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# Guidelines for the application of an ecosystem approach for development of sustainable aquaculture in ORs and OCTs

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# 1. Summary

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Given the relevance of Outermost Regions (ORs) and Overseas Countries and Territories (OCTs) in the European maritime policy context, with their intrinsic huge marine biodiversity and its potential for Blue Growth, it was considered essential to address the issue of aquaculture as part of the European Blue Economy Strategy and Maritime Spatial Planning Policy in the ORs and OCTs.

An International Workshop on “*Application of an Ecosystem Approach for the development of Sustainable Aquaculture in ORs and OCTs*” was organised as part of the Ecoaqua project ([www.ecoaqua.eu](http://www.ecoaqua.eu)) from 13 to 16 July 2015 at the University of Las Palmas de Gran Canaria (ULPGC), Canary Islands, Spain. The workshop was attended by experts representing different ORs (Spain, Portugal, France) and OCTs (New Caledonia and OCT Association) together with regional, national and European administrations, as well as representatives of international bodies such as FAO and IUCN.

*“An ecosystem approach to aquaculture (EAA) is a strategy for the integration of the activity within the wider ecosystem such that it promotes sustainable development, equity, and resilience of interlinked social-ecological systems.”*

The EAA is guided by three strategic principles:

1. Aquaculture development and management should take account of the full range of ecosystem functions and services, and should not threaten the sustained delivery of these to society.
2. Aquaculture should improve human well-being and equity for all relevant stakeholders.
3. Aquaculture should be developed in the context of other sectors, policies and goals as appropriate.

The EAA, shaped on the basis of the FAO Code of Conduct for Responsible Fisheries (CCRF), builds on these principles to provide a planning and management framework for integrating the aquaculture sector effectively into local planning. The approach provides clear mechanisms for producers and government authorities to engage with one another for the effective sustainable management of aquaculture operations by embracing simultaneously the environmental, socio-economic and governance objectives of the sector (FAO, 2010).

The Workshop identified different challenges, which hamper the development of marine aquaculture production in the Outermost Regions and Overseas Territories and Countries. The main challenges identified during

the workshop were:

- The development of monitoring techniques to assess continuously the production processes contributing to:
  - Improve production efficiency
  - Improve welfare and growth
  - Improve escapees/accidents management
  - Estimate site carrying capacity
- Development of cost effective production systems to better manage and reduce the costs of feed and/or energy.
- Implementation of marine spatial planning tools to speed up the site allocation administrative process.
- To improve the selection of suitable production sites together with alternative production techniques such as “Off shore” structures or IMTA and recirculation systems to reduce nutrient discharges.

Such actions together with improved feed sustainability will facilitate the development of innovative production technologies, contributing to reduce production costs and foster environmentally friendly activities.

Besides, improved communication and educational activities were mentioned as strategies to improve the aquaculture image, increase awareness towards the sector and facilitate the integration of this marine production activity within local societies.

Generally, the reduction of administrative burdens; was identified by the representatives of ORs and OCTs; as one of the main issues to be tackled to facilitate the expansion of aquaculture activities.

Challenges that were identified as capable of contributing to foster aquaculture development more specifically in the OR's and OCT's were:

- The selection of local species, adapted to their environment, that would contribute to differentiate the products and target local and niche markets together with the development of labelling, certification and marketing strategies common to OR's and OCT's
- The setting up of producers organisations
- The use of technological transfer centres to facilitate knowledge transfer between OR's and OCT's partners

All participants agreed on the need for producing a concise document (i.e. guidelines) to inform concerned coastal and maritime stakeholders and decision-makers with crucial and sound information. Thus, the EcoAqua staff, together with various scientists and stakeholders, has been working in the definition of a Guideline document to tackle those main challenges and foster sustainable aquaculture production under an ecosystem approach in

EU Overseas.

This document provides an overview of the environmental, social and economic characteristics of ORs and OCT, describes the main bottlenecks encountered in each thematic area and provides information on the state of the art for each of them. Finally it aims at providing a set of recommendations, based on robust scientific information, to promote Sustainable Aquaculture practices in the EU Overseas.



## 2. Introduction

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The Blue Growth initiative implies harnessing the full potential of Europe's oceans, seas and coasts for creating jobs, for creating value and for sustainable development. Five sectors are considered to hold high potential for this sustainable Blue Growth: **Aquaculture, Biotechnology, Coastal & maritime tourism, Mineral resources** and **Renewable energy**.

Over the past sixty years, at a global level, the wild capture fisheries remain more or less stable while aquaculture continues to grow (FAO, 2016), contributing more and more to the human seafood basket. According to OCDE (2012), total seafood production volume is getting above that of beef, pork or poultry, thanks to Aquaculture which is increasing, whereas capture fisheries is at best stable for the past thirty years at about 90 million tons. In 1980, aquaculture supplied 9% of seafood, today it represents more than 45% of seafood and by 2030, aquaculture is expected to supply 83 million tons.

Aquaculture is, thus, the fastest expanding global animal food production sector and is a key future contributor to food security globally. An increase in food security will be dependent upon the development and improvement of sustainable practices. It is becoming more and more evident that given the potential of aquaculture in converting feeds into food in the most efficient manner, more attention is needed to consolidate the sector at all levels and in all regions of the world.

The FAO Code of Conduct for Responsible Fisheries prepared the grounds for the EAA first by introducing the principles of sustainable development from the 1992 United Nations Conference on Environment and Development and Agenda 21 (UN 1992) in fisheries. In a similar manner, the EAA has been instrumental in raising awareness of the importance of these principles and placing them at the heart of aquaculture planning and the work of those supporting and acting for the development of the sector.

Aquaculture involves a number of groups: plants, bivalves, crustaceans and finfish. A socially and environmentally acceptable way to develop sustainable aquaculture in marine and coastal areas is to use an ecosystem approach.

European lead in the sustainable aquaculture development can indeed contribute towards such an approach at the global level. Existing initiatives such as the **European Aquaculture Technology and Innovation Platform** (EATiP, <http://www.eatip.eu/>) illustrate the European potential to contribute to increase food security through the development and improvement of sustainable practices.



Similarly, the **Sustainable Aquaculture Technological Platform** of the IU-ECO AQUA (<http://www.ecoaqua.ulpgc.es/Platform>) can indeed contribute towards sustainable aquaculture development at a global and regional level.

Given the importance of Outermost Regions (ORs) and Overseas Countries and Territories (OCTs) in the European maritime geography, its intrinsic huge marine biodiversity and its potential for blue growth, it is considered essential to address the issue of aquaculture as a key element of the maritime policy in the ORs and OCTs.

Bearing this in mind, the objectives of the EcoAqua Project were designed to create and consolidate research excellence in Sustainable Aquaculture under an Ecosystem Approach, to strengthen the development of existing research lines within the ULPGC to further enhance research capacities on Aquaculture in ORs and OCT's through the establishment of collaborations and exchange of knowledge between overseas regions and territories. The final aim is to promote best practices in sustainable aquaculture within the local environment of different ORs and OCTs taking into account associated interactions.

## 3. Scope and main objectives

EU Overseas comprises the largest EEZ of the World, with impressive assets of marine life and valuable biological resources. In many cases, the low visibility of EU Overseas on mainland/EU policies precludes the uptake and consideration of its specific challenges and biological assets / resources. In order to highlight the marine opportunities being offered by these territories to contribute to the European Blue Growth Strategy, the outcomes of various consultation processes are synthesized in the form of guidelines

These guidelines are intended to provide useful **recommendations** to foster **sustainable aquaculture practices** in the **EU Overseas under an ecosystem approach**, taking into account local realities and integrating new available knowledge.

### Ecosystem approach to aquaculture definition:

“An ecosystem approach to aquaculture (EAA) is a strategy for the integration of the activity within the wider ecosystem such that it promotes sustainable development, equity and resilience of interlinked social-ecological systems.” (FAO, 2010)

Knowledge-based scientific approaches at various scales, from island to regional level, will allow the implementation and facilitate implementation of research results to strengthen **EU Overseas Blue Economy**, especially in biodiversity conservation and marine aquaculture sustainable production processes.

These guidelines are based on the main conclusions reached during an **International Workshop** on the **Application of an Ecosystem Approach for the development of Sustainable Aquaculture in ORs and OCTs** organized by the EU EcoAqua project in July 2015 and consulting processes with diverse coastal stakeholders at local, regional, national and international levels.

The Workshop involved the participation of more than 30 stakeholders of diverse backgrounds, representing different ORs (Spain, Portugal, France) and OCTs (OCT Association and New Caledonia) as well as regional and national authorities and representatives of international organizations such as the European Commission, FAO and IUCN (Fig. 1).

One of the main outputs from that Workshop was the identification of different thematic challenges (Table 1) that are hampering the development of marine aquaculture production in the Outermost Regions as well as in the Overseas Territories and Countries. As a result, there is a clear need for a concise document based on keystone and robust scientific information to inform concerned coastal stakeholders and decision-makers.



*Figure 1: Working group activity during the July 2015 EcoAqua Workshop.*

In this sense, this document proposes a range of measures which can serve as reference material to different actors concerned: Aquaculture production sector, the Maritime sector, the Tourism sector, other maritime industrial sectors as well as environmental NGOs.

These guidelines also provide a roadmap for administrations, decision makers and politicians in order to foster a robust trend of responsible aquaculture development under an ecosystem approach in the EU's Overseas, taking fully into consideration the intrinsic local characteristics.

**Table 1:** Summary of main thematic Challenges identified at various level of consensus (**Green:** High consensus; **Blue:** Medium consensus; **Red:** Low consensus) among participants during the July 2015 EcoAqua Workshop.

Technology	Economics	Legal and Societal	Environment
<ul style="list-style-type: none"> <li>- Production of local species adapted to local demand and offer.</li> <li>- Improvement of feeds efficiency distribution within sea cages to control discharges.</li> <li>- Implementation of technologies enabling monitoring of environmental parameters.</li> <li>- Implementation of IMTA (Integrating Multi-Trophic Aquaculture) and recirculation systems.</li> <li>- Use of microalgae as sources of protein and fatty acids.</li> <li>- Development of autonomous offshore facilities and offshore technology innovation for aquaculture.</li> <li>- Innovation in technology to design and develop solutions to prevent escapees.</li> <li>- Increase capacities of human resources</li> <li>- Use of technological tools for site selection and management (MSP).</li> <li>- Development of easy &amp; standards tools for Environmental Impact Assessment (EIA) (LCA analysis).</li> <li>- Scientific support to help local administration's to develop aquaculture.</li> <li>- Increase individuals' traceability in aquaculture.</li> </ul>	<ul style="list-style-type: none"> <li>- Establishing aquaculture lobbying, products labelling and marketing strategies highlighting European aquaculture products.</li> <li>- Development of cost effective production systems through table market prices, establishing measures to stabilise and reduce the costs of feed and/or energy.</li> <li>- Favour local production through regulation of importations.</li> <li>- Reduce distance to the markets and transport costs.</li> <li>- Diversification of production and creation of market for new local species</li> <li>- Creation of Marine parks</li> <li>- Acceptability of aquaculture, public awareness and public image</li> <li>- Development of fiscal instruments towards sustainability</li> <li>- Establishing strategic planning and legal framework (regional and local level) to foster competitiveness at equal levels playing fields</li> </ul>	<p style="text-align: center;"><b><u>Licenses and Legal issues:</u></b></p> <ul style="list-style-type: none"> <li>- Labelling, Traceability &amp; Competitiveness.</li> <li>- Increase administration expertise.</li> <li>- Simplify and facilitate aquaculture legislation: reduce license acquisition delay, integration with other activities and reduce the plurality of administrations (E.U./country/regional).</li> <li>- Appropriate penalties/fines for poachers and the setup of rapid environmental assessment matrix adapted to ORs &amp; OCT.</li> </ul> <p style="text-align: center;"><b><u>Public awareness/perception issues:</u></b></p> <ul style="list-style-type: none"> <li>- Education regarding aquaculture to foster social acceptance and valorisation of the sector.</li> <li>- Increase transfer knowledge between stakeholders (producers, researchers and administration).</li> <li>- Promote inter-professional dialogue between producers, fishermen, and importers.</li> <li>- Disseminate information and promote actions to improve aquaculture image (e.g. health benefits and sustainability, Aquaculture festivities and aquaculture tourism)</li> <li>- Promote the development of fair trade in the sector.</li> </ul> <p style="text-align: center;"><b><u>Local integration of aquaculture</u></b></p> <ul style="list-style-type: none"> <li>- Develop and boost local economy through aquaculture</li> <li>- Reduce Usage conflicts between activities sectors (aquaculture vs tourism).</li> </ul> <p style="text-align: center;"><b><u>Education &amp; Training:</u></b></p> <ul style="list-style-type: none"> <li>- Develop educational instruments in schools, supermarkets, and media to improve the acceptance of the aquaculture in the society.</li> <li>- Increase/ promote aquaculture literacy</li> </ul>	<ul style="list-style-type: none"> <li>- Improve site selection, site management, ecosystem health and characterization of the farm impact by modelling of biological and physical data on environmental and production carrying capacity to obtain simple tools that facilitate administrative decisions</li> <li>- Develop sustainable feeds, improving feed efficiency and feeding strategy. Develop sustainable local feed production.</li> <li>- Develop technologies to control nutrient discharge and facilitate their recycling (IMTA, RAS).</li> <li>- Establish planning process for aquaculture development in accordance with the local expectations and set up aquaculture models adapted to specificities of outermost territories.</li> <li>- Prevent escapees.</li> <li>- Develop aquaculture of native local species.</li> <li>- Reduce gas emission and carbon footprint of aquaculture and assess their impact at all stages of a product's life (LCA analysis).</li> <li>- Improve seed production techniques contributing to the regulating of the use of wild seeds.</li> </ul>

## 4. Geographical, biological and socio-economic context

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Besides the countries and islands surrounding the European continent, the European Union has a much larger Economic Exclusive Zone (EEZ) because of the diverse overseas entities. Outermost Regions (ORs) and Overseas Countries and Territories (OCTs) of Europe – collectively named hereafter as EU Overseas – are mainly located in the tropical and subtropical regions of the World, sharing unique and remarkable natural, social and economic characteristics.

EU Overseas cover an area of 4.4 million km<sup>2</sup>, equivalent in size to continental Europe, and have a combined Exclusive Economic Zone of over 15 million km<sup>2</sup>, the largest in the World. EU Overseas are mostly islands or archipelagos most of them scattered in 4 regions (Caribbean, Macaronesia, Indian Ocean and Pacific) and oceans with a large range of geo-climatic characteristics, high and distinctive biological diversity and drivers. The EU overseas entities are also home to an outstanding diversity of species, ecosystems and landscapes. These 34 regions and territories host around 70 % of Europe's species and are recognized as representing a significant part of global biodiversity. Most of their biodiversity components are still unknown, especially in the marine / coastal ecosystems. At the same time, those islands are isolated, with limited land space and high ratio of coastline, vulnerable to natural disasters and increasingly impacted by human activities.

From the socio-economic perspective, these territories exhibit diverse patterns of interactions with nature, with local knowledge and traditional approaches to exploit natural resources sustainably (Netbiome-CSA, 2016); have original levels of interrelations and cooperation, with their respective member state, with the European Union and within their regional environment; a common aspiration for socio-economic growth, which is largely dependent on natural resources (living and non-living, terrestrial and marine) and its productive sectors suffer from fragmentation, distance to main markets and lack of critical mass of capacities.

The islands have all different conditions of size, population, infrastructures, modes of governance, institutional knowledge, financial and social structures, etc... meaning that the structure and process of every challenge is unique, although presenting common characteristics. Therefore each of the islands clearly stands to benefit

from the experiences of the others and always have something to learn from each other.

In many cases, the low visibility of EU Overseas on mainland/EU policies precludes the uptake and consideration of its specific challenges and the economic exploitation of its marine biological resources in a sustainable way.

In many ORs and OCTs areas, tourism is the mainstream economic activity based largely on the cultural services provided by local natural biodiversity, although the primary sector (Fisheries, Agriculture, Husbandry and Forestry), is recognized as socially important. Although distant from each other, and administered differently according to their nationality and status, these territories share similar constraints for the development of their respective aquaculture sectors through a sustainable and ecosystem approach. Just to provide an insight on the difficulties encountered we can cite: **insularity, distance from markets, additional costs of supply, costs for export, protection of fragile ecosystems, conflictive use of the coastal zone, absence or insufficient overall spatial planning that integrates coastal activities, image of the aquaculture products, lack of skills, lack of knowledge, binding regulations and finally lengthy administrative procedures.**

Marine aquaculture is an emerging industrial sector in various overseas regions and territories, with an array of tropical and subtropical marine species with high potential for feasible economic production. The development of aquaculture must be considered as an integral part of their strategy to reach food self sufficiency, while reducing importations, and it is of the greatest interest to ensure that the development of this sector follows sustainable criteria.

## 5. Guidelines

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The ORs and OCTs are remote areas from continental Europe that, thanks to recent tourism industry expansion, support an increasing population growth, and needs to import a large quantity of food products for local consumption. In most cases, artisanal fisheries do not provide enough to cover the demand.

Sustainable aquaculture research and technology have to be fully developed to initiate innovative approach for aquaculture development within the Ecosystem-based approach to improve European marine food production and design an effective and innovative research governance framework based on sound scientific knowledge.

Moreover, this scientific knowledge needs to be extended among Economic and Social Sectors (industry, local SMEs and other relevant private/public actors) whereas the public awareness about the sector has to be created/strengthened through dedicated Workshops and Conferences and other dissemination and promotional activities in order to develop adapted and appropriate future management schemes.

The selection of the different thematic aspects related to the development of sustainable aquaculture practices under an ecosystem approach in the EU Overseas reflect the outcomes of the International Workshop organized in July 2015 at the facilities of the University Research Institute IU-ECO AQUA and diverse consultation processes undertaken by the EcoAqua Research Team with concerned partners and a number of stakeholders. In this sense, the recommendations included in this document are the main conclusions of this extensive consultation process including the review of key publications related to sustainable aquaculture production.

The implementation of sustainable aquaculture production is foreseen through a variety of measures, which are based on robust science and practitioner's experiences. Table II displays the major recommendations that were defined by the participants in the July 2015 Workshop. These recommendations are organized following the same four pillars identified as High Challenges for the Sustainable Aquaculture Development in ORs and OCTs.

Table 2: Major recommendations linked to the High Challenges identified during the July 2015 EcoAqua Workhsop.

Technology	Economics	Legal & Societal	Environment
Use of innovative technological tools for site selection	Differentiation of the products (specificity, quality) through associated labelling, certification and marketing strategies	Reduction of administrative burdens to license aquaculture production sites	Adopt a Marine Spatial Planning Strategy to allocated aquaculture production sites among other coastal users
Development of “Off shore” adapted aquaculture structures	Target local and niche markets with added-value aquaculture products	Increase aquaculture awareness through communication and education	Improve feed sustainability
Implementation of IMTA and Recirculation Systems to reduce nutrient discharges	Reduction of production costs	Increase of the integration of aquaculture within local societies	Define the carrying capacity of selected aquaculture sites
Adoption of monitoring techniques to evaluate continuously the efficiency of production processes, wastes and welfare of animals	Enhance the setup of producer organizations based in ORs and OCTs	Develop easy to apply & standards tools for Environmental Impact Assessment (EIA).	Develop innovative environmentally friendly production technologies
Use of technological transfer centres to facilitate knowledge transfer among OR's and OCT's partners	Support and develop Market Access Strategies common to OR's and OCT's		Implementation of techniques to avoid escapees / accidents



Various specific topics fall under one specific Challenge pillar or across several of them. Each topic is described with series of specific recommendations illustrated by existing actions that are taking place in diverse ORs or OCT'S. The aim of these recommended measures is to avoid the related bottlenecks and to guide future implementation of sustainable marine aquaculture practices at different scales: local, island, archipelago, region and international.

## **CHALLENGE TECHNOLOGY / ENVIRONMENT**

TOPIC: **Choice of species**

**Recommended measures:**

- **The choice of species for farming purposes in the ORs and OCTs should principally be of local origin. (Fig. 2)**



Figure 3: *Lodianus sebae* production New Caledonia. (Picture: AquariumfishNC)



Figure 2: *Tridacna maxima* French Polynesia (Picture: DRMM-PF)

- **In order to maintain the local biodiversity and for ensuring either restocking activities or seafood production, the species of interest should be chosen from an established local stock or population. (Fig. 3) (Fig.4)**



Figure 4: *Seriola dumerili*, Canarias (Picture: IU-ECOQUA)



- In the case of species, which have already been introduced, they should have been established over several generations within the geographical area. (Fig. 5)

Figure 5: *Macrobrachium rosenbergii* introduced in 1977 in Guadeloupe. (Picture: François Herman)

## CHALLENGE TECHNOLOGY / LEGAL & SOCIETAL / ENVIRONMENT

### TOPIC: interactions with wild marine biodiversity

#### Recommended measures:

- Any aquaculture initiative should consider the maintenance of local biodiversity as a prime criterion. (Fig. 6) (Fig.7)



Figure 7: Sensitive seagrass meadow and school of fish nearby fish cages. (Picture: IU-ECO AQUA)

- As mentioned above, the choice of species selected for farming should not have any adverse effects on the overall trophic chain. There should be no possible negative interaction between farmed species and endangered and / or endemic species. (Fig. 8).



Figure 6: Pearl oyster farm French Polynesia. (Picture:DRMM-PF)

- Escapees from aquaculture sites should be prevented and contingency plans associated to mitigations measures need to be contemplated and implement in



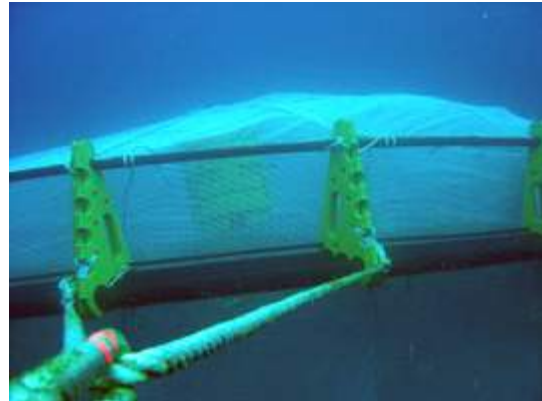
Figure 8: *Sciaenops ocellatus* Guadeloupe. (Picture: Francois Herman)

## **CHALLENGE TECHNOLOGY**

TOPIC: **innovative off-shore production**

**Recommended measures:**

- **Given the potential of the ORs and OCTs in terms of geographical areas available to European Blue Growth bio-economic initiatives, appropriate incentives should be sought to fully exploit and apply existing technologies developed in mainland Europe for off-shore or near off-shore farming based on appropriate site selection procedures. (Fig. 9) (Fig. 10)**
- **Full application of multi-user platforms including aquaculture can be really demonstrated in ORs and OCTs.**



*Figure 9: Submerged off-shore cage Guadeloupe. (Picture: François Herman)*



*Figure 10: Off-shore fish farm Madeira. (Picture: Carlos Andrade)*

## **CHALLENGE TECHNOLOGY / LEGAL AND SOCIETAL**

TOPIC: **Welfare, diseases and parasites**



*Figure 11: Pagellus bogaraveo juveniles Madeira. (Picture: Carlos Andrade)*

**Recommended measures:**

- **As in any animal production system, maintenance of good health is primordial for aquaculture. We should avoid intensive rearing conditions leading to possible environmentally induced stress and poor welfare. (Fig. 11)**



- As far as possible, we should use potential health modulators of natural origin, based on locally available knowledge or by developing specific health promoters of local origin. (Fig.12)

Figure 12: *Pagrus pagrus* larvae. (Picture: Carlos Andrade)

## CHALLENGE ECONOMICS

### TOPIC: Added value seafood products

#### Recommended measures:

- As with any aquaculture production, developing seafood products accessible to local populations is mandatory contributing towards increased food and nutritional security, taking full advantage of the proximity of the maritime areas. (Fig.13)



Figure 13: *Sciaenops ocellatus* production Mayotte. (Picture: Myriam Callier)

- Given the remoteness of the islands from mainstream markets and given the possible importance of tourism in the ORs and OCTs, there is also definitely a need for developing high value seafood products appealing to the discerning consumers. (Fig.14) (Fig.15)



Figure 14: *Haliotis tuberculata coccinea* Canarias. (Picture: G Courtois de Viçose)



Figure 15: Tahitian pearls. (Picture: DRMM-PF)

## **CHALLENGE ENVIRONMENT**

TOPIC: **Marine spatial planning**

### **Recommended measures:**

- **Given that sustainable development of aquaculture should be based on an overall ecosystem approach, all stakeholders should be part of the decision-making process before initiating concrete aquaculture operations.**
- **The site selection should take into account all existing demands and possible competing interests and try to achieve a compromise respecting existing spatial planning as well as future developments.** (Fig.16)
- **The contribution of an aquaculture operation should be integrated completely and responsibly with the environmental, economic and social issues.** (Fig.17) (Fig.18)



*Figure 16: Shrimp ponds New Caledonia.  
(Picture: Martial Dosdane)*



*Figure 17: Fish cages New Caledonia.  
(Picture: Antoine Gilbert)*



*Figure 18: Oyster production New Caledonia.  
(Picture: Martial Dosdane/PSud)*

## **CHALLENGE ENVIRONMENT**

TOPIC: **Water quality**

**Recommended measures:**

- Given that the maintenance of good physico-chemical quality of water bodies is primordial for the existence and success of any aquaculture operation, proper consideration for the quality of the immediate environment bears



great significance in the context of aquaculture. (Fig.19)

*Figure 19: Shrimp production New Caledonia. (Picture: PSud)*

- Given that maintenance of good water quality is an essential prerequisite for any aquaculture operation, sustainable development of aquaculture should be based on an overall resource efficiency including water use.



(Fig.20)

*Figure 20: Litopenaeus stylirostris production New Caledonia. (Picture: GFA)*

- The choice of specific rearing systems such as recirculated aquaculture systems (RAS) or the integration of aquaculture with other food production activities should be given due consideration.

- One possible way of reducing the impacts is to encourage integrated multi-trophic aquaculture (IMTA) involving production of plants / animals benefiting mutually. Here the choice of economically interesting species can further incur more benefits to the overall system. (Fig.21) (Fig.22).



Figure 22: Sandfish aquaculture New Caledonia. (Picture: Thomas Thiburzio)



Figure 21: IMTA algae production. Canaries. (Picture: G. Courtois de Viçose)

## CHALLENGE ENVIRONMENT

TOPIC: **Appropriate choice of feed ingredients**

**Recommended measures:**

- Given that the availability of fishmeal (FM) and fish oil (FO) derived from dedicated capture fisheries is not expected to increase in the near future, there is a need to make the best and efficient use of such high quality feedstuffs. All efforts already made through European research initiatives in replacing FM and FO should be fully applied in the context of aquaculture in ORs and OCTs.
- Developing feeds using locally available feedstuffs or upgrading feeds with existing underutilized sustainable ingredients should also contribute towards circular economy, reducing environmental food print of the feeds used for farming fish or shrimp. (Fig.23)



Figure 23: Feed ingredients. (Picture: F. Terrier INRA)

The list of recommendations presented in this document does not represent a finalized work. Sustainable aquaculture practices are dynamic, evolving processes. Therefore, these guidelines should be considered as a starting point for the design and definition of novel actions aiming to foster sustainable development of aquaculture in ORs and OCTs. The overall goal is to produce innovative solutions to promote a better integration of marine aquaculture production sites with the society and the surrounding environment that support them.



## 6. Acknowledgments

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Table 3: Main contributors to the guidelines

Institution	Web site
EcoAqua	<a href="http://www.ecoaqua.eu">www.ecoaqua.eu</a>
IUCN	<a href="http://www.iucn.org">www.iucn.org</a>
UAOM	<a href="http://www.uaom.eu">www.uaom.eu</a>
ADECAL technopole	<a href="http://www.technopole.nc">www.technopole.nc</a>
IFREMER	<a href="http://wwwz.ifremer.fr">wwwz.ifremer.fr</a>
Universidade dos Açores	<a href="http://www.uac.pt">www.uac.pt</a>
Direcção Regional das Pescas Madeira	<a href="http://www.madeira.gov.pt/srap">www.madeira.gov.pt/srap</a>
OCTA-Innovation	<a href="http://octa-innovation.eu">octa-innovation.eu</a>
FAO Fisheries and Aquaculture Department	<a href="http://www.fao.org/fishery/en">www.fao.org/fishery/en</a>

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