management.
- It is the only way to ensure that the outputs from one of the species are actually used by the others.
- At least close or within a certain distance that not induce extra transportation costs.
- For the mutual beneficial interaction yes. For just bio-remediation no.
- The definition of site should not be the most important
- Proximity decreases cost

Key point will be to define how the compartments should be connected for IMTA

Ex. : Does transporting fish effluent by truck to a seaweed farm that is several kilometers away fit the concept of IMTA?



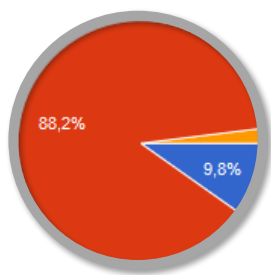
SLIDE 12



3.6 Regulatory Framework

Knowledge of IMTA Legislation: All 53 contributors answered this question. The large majority of respondents were unaware of any IMTA specific legislation either within (82 %) or outside (86 %) the EU. This was with the exception of Denmark’s L111 bill which makes approval of new sea farms or extension of existing farms possible where ‘compensatory’ measures are put in place. Comments also suggested other non-specific but IMTA relevant regulations or policies (Slide 13).

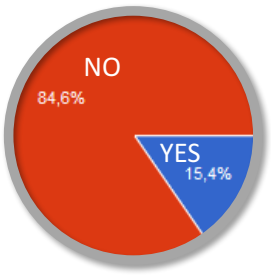
Do you know of any EU IMTA regulations?



- Yes
- No
- Wouldn't know

- Some locations do not allow for co-culture of organisms.
- There is a law in Denmark called L111, which covers the aspect.
- Certification of IMTA
- I only know of a policy indicating IMTA as a good practice (COM (2012) 494).
- In the Organic Cert regulation (EC710/2009), polyculture is mentioned as practice that can lead to organic cert.
- Allowable heavy metal concentrations in cultured seaweed

Do you know of existing IMTA regulations in other parts of the world?



- Canada, but still a lot of work to be done!
- UK licensing
- No specific IMTA regulations in South Africa, but it is used as a specific benefit included in EIA proposals, so potential benefits are known to the industry and government.
- Norway has strict aquaculture regulations. There are not yet regulations than safety for the fish farm and people, nature involved.
- South Africa allows co cultivation



SLIDE 13

3.7 Summary

From the analysis of the questionnaire several areas were identified that needed further teasing out, and these were formed into four sets of questions around the following themes:

- Global definition; inclusion of terrestrial organisms; no. of species
- Costs/benefits and IMTA system monitoring
- Integration and geographic scale
- Regulatory framework

These questions are elaborated in section 3 below.



4 INTEGRATE IMTA EVENT

The IMTA definition event took place on the 9th May 2019, at the Interreg Atlantic Area Joint Secretariat Facilities in the North Regional Coordination and Development Commission (Rua Rainha D. Estefânia, 251) Porto, Portugal. Introductory sessions outlining the INTEGRATE project, the aims of the day and the results of the questionnaire were followed by 4 presentations. These were geared towards giving participants summaries of different perspectives around the subject of defining IMTA and providing food for thought for the discussion sessions.

Participants were then split between “land-based” and “sea-based” groups, and each group was tasked with considering 4 topic areas (see section 4 below); each group was facilitated by a group leader, and minutes of the discussions were collated by a group rapporteur. After the group discussions, all participants re-convened and the rapporteur summaries were presented, prior to re-opening the discussion to the floor.

The programme can be found in Appendix 3.

4.1 DISCUSSION SESSION QUESTIONS

Session 1, Q1: Is it possible to find a global definition of IMTA that is suitable for all systems (land-based, marsh/lagoon, sea-based)? If not, should we define different criteria for each system?

Can IMTA include terrestrial organisms?

- Non soil-based organisms
- Soil-based organisms
- Any, once there is at least one aquaculture component in the system
- Can the fed component be terrestrial?

Should the definition refer to a minimum number of ‘compartments’?

- How many? (From the questionnaire, the consensus is ‘2’.)
- Is it compulsory to include both organic and inorganic extractives?
- Should these compartments refer to: Species? Trophic levels? Functional groups?

Session 1, Q2: From the questionnaire; there is broad agreement that environmental benefits (in the form of nutrient remediation) are implicit, but lack of consensus as to whether social or economic benefits should also be requisite.



- Should any other environmental ‘benefits’ be part of the definition?
- Should the possible net negative impacts of IMTA be included in its definition?
- What are the most appropriate bio-indicators of a functioning IMTA system?

Session 2, Q1: What does the ‘I’ in IMTA mean? With reference to geographic scale and co-location of IMTA compartments, how should the compartments be connected?

- Does transporting fish effluent by truck to a seaweed farm that is several km away fit the concept of IMTA?
- Should IMTA require proof of trophic/energetic connectivity?
- Is it compulsory to quantify the connectivity?

There is broad consensus that multi-party ownership is acceptable for IMTA. Is it compulsory to certify all components of an IMTA system?

Session 2 Q2: Do we have an existing regulatory framework that could be appropriate for IMTA?

- Do we need new regulatory instruments or can IMTA be monitored under the WFD/MSFD/nutrient trading schemes etc.?
- Is an IMTA specific standard required/appropriate or can it be incorporated into existing aquaculture standards?
- Would an IMTA eco-label be appropriate?

4.2 DISCUSSION SESSION REPORT

Session 1, Question 1:

A global definition of IMTA - is it possible or should we define different criteria according to each system?

Yes, it is possible and **necessary to have a global IMTA definition** including all its various iterations i.e. freshwater/marine; land-based/open-water; recirculating/flow-through, amongst others. It is essential that the definition be broad and all-encompassing so that it can be understood across the board, and this simple definition will be accompanied by a technical standard which can be detailed and layered. In this way, all stakeholder groups will be represented at an appropriate level of detail for their needs, and this will help to guarantee wider adoption of IMTA practices in the European Atlantic Area.

Are terrestrial organisms compatible with IMTA systems?

Although integrated systems can also include terrestrial organisms, all agreed that the **primary product and core activity** must be **aquatic**. The question remains as to how this



core activity should be determined? By economic value? By production volume? By nutrient output or uptake?

Number of species/compartments/functional groups/trophic levels?

Are phrases such as ‘trophic levels’ or ‘functional groups’ useful and easily understood by public and policy makers? Should we use something as complex, or use an all-encompassing, easier term? Neither trophic levels nor species are adequate terms. **Functional group** was agreed to be the most appropriate descriptor of the ‘unit’ in an IMTA system as it is the ‘function’ of each organism that dictates its compatibility alongside other organisms to create balanced IMTA.

As it is important not to constrain the definition too tightly and limit its use, prescriptive formulae such as ‘IMTA must include an excretive only organism’, or ‘IMTA must include both organic and inorganic extractive groups’ are not appropriate within a definition. But there must be a minimum number of two distinct functional groups, i.e. at least one **excretive species** and one **extractive**. This would move away from a ‘fed aquaculture’ definition, to one where the ‘income of nutrients’ is a defining factor – perhaps a change in perception of the system.

Similarly, quantification of the degree of trophic connectivity should not be specified in any definition. There should be broad scope for inclusion of all IMTA systems, whether these are strongly or weakly energetically connected. What matters are not absolute values, but that IMTA farms do not compromise functionality of the ecosystems in which they are situated.

A part of the discussion focused on management of the energy flow between organisms. There was a broad consensus that the **energy exchange** between them must be **intentionally managed**. This means it is possible to use wild organisms that proliferate naturally in IMTA systems if their proliferation is intentional and managed. For example, tilapia grown in green water that feed on naturally proliferating phytoplankton. What is imperative is the harvest/removal (not necessarily sale), of the secondary species that allows manipulation of nutrient cycles – the critical factor is the removal of biomass, and therefore control of, for instance, N and P, within the system.

Session 1, Question 2:

Environmental benefits versus social and economic benefits?

Food production needs aquaculture, and aquaculture needs to be sustainable and efficient. Therefore, the focus of the work should be towards increased sustainability and efficiency, *which the final definition should facilitate*. Neither a definition *per se*, nor IMTA-certification are end goals but aim at stimulation of good practice in industry via an economic incentive.



It is clear that social and economic benefits cannot be disassociated from environmental benefits – and that these benefits will have a bearing on various relations in areas where aquaculture is important - i.e. in areas with the tourist industry or where the image of aquaculture is a problem. These social and economic factors can be used as opportunities for communication and promotion of IMTA. However, the core-principle of IMTA is *multi-trophic*, as this is what singles it out from other types of aquaculture. IMTA is by definition an environmental concept as nutrient uptake is the core principle, therefore nothing else is necessary in order to define it.

So, although social and economic benefits are inevitable and coupled to environmental benefits, they should not be part of the definition; they are associated indirect effects. In fact, careful thought should be given before including such factors in any definition/standard as they can result in difficulty managing the expectations of those gaining certification by implying benefits that may, or may not, materialise.

SUMMARY SESSION 1

There should be **one global definition with sub-definitions** to accommodate the diversity of systems that constitute IMTA. The global definition should be **simple, aimed at legislators and policy makers and accompanied by a technical standard**, which can be exacting and layered. It could be possible to define different levels of IMTA accreditation depending on the system used.

The definition should contain reference to the following components:

- Principally aquatic
- Controlled/semi-controlled flow of nutrients
- Between 2 (or more), managed, functional groups
- The secondary (tertiary etc.) species must be harvested

The definition should NOT specify:

- The degree of trophic connectivity between compartments
- Social or economic performance markers

Session 2, Question 1:

What does the I in IMTA mean?

Integration issues are key – what are the geographical or space issues? Can they be better defined? Within land-based, closed systems (e.g. connected tanks, ponds, etc.) these are easy to demarcate, however in *open* systems (in oceans, seas, lagoons, lakes, rivers, etc.) there is a challenge in understanding and/or managing what goes where.

After the note made by Adam Hughes in his presentation about 60m nutrient dispersion distances, several participants mentioned the practical difficulties of establishing ‘true’ (i.e. direct nutrient transfer between functional groups) IMTA, as this can be very difficult to achieve operationally. It was stressed that the system has to be practical to implement. Related

to this, offshore farming might create an issue for IMTA – will IMTA still be relevant if large parts of the industry move offshore?

What is clear is that integration relates to the water connectivity rather than scale over which this connectivity occurs. The connectivity between functional groups must be initially proven, and after that a modelling approach could be used to anticipate and balance nutrient transfer. This lessens the burden of proof that would otherwise fall on the producers and is currently difficult and costly to carry out (e.g. isotopic tracing).

Importantly, a point was raised that it is not restrictive enough to talk only about connectivity. It is also possible that the impact of the emission at source is not dealt with even if there is an extractive culture downstream. In such a case, the system would be physically connected but near-field impacts would be missed. In his pre-event presentation, Chopin states; ‘The integrated in IMTA should be understood as cultivation in proximity, not considering absolute distances but connectivity in terms of ecosystemic functionalities’. This ‘connectivity in terms of ecosystemic functionalities’ perhaps is enough to capture the necessity of both physical connectivity between compartments and address emissions related impacts wherever they occur.

Session 2, Question 2:

New Regulatory Instruments?

It was concluded that we are not yet at the right stage to discuss the regulatory framework. It is not certain what should be monitored yet, and IMTA will have to comply with existing aquaculture legislation in any case. Furthermore, new regulations will add complexity to an already heavily regulated enterprise – There was concern that IMTA could make it more difficult for new developments to occur if it became a compulsory regulation by government, for example – (i.e. might the cost in development increase?)

However, if and when the time comes, there are tools to **adapt the existing regulation** and incorporate IMTA into existing frameworks. For example, above the national regulations sits the Marine Spatial Planning-Ecosystem Based Management (MSP-EBM) approach and it would be possible to introduce IMTA at this level. The re-evaluation cycles for the EU legislation, for example the Water Framework Directive (WFD), are reviewed every 6 years; therefore, it may be possible to incorporate IMTA by coordinating the timing with these re-evaluations. It was felt that whichever regulatory framework is adapted to include IMTA, it should *specifically acknowledge IMTA* in order to support its development. Underneath the broader regulatory framework within which IMTA eventually sits, new and specific legislation would be appropriate as, for example, fish and invertebrate industries currently conform to different regulatory standards.

Finally, the polluter pays principal was briefly discussed; what would the currency for this pollution to be measured in? Who will decide this, the farmer or the regulator? Currencies already exist for water, carbon etc., could

these be used? Which would best suit IMTA? No resolution to any of these questions was achieved.

IMTA specific standard/eco-label?

An IMTA specific eco-label is desirable in due course and should be industry driven, although it is important to clarify why a specific eco-label is more appropriate than incorporation of an IMTA section into already existing labels. One reason refers to the fact mentioned above that different aquaculture sectors conform to different standards. It could be possible in the future to have an IMTA 'system' certification, while currently, each species would have to apply individually for certification. The ASC have previously discussed the possibility of an IMTA system certification but felt that the data was not sufficient to inform it yet. It could be developed in the future, but more data is needed beforehand. Pilot and pre-commercial scale data should expand the knowledge of what an IMTA system is. This process also aims to clarify many of the issues about what is or is not IMTA, and whether the end result is an eco-label, the process itself is important in terms of further developing the industry.

5 DRAFT DEFINITION & TECHNICAL STANDARD

Definition:

The definition of IMTA must be broad enough. Due to the nature of the regulatory process, which requires concrete boundaries in order to draft associated monitoring and compliance terms, the tendency may be for it to become more restricted. For this reason it is imperative to keep this draft definition loose and flexible. The core elements for a definition are clear but need wording and validation:

0. aquaculture: enhanced production + harvesting + aquatic
1. two or more different functional groups
2. managed (demonstrated) nutrient flux

IMTA = Enhanced production of aquatic organisms (with or without terrestrial organisms) of two or more functional groups, that are trophically connected by demonstrated nutrient flows and whose biomass is fully or partially removed by harvesting to facilitate ecological balance.



Technical Standard:

This definition will be accompanied by a technical standard in which some, or all, of the following aspects (amongst others) will be treated in more detail.

- Scope –
 - the aim of this technical standard is to flesh out the definition to make it usable
 - It is aimed primarily/initially at regulators and policy makers
 - It relates to **ecological/environmental** aspects of IMTA as the definition does not relate to other (social/economic) aspects directly
- Sub-definitions – for different IMTA systems; land-based ponds/land-based tanks/at-sea, etc.
- Definition/scope of each term used in the proposed definition:
 - enhanced production
 - harvest
 - aquatic
 - functional group
 - trophic / trophically
 - demonstrated nutrient flow
- Specification – related to enabling assessment and/or monitoring IMTA installations:
 - Determination of the core activity – how will this work? By production volume? By economic value? By nutrient output/uptake? Other?
 - ‘Proof’ of trophic connectivity – What will be required?
- Monitoring/IMTA compliance – How will this be approached?
- Glossary of terms



6 APPENDIX 1: ATTENDEES

| No. | Name | Organisation | Country |
|-----|-----------------------------|--|-------------|
| 1 | Yngvar Olsen | EATIP/NTNU | Norway |
| 2 | Xinhua Yuan | FAO | Italy/China |
| 3 | Dénes Gal | Geofish Ltd. | Hungary |
| 4 | Laura Gagliardi | Interreg | Italy |
| 5 | Bertrand Jaquemin | CEVA | France |
| 6 | Damien Toner | BIM | Ireland |
| 7 | Erik Malta | CTAQUA | Spain |
| 8 | Jessica Ratcliff | NUIG | Ireland |
| 9 | Maria Galindo | NUIG | Ireland |
| 10 | Peter Bossier | Ugent | Belgium |
| 11 | Patricia Bianchi | MSC/ASC | UK |
| 12 | Dror Angel | University of Haifa | Israel |
| 13 | Adam Hughes | SAMS | UK |
| 14 | Lars Brunner | SAMS | UK |
| 15 | Marie Lesueur | Agrocampus Ouest | France |
| 16 | Pierre Eyrolles | Agrocampu Ouest | France |
| 17 | Marine-Océane Guillermand | ITAVI | France |
| 18 | Sofia Gamito | CCMAR/IPMA | Portugal |
| 19 | Gabriela Oliveira | IPMA | Portugal |
| 20 | Sónia Seixas | Univ. Aberta | Portugal |
| 21 | Luis Lozano Gutiérrez | Dalula Marine | Spain |
| 22 | Maria Emília Cunha | IPMA | Portugal |
| 23 | Gercende Courtois de Viçose | ULPGC | Spain |
| 24 | Carla Guimarães | Atlantic Area | Portugal |
| 25 | Ana Margarida Magalhães | APA/ARHAlgarve | Portugal |
| 26 | Sebastien Lefebvre | Univ. Lille | France |
| 27 | Sandra Tavares Silva | Interreg AA | Portugal |
| 28 | Tanía Afonso | JS | Portugal |
| 29 | Ana Isabel Lillebø | Univ. de Aveiro | Portugal |
| 30 | Ricardo Calado | Univ. de Aveiro | Portugal |
| 31 | Clive Dove | CSIC | Spain |
| 32 | Rui Pereira | ALGAPLUS | Portugal |
| 33 | Martha Dunbar | CTAQUA | Spain |
| 34 | Kate Dempsey | Aqualicense | Ireland |
| 35 | Barbara Pitarma | ALGAPLUS | Portugal |
| 36 | Jose Cabello | CTAQUA | Spain |
| 37 | Rita Araujo | JRC | Italy |
| 38 | Anna Soler | ISC | Ireland |
| 39 | Dieter Auner | ISC | Ireland |
| 40 | Amir Neori | Morris Kahn Research Station; University of Haifa | Israel |



7 APPENDIX 2: QUESTIONNAIRE

Project INTEGRATE – IMTA in the Atlantic Area and discussions about a European consensus definition of IMTA

INTEGRATE is an Interreg Atlantic Area project launched in 2017 to strengthen transnational networking amongst academia, business-industry groups and civil society on the topic of eco-efficient aquaculture through a territorially-based collaborative approach.

Project INTEGRATE is asking relevant experts to provide their input prior to an event where we will discuss Integrated Multi-Trophic Aquaculture (IMTA) and the need for a European consensus definition of IMTA. Your answers to this questionnaire will contribute to facilitating meaningful discussions.

For more information about the project and upcoming events please visit our website at www.integrate-imta.eu

Follow us on Twitter @INTEGRATE_IMTA and LinkedIn

Contact details for follow-up

We may contact respondents individually for the purpose of follow-up work. Please give us your e-mail address if you wish to be contacted in the event of follow-up consultation - note that not all respondents may be contacted. Your e-mail address will only be used for project purposes and will not be passed on to anyone outside project INTEGRATE.

1. Please type in your e-mail address if you wish to be contacted in the event of follow-up consultation.
2. Please tick the box if you wish to be considered for participation at INTEGRATE events
 - I wish to be considered for participation at INTEGRATE events.

About yourself

3. Please describe your field of expertise:

The Concept of IMTA

4. Does IMTA need to be defined?
Mark only one:
 - a. Yes
 - b. No
 - c. Undecided
5. Do you use other terms to describe IMTA?
Mark only one:
 - a. Yes
 - b. No
6. If your answer to the previous question was yes, please provide other terms that you normally use to refer to IMTA:

7. Please select five keywords from the list below to illustrate IMTA. You may also choose to add a keyword of your own.

Check all that apply:

- a. Sustainable
- b. Recycling
- c. Diversification
- d. Bioremediation
- e. Trophic relations
- f. Disease prevention
- g. Pathogen modulation
- h. Nutrient credits
- i. Resource efficiency
- j. Eutrophication
- k. Risk spreading
- l. Biotechnology
- m. Multidisciplinary
- n. Primary producers
- o. Ecological engineering
- p. Eco-friendly
- q. Eco-efficient
- r. Zoo-technology
- s. Benthic amelioration
- t. Seafood
- u. Circular economy
- v. Nutrient sequestration
- w. Polyculture
- x. Capacity enhancement
- y. Detritivores
- z. Filter feeders
- aa. Spatial economy
- bb. Phytoplankton
- cc. Microbiota
- dd. Blue economy
- ee. Environment
- ff. Fish
- gg. Seaweed
- hh. Shellfish
- ii. Aquaculture
- jj. Reduced impact
- kk. Smart growth
- ll. Other:



Key Aspects of IMTA - technical, environmental social and economic issues

8. Are you aware of a successful IMTA operation (land-based or at sea)?
Mark only one:
 - a. Yes
 - b. No
9. If your answer to the previous question was yes, please describe your best example of an IMTA operation. Specify location (land-based or at sea), number of co-cultured species, etc.
10. Please explain why this is a good example of IMTA
11. Please specify if your example of an IMTA operation is commercial or experimental.
12. Please describe the co-cultured species at your IMTA example.
13. In your opinion, what is the minimum number of co-cultured species in an IMTA system?
14. Does IMTA necessarily imply environmental benefits?
Mark only one:
 - a. Yes
 - b. No
15. If your answer to the previous question was yes, please describe the environmental benefits.
16. Does IMTA necessarily imply technical benefits?
Mark only one:
 - a. Yes
 - b. No
17. If your answer to the previous question was yes, please describe the technical benefits
18. Does IMTA necessarily imply social benefits?
Mark only one:
 - a. Yes
 - b. No
19. If your answer to the previous question was yes, please describe the social benefits
20. Does IMTA necessarily imply economic benefits?
Mark only one:
 - a. Yes
 - b. No
21. If your answer to the previous question was yes, please describe the economic benefits
22. Would you consider that combinations of terrestrial farming operations (livestock, agriculture, etc.) and aquaculture are a type of IMTA?
Mark only one:

- a. Yes
 - b. No
23. Please explain your answer to the previous question.
24. Must producers generate revenue on all components of their farming operation for it to be considered IMTA?
Mark only one:
- a. Yes
 - b. No
25. Please explain your answer to the previous question.
26. Must producers manage all components of the combined farming operation for it to be considered IMTA?
Mark only one:
- a. Yes
 - b. No
27. Please explain your answer to the previous question.

Key aspects of IMTA - Interactions between co-cultured species

28. What do you consider to be the most important interaction(s) between the co-cultured species in an IMTA system?
29. Please explain why you consider these the most important (or with respect to what, e.g. environmental or economic benefit, etc.).
30. Do you think there are interactions that can have a negative effect on aquaculture in an IMTA system?
Mark only one:
- a. Yes
 - b. No
31. If your answer to the previous question was yes, please describe the negative interactions and their effects on IMTA systems

Key aspects of IMTA - Geographic scale

32. Must all functional groups in an IMTA system be owned by the same company or person?
Mark only one:
- a. Yes
 - b. No
33. Please explain your answer to the previous question.

34. Do all co-cultured species in an IMTA system have to be located at the same farming site?

Mark only one:

- a. Yes
- b. No

35. Please explain your answer to the previous question.

36. Does IMTA have to prove a minimum threshold of direct nutrient or energy flow irrespective of the geographic location of the different co-cultured species within the system?

Mark only one:

- a. Yes
- b. No

37. If your answer to the previous question was yes, please suggest what the threshold might be and how must nutrient or energy flow be proved.

38. If your answer was no, please explain why a minimum threshold is not needed. What then could be an acceptable distance between the co-cultured species?

Key aspects of IMTA - Regulatory framework

39. Do you know of any EU IMTA regulations?

Mark only one:

- a. Yes
- b. No

40. If your answer to the previous question was yes, please specify.

41. Do you know of existing IMTA regulations in other parts of the world?

Mark only one:

- a. Yes
- b. No

42. If your answer to the previous question was yes, please specify.

REMARKS

43. Please leave your remarks here:



8 APPENDIX 3: Programme of the Event



Integrate Aquaculture:
an eco-innovative solution to
foster sustainability in the
Atlantic Area

09 MAY 2019
PORTO- Portugal

INTEGRATE IMTA Event
Definitions of Integrated Multi-Trophic
Aquaculture: towards a policy concept
of IMTA in the Atlantic Area –
bottlenecks and opportunities

PROGRAMME

8.15 – 8.45h: ARRIVAL AND REGISTRATION

8.50 – 9.00h:

Welcome Address – *Sandra Tavares da Silva, Executive Manager of the Interreg Atlantic Area Managing Authority*

9.00 – 11.00h:

Introductory Session – Project INTEGRATE and the need for a European definition of IMTA

1. Introduction:

Brief presentation of the INTEGRATE Project
Erik-Jan Malta, Project Manager, Aquaculture Technology Centre (CTAQUA)

Results of the online questionnaire

Bertrand Jacquemin, Project Manager, Centre d'Étude et de Valorisation des Algues (Ceva)

Aims of the day; overview of the process for the day

Luis Lozano Gutiérrez, Consultant on Blue Growth and marine issues, Co-Founder Dalula Marine SL, Moderator of the IMTA Definition Event

2. IMTA towards a Sustainable Aquaculture

Xinhua Yuan, Senior Aquaculture Officer, Aquaculture branch, Fisheries and Aquaculture Department, Food and Agriculture Organization of the United Nations (FAO)

3. Models of land-based IMTA developed in Israel

Amir Neori, Senior Scientist at the Israel Oceanographic and Limnological Research (IOLR), National Center for Mariculture

4. Trade-offs in European IMTA: who benefits and who pays?

Adam Hughes, Senior Lecturer in Sustainable Aquaculture, Scottish Association for Marine Science (SAMS)

5. Seaweed certification - considerations and challenges

Patricia Bianchi, Seaweed Account Manager for the Aquaculture Stewardship Council (ASC) and Marine Stewardship Council (MSC).



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11.00 – 11.20h: Coffee Break

11.30 – 13.30h:
Discussion Session 1 - Facilitated group discussion

13.30 – 14.30h: Lunch

14.40 – 16.40h:
Discussion Session 2 - Facilitated group discussion

16.40 – 17.00h: Coffee Break

17.05 – 17.50h:
Wrap-up and closure; conclusions and summary comments from the day
Luis Lozano Gutiérrez. Consultant on Blue Growth and marine issues. Co-Founder Dalula Marine SL. Moderator of the IMTA Definition Event.

20.00h – open: Joint dinner



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Atlantic Area

INTERREG Atlantic Area 2014-2020 Project EAPA_232/2016

 **COORDINATOR**
Fundación Centro Tecnológico Acuicultura de Andalucía
(CTAQUA)



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WP4 Coordinators/Report Editors: Jessica Ratcliff and Bertrand Jacquemin

Date: 6/12/2019

