WP8.3 – Strategic Report
Aquaculture & Blue Life Sciences combination for the Atlantic basin

1 Introduction

The combination is a technological improvement of the aquaculture industry rather than a multi-use combination. The concept of this combination is that blue life sciences (i.e.: biotechnology application in the marine environment) can be and are used to increase production, environmental sustainability or bioremediation of aquaculture, or reduce the risk of unpredictable loss of production (incl. vaccination methods, protein-carbohydrate feed complexes, modified ingredients, modified probiotics, cage coating, etc.). Biotechnology can also be used for food safety and tracing through genomics.

The technical and practical advantages of this combination mostly benefit aquaculture, although biotech companies will increase revenue and may benefit from the production of resources in aquaculture. The demand from aquaculture for biotechnological solutions does not advance biotechnology itself; other than fine-tuning to specific circumstances, no core biotechnological development is needed.

The rating for the combination of blue life sciences (BLS) and aquaculture is high for the Atlantic. In the already technology intensive aquaculture sector of the Atlantic, applying biotechnology will have little to no negative effects on socio-economics like existing employment. On the other hand, an increasing demand for biotechnology from the aquaculture sector will lead to more employment in biotechnology. These are often jobs for highly skilled and trained people. This also drives further innovation at research level. Also, because aquaculture in the Atlantic basin is intensive already, this region is most suitable for biotechnology to invest in; potential technical and financial gains are highest.

In this combination there are several challenges to be dealt with prior to development, such as public acceptance of the use of biotechnological techniques, legal constraints of using non-native organisms or derivatives, motivating the biotechnology sector to invest in aquaculture applications. When developments are applied, one of the challenges is to balance production rates and environmental care or pressure on the environment.

2 Products

- Description of products/services (products/services in brackets)

The combination can enable a more stable and higher production rate of sustainably farmed marine proteins (increased health, growth-rate, reproduction), increasing at the same time Europe's local food security (reducing the dependability for marine proteins from Asia, cheaper production), a higher food security for the customers (track and trace, from feed to food) and remediate or mitigate the negative output from marine aquaculture.

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- Current and near-term planned

Feed development to improve production and reduce environmental impact in fish aquaculture is already taking place. Applications from BLS can be implemented in this process. Identification of suitable species combinations in IMTA (integrated multi-trophic aquaculture) based on BLS-techniques can improve efficiency and reduce environmental impact.

3 Market Analysis

- Sizing

Table 1 The volume in thousands of tons of main product groups from the various culture environments were as follows in 2013 (brackish water production is included in the marine environment.)

Product	Freshwater	Marine	Total
Finfish	40,503	6,568	**47,071**
Crustacean	2,578	4,134	**6,712**
Molluscs	283	15,231	**15,514**
Aquatic plants	82	26,896	**26,978**
Other aquatic animals and products	527	400	**927**
Total	**43,974**	**53,228**	**97,202**

Data from: © FAO - Fisheries and Aquaculture Information and Statistics Service - 01/07/2015

Guillen & Motova (2013) showed that income in the EU aquaculture sector mainly originates from the marine and shellfish sectors, followed by the freshwater, hatcheries and nurseries. Most of the value added (GVA) is generated in the shellfish sector.

The annual growth rate of the world aquaculture in the next decade is expected to be 2.5% (FAO/OECD), which is significantly lower than the growth rate of 5.6% p.a. experienced in the previous decade.

Lane et al. (2014) focused on the aquaculture development of the EU-28 countries in their study and projected a much larger expansion of the aquaculture in the European Union. The study estimated a total increase in volume from 2010 to 2030 of 772.000 tonnes (+56%), with a corresponding value increase of 2.7 billion euros and requiring an additional 395.000 tonnes of feeds.

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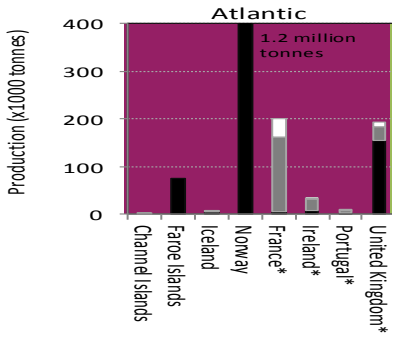

Figure 1: Marine aquaculture production in the EU in 2013 divided per production type (Marine finfish (black), Marine shellfish (grey), Freshwater (white bar)). *Indicates if the state is part of the Eu-28. (Data from: FishStat FAO).

- Development drivers

The main constraints of aquaculture development in the EU countries are often listed as follows (Lane et al. 2014) and are also valid for the combination of BLS and aquaculture in the Atlantic basin:

- Fierce and often unequal competition with cheap-labour countries that brings market prices down.
- High labour and capital costs and administrative burdens.
- Lack of understanding from the planning authorities of the spatial needs and infrastructure for the industry.

Driving forces of aquaculture growth on a global level (Guillen & Motova 2013, Lane et al. 2014):

- Growing demand, decreasing wild fish stocks.
- More efficient in terms of freshwater use and energy than other animal production sectors.
- Large availability of marine space.
- Room to make aquaculture more profitable.

Limitations of aquaculture growth on a global level which can be ameliorated by applications of BLS:

- Dependency on and availability of sustainable fish meal sources.
- Direct environmental interactions: pollutions, predators, diseases, algal blooms…
- Poor husbandry practices: use of antibiotics, antifungal, herbicides…
- Availability/production of life-stock in hatcheries.
- Consumers' attitudes and trends.
- Deterioration of the quality of water bodies suitable for aquaculture.

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4 Customers

- Key customers

The European Union is a major consumption market of seafood products in the world. Consumption of aquaculture products represents 24% of total EU consumption.

The EU is the first importer of seafood products, absorbing 24% of total world exchanges in value. Seafood consumption per capita in the EU seems to have reached a plateau after a decade of dynamic growth. The consumption per capita in 2011 was 24,5 kg. This is a change in trend after a robust growth in per capita consumption since 2000. Northern Member States are more focused on processed fish while Southern Member States still favour fresh products and devote a larger part of household expenditures to fish. Central and Eastern European countries are below the EU average but register increase in consumption. Expenditure on seafood decreased in EU countries most affected by the economic crisis. Consumer prices for seafood increased faster than other food products since 2010.

The combination here proposed could satisfy the western-European need for food-safety (food-tracking). It could also increase production efficiency and capacity of aquaculture and thereby decrease costs, creating the possibility for an increased market-share of aquaculture products in sea-food consumption.

- Actual & Desired

Only 10% of EU consumption of aquaculture products is currently from EU aquaculture. These statistics suggests that demand exceeds supply and there is great potential to expand aquaculture production in the EU to meet the demand, improve food security and improve the economy which can be positively affected by applications from BLS. Once these applications have shown improvements, the potential market for these applications is worldwide.

5 Competition

Table 2: Competitors to Combination Concept

Competitors	**Key differentiators**	**Rating** (1-10, 10 is most desirable/competitive)
Agriculture*	Commonplace, large market/turn-over	9
Pet-industry*	Commonplace, niche-market/luxury products	8

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Traditional feed-industry		8
BLS-Aquaculture in Asia*	Cheap labour, vast production capabilities, environmentally unfriendly	9

*Aquaculture in Europe is competing with these sectors for applications from BLS

6 Revenue

- Tariffs

The aquaculture sector as a whole is significant in socio-economic terms with a turnover of roughly EUR 3.5 billion and some 85 000 employees (including part-time and full-time jobs) (EU statistic 2014). This job creation value is especially important for marine rural areas where, besides fishery, aquaculture and fish processing often provide the main job opportunities. The proposed combination can increase turnover (increasing job-potential), but also decrease the need for labour-intensive management of life-stock (decreasing job-potential).

- Grants & Subsidy

Since this combination is mainly an application of known solutions in BLS to aquaculture production, the development of this combination is dependent on aquaculture companies applying and fine-tuning BLS solutions. The majority (87%) of the aquaculture companies are micro-enterprises (with less than 10 employees) and tend to be family owned. These companies mostly rely on external funding for development of business. Different types of aquaculture have different developmental focus and use different sources of grants and subsidy.

Fish production is largely bank-financed, while institutional investments are also common. For the introduction of new species and technologies, R&D grants are used. The investments in the mollusc and crustacean industry are mainly in marketing and the combination of farming and tourism. Developments in algae-production are funded with R&D grants and EU or governmental funding. Introduction and development of IMTA are dependent on subsidies (EMFF aqua-environmental measures) and joint ventures between companies producing complementary products (e.g. fish and seaweed).

- Investor

Investments in aquaculture stem from the sector itself, from private investment funds and from public sources:

The Future Expectations Indicator (FEI) indicates whether the industry in a sector is investing more than the depreciation of their current assets. Guillen & Motova (2013) estimated that the FEI for the EU-28 aquaculture sector was 4.9%. Therefore, the industry is investing in itself, and consequently should have positive expectations for the future development of the sector.

Some examples of funds that specifically invest in aquaculture include: Oceanis Partners, A-Spark Good Ventures, Watershed Capital Group, Fish 2.0.

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Public investments are mostly linked to the European Maritime and Fisheries Fund (EMFF), which is the EU financial instrument to support the Common Fisheries Policy (CFP) implementation. The Commission is keen to use the opportunities presented by EMFF to boost aquaculture growth. It therefore requires Member States to produce Multiannual National Plans (MANPs) outlining how each member state intends to foster growth in the aquaculture industry.

7 Strategic Roadmap

Table 3: 5 year Strategic Roadmap

2016	2017	2018	2020	2025
→	→	→	→	→
TRL 4	TRL 6		TRL8	
Identify known BLS-applications for problems in aquaculture (production, regulations, etc).	Test BLS-applications in the field.		Assess improvements. Work towards meeting policy regulations.	Anticipate on changes in policy regulations and circumstances.
EU funding Sector investments	EU funding Sector investments	EU funding Sector investments	EU funding Sector investments	Sector investments External investors
IRL 8				IRL 9

The investment readiness level (IRL) for aquaculture is already high with reasonable profits. The application of BLS solutions can increase IRL if the sector grows with the help of BLS.

8 Conclusion

Since BLS only applies techniques and knowledge to the aquaculture sector in this proposed combination, the technological profits of this combination are all in favour of the aquaculture sector. While biotech companies might be interested in a relatively new potential market to increase their sales, they will likely not experience technological advance in this combination. The aquaculture sector is dependent on the techniques of BLS to advance their own production, sustainability and possibilities to gain access to restricted areas. The biggest decelerating issue in this combination is that many BLS-applications that could increase productivity of life-stock is species, or at least group-specific; fish need other BLS-applications than mussels, and different species of fish have different needs as well. That makes fine-tuning of BLS-applications only cost-effective if it concerns a large retail-market like Atlantic salmon. The first levels of TRL can be reached rather straightforwardly using, for instance, European funding. Subsequent levels, however, largely depend on the development of the aquaculture sector in the Atlantic. Without necessary size of market-share and revenue, the continuous fine-tuning required between aquaculture-circumstances, regulations and BLS-applications will not be cost-effective. A continuous improvement of this combination and its

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implications on production and sustainability is only possible when the aquaculture sector keeps growing and when compliance with existing and future regulations increases.

8 References

Lane, A. Hough, C. Bostock, J. (2014). The long-term economic and ecologic impact of larger sustainable aquaculture, Study for the European Parliament's Committee on Fisheries, European Union, 2014.

Guillen J. and Motova A. (editors) (2014) Scientific, Technical and Economic Committee for Fisheries 2013 Economic Performance of the Aquaculture (STECF-13-29) ISBN 978-92-79-34809-9

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