

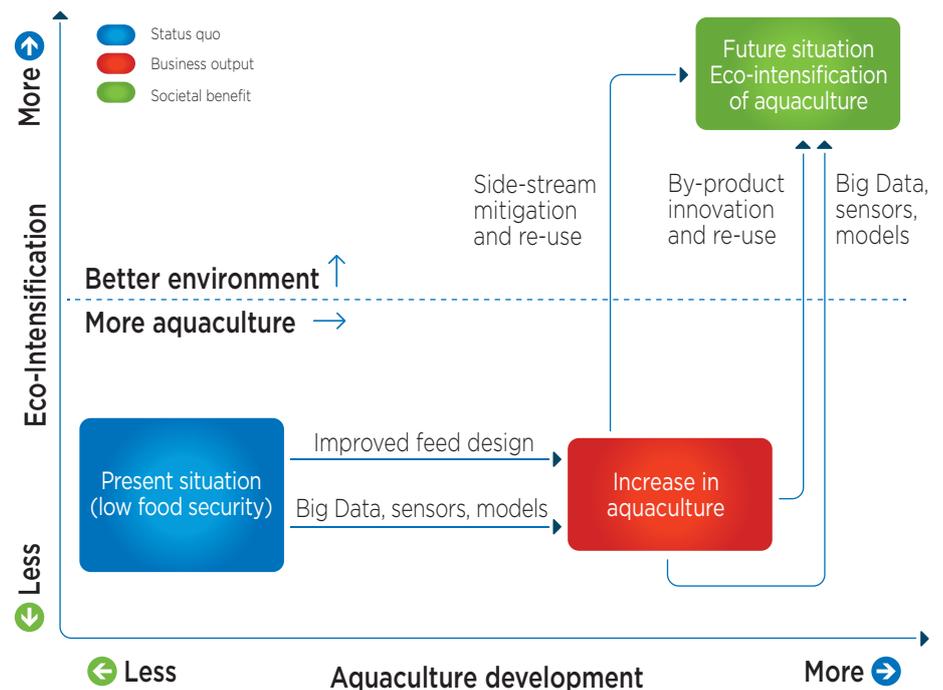
Editorial

GAIN is a collaborative project funded by the European Union (EU), designed to support the **ecological intensification of aquaculture** in the EU and European Economic Area (EEA), with the dual objectives of increasing production and competitiveness of the industry, while ensuring sustainability and compliance with EU regulations on food safety and environment. **Eco-intensification of European aquaculture is a challenge** that requires the integration of scientific and technical innovations, new policies and economic instruments, as well as addressing social considerations, in order to promote the implementation of the principles of circular economy in aquaculture.

GAIN specific objectives are:

1. Design and test an innovative range of finfish feeds;
 2. Develop and test a platform for supporting the implementation of precision aquaculture by combining sensors, Big Data analysis, and predictive models;
 3. Add value to cultivation of both finfish and shellfish by means of innovation in co-products from improved re-use of secondary materials, thus increasing profit and minimizing the environmental footprint of aquaculture;
 4. Support integrated policies concerning aquatic food production, by addressing current barriers to the circular economy;
 5. Promote market access, and help consumers, both in Europe and elsewhere, to understand the true value of quality production from European waters;
 6. Provide guidelines for sustainable ecological and economic intensification of European aquaculture, and disseminate and exploit these findings and recommendations to farmers, managers, and policy-makers.
- In order to achieve these ambitious goals, GAIN is structured in 8 Work Packages, two of which are described in more detail in this first Newsletter.

Approach



Eco-intensification entails the improved use of aquaculture side-streams and by-products

Enhancement of secondary outputs (GAIN WP2) addresses the integration of aquaculture activities with other sectors which can benefit from the valorization and re-use of side-streams and by-products of fish and shellfish production and processing. This approach incorporates circular economy principles and involves the consideration of multiple in- and outputs and multiple outputs along the aquaculture value chain. There is a need to quantify the drivers and barriers for the utilization of side-streams and by-products with the ultimate objective of eco-intensification of the European aquaculture industry.

The valorization of aquaculture side streams with innovative systems has been designed to investigate new approaches for capturing and reusing nutrients from fish farm side-streams and also for obtaining products which may produce significant benefits. Two main sources of nutrients will be addressed: particulate matter and dissolved nutrients. The partners involved have started to test coagulation, flocculation and filtration technologies to capture both types of material and an industrial scale prototype has been already set up in Norway. The resulting recovered nutrients has been tested with seaweed in controlled environments. On the other hand, innovative technologies, such as that using mechanical fluidization and superheated steam, are being tested for the conversion of sludge from land-based fish farms into fertilizer products. Additionally, this new technology has been tested

with a pilot dryer at Sundsfjord smolt facilities in Norway for the sanitation of mortalities.

GAIN also works on improving the valorization of secondary products of the aquaculture supply chain and evaluates volumes and type of by-products generated in different countries. The economic analysis of potential valorization of by-products by increasing edible uses, alternative products and reduction of wasted raw material is one of the research objectives (Figure 1a,b). Additionally, partners are investigating the adequacy of different types of by-products from farmed salmon, trout, carp, turbot and seabream, including the use of protein-rich frames, skins, heads, and viscera to produce ingredients for aquafeeds (e.g. protein hydrolysates, gelatins, oils rich in Omega-3, and minerals).

Mussels is one of the major species (25% of total) in aquaculture production in UE, however their production and transformation generates calcium carbonate rich shells which represent a challenge to manage and valorize. GAIN is exploring the use of shells as components of bio-filters for nitrification-denitrification processed in RAS aquaculture systems and also for the removal of phosphorus from land-based farm effluents. GAIN is also performing the assessment of the potential role of European shellfish farming in the control of coastal eutrophication and nutrient capture.



Figure 1: Left: Carp head for by-product quantification. Right: Flesh yield analysis



Figure 2: Salmon mean flesh yields

A novel framework for eco-Intensification of Aquaculture

In order to achieve a successful eco-intensification of European aquaculture, possibilities explored by **GAIN** need to be combined and examined. This includes applying socio-economic methods of analysis both at farm scale and for the value chain. At farm level, the cost-benefit of applying the innovations developed in GAIN is to be analysed considering the impacts of both production and environmental variables. For each set of species, bivalves and finfish, these are to be tested, considering the most appropriate methodologies. The resulting framework is expected to enable a farm and sector estimate of the impacts of such innovations.

For a better understanding of the socio-economic and environmental impact of GAIN's innovations for aquaculture eco-intensification, strong interaction with stakeholders is required. The benefits and constraints need to be measured throughout the supply chain, as well as considering potential impacts on small- and large-scale producers.

Consumer willingness-to-pay for eco-intensified farmed seafood will also be assessed, as consumers are a key part of the supply chain. The information collected with stakeholders, coupled with environmental and economic data on benefits of GAIN's innovations, gathered over the project life-cycle, enables the creation of an index to assess the sustainability of eco-intensification. This index allows GAIN's innovations to be scored for three categories: environmental, economic and social.



Figure 1. Consumer willingness-to-pay for sustainable products is key in Eco-Intensification of farmed seafood efforts. Picture from C. Kreiß, Johann Heinrich von Thunen-Institut.



Figure 2. What constitutes a 'good fish', and can farmed fish meet the criteria? Picture from Culmarex, Murcia.

Specific criteria are included in weighting parameters and creating the matrix index composed by each category, such as new by-products and side-stream re-use, economic welfare and the creation of new indicators to be considered in the development of the index.

One of the limitations of the aquaculture sector is the lack of connection between different stakeholders. **GAIN** is addressing this issue by examining innovative technologies that would allow for a more level playing field for small-scale producers to compete in the global market. Concerns of consumers and policy-makers with transparency and setting growth targets are also being addressed by looking into new tools that can help combine precision aquaculture, improved feeds or other innovations for the eco-intensification of farmed fish. The demographic shift to millennials and Generation Z has introduced animal welfare and traceability as key factors in purchasing decisions. In order to address these factors, the aquaculture sector needs to provide safe, healthy, and socially responsible food for generations to come. GAIN will support this in various ways, including through the definition of metrics for what constitutes a 'good fish'.

The GAIN consortium

The **GAIN** consortium includes 21 partners from 8 academic and research institutes, 8 companies, including 6 SMEs, and 2 non-profit organizations, which together will fulfil the project objectives through delivery of products tailor-made for industry, policy-makers, and the public (details can be found on the project website, www.unive.it/gainh2020_eu).

In order to achieve the transdisciplinary focus required for **GAIN**, the partnership includes large European and North American institutes—non funded partners from the United States and Canada will as well as international corporations, that cover multiple research areas in both the natural and social sciences, including relevant aquaculture disciplines (husbandry, welfare, carrying capacity modelling), oceanography, biotechnology, economics, sociology, computer, science, and Big Data).



The GAIN consortium



More info:
www.unive.it/gainh2020_eu
 twitter <https://twitter.com/gain2020>
 Facebook: <https://www.facebook.com/gain2020>

Coordination:
 Roberto Pastres
 Email: gain2020@unive.it

Communication and press:
 Teresa Vairinhos
 Email: info@gain2020.eu

Main topics for the coming issue:

- Improvements to feed design and implementation of precision aquaculture
- European aquaculture needs refined policies and market development

