Interreg Italy - Croatia AdriAquaNet

EUROPEAN UNION

AdriAquaNet

Enhancing Innovation and Sustainability in Adriatic Aquaculture

MID TERM TECHNICAL-SCIENTIFIC REPORT OF **WP3**

Period: 01.01.2019-30.06.2020

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The challenge

Adriatic mariculture provides highly valued fish products for both local and distant markets. This sector can further develop thanks to new available technologies and stronger information for consumers. The sector can offer high qualification job opportunities and boost local economy.

The team

Within **AdriAquaNet** project, **4 industries**, **1 consortium** and **6 research laboratories** from both **Italy** and **Croatia** are teaming up to develop and apply technologies for fish farming and marketing. This is the first ever initiative for improving the quality of fish farming and marketing by cooperation between both sides of the Adriatic Sea.

Partners

UNIVERSITÀ DEGLI STUDI DI UDINE
hic sunt futura

UNIVERSITÀ DEGLI STUDI DI TRIESTE

INSTITUT ZA OCEANOGRAFIJU I RIBARSTVO SPLIT

Istituto Zooprofilattico Sperimentale delle Venezie

SVEUČILIŠTE U RIJECI UNIVERSITY OF RIJEKA
FAKULTET ZA MENADŽMENT U TURIZMU I UGOSTITELJSTVU
FACULTY OF TOURISM AND HOSPITALITY MANAGEMENT
OPATIJA, HRVATSKA CROATIA

Consiglio Nazionale delle Ricerche
Istituto di Chimica Biomolecolare

KLASTER MARIKULTURA

FRIŠKINA d.o.o. uzgoj ribe i školjki

ITTICA CALDOLI SOCIETÀ AGRICOLA ARL

ORADA ADRIATIC

ROYAL ADRIATIC

Friul Trota

THE MID TERM TECHNICAL-SCIENTIFIC REPORT

It is a deliverable of WP2.2 due on 30.06.2020 (3rd report) and it was postponed to be delivered with the PR4. Its aim is to show the progress and achievements (state-of-the art) in WP3-4-5 to the project stakeholders (administrative professionals, SMEs and associations, consumers). At the end of the project, this mid-term will be refined in order to prepare the final technical-scientific report. The report will support the scientific management of the project's activities. Scientific Board and the WP leaders (LP, PP1, PP3) are responsible for the content, while LP supervises the work of all WPs. LP supervises all WPs. PP2 assists in formatting, editing and using contents for WP2.

GOAL 1
New approaches to improve fish nutrition and ensure efficient waste management

the fish farm

ACTIONS
- Implement novel feeds to improve farmed fish welfare
- Provide tailored feeding protocols to allow an innovative food management
- Provide new technologies to improve energy saving and farm environmental footprint

GOAL 2
New strategies to enhance fish health and welfare

the fish doctor

ACTIONS
- Develop new vaccines/ vaccination strategies
- Test novel probiotics/ nutraceuticals for controlling infectious diseases
- Develop easy, rapid and effective methods to assess fish welfare

GOAL 3
New fish products for different classes of consumers

the fish market

ACTIONS
- Apply new technologies to develop high-quality fish products
- Transfer knowledge to SMEs for improving the quality of fish products and their marketing
- Promote to consumers the nutritional value of farmed fish and health benefits of its consumption

WP 3
IMPROVE ENVIRONMENTAL SUSTAINABILITY OF FISH FARMING

WP 3 Leader
Emilio Tibaldi
University of Udine, Department of Agri-food, Environmental and Animal Sciences, Italy

1. OBJECTIVES, APPROACH & ACTIVITIES

This WP focuses on sustainable aquafeeds and green energy for the blue growth. In recent years, research has shown that feeds and feeding practices play a major role in affecting sustainability and quality of farmed fish species. By designing and testing new aquafeeds and by biomodelling fish growth and emissions in cages, we shall provide answers to fish farmers and consumers. Furthermore, by extracting biofuel from waste effluents and through energy saving and renewable energy applications we aim at reducing the environmental footprint of fish farming. The primary objectives of this WP are:

- Design and implement novel sustainable aquafeeds;
- Provide tailored feeding protocols to allow an innovative feed management;
- Provide new technologies to produce renewable energy from waste, to improve energy savings and to reduce farm environmental footprint.

In the frame of the WP3.1 activity (new environmentally sustainable dietary formulations for cultured marine fish), during the first 4 months of the AAN project, University of Udine (LP) in cooperation with the Institute of Oceanography and Fisheries (PP3) and by consulting various stakeholders (fish farmers and feed mill companies), studied and designed **a panel of prototype aquafeeds for sea bass and sea bream** to be preliminary tested in Lab scale experiments. To face the sustainability, the primary objective has been **to generate original feed-formulations with reduced or minimal levels of fish meal and oil with a substantial proportion of vegetable protein sources that replace the conventional processed animal proteins, such as poultry, by product meal (PBM) and novel ones, such as insect meal obtained by defatted pupae of black soldier fly-BSFM (*Hermetia illucens*).** From the beginning of the second semester of the project (July 22, 2019) up to the beginning of the third semester (January 28, 2020), long-lasting feeding experiment with Gilthead sea bream and European sea bass were carried out at the LP's and PP3 experimental fish farming facilities to compare the prototype diets over the growing out and finishing periods. The outcomes of these trials

allowed us to select the more sustainable feed formulations for testing under practical farming conditions by the project's partners Friškina (PP8) and Orada Adriatic (PP10) in two different locations along the Croatian coast in order to be proposed further to the feed-mill industry in Italy and Croatia.

The first half of the project has also been dedicated to the development of **models for predicting growth performance and emissions of seabass and seabream farmed in sea cages**, including evaluation of the environmental impact at the local scale, thanks to the collaboration and cooperation with a private Italian company Bluefarm, a LP's subcontractor. This activity started in November 2019, and included the following three lines of development:

- the first simulations aimed at reproducing the "business as usual" situation at the two Croatian farms, Friškina (PP8), and Orada Adriatic (PP10).
- A set of background data was collected at the two farms, in order to define the site-specific parameters of the model.
- Two complete simulations, covering a growth-out cycle were carried out, one at each study site. This corresponded to a simulation of 457 days (~ 15 months) at Friškina farm.

In the frame of the 3.2 activities WASTE MANAGEMENT, EMISSION REDUCTION, RENEWABLE ENERGY AND ENERGY SAVING the following actions were performed:

- Drafting of the "State-of-the-art" on anaerobic digestion (AD) applied to marine and brackish fish wastewater. A database was set up collecting the most relevant parameters and results from literature dealing with the anaerobic digestion of fish waste in marine and brackish conditions.
- Study of the waste treatment systems for concentrating organic substances from hatchery tank effluents. Technical examinations were performed at Ittica Caldoli (PP9), in order to verify the treatment systems implemented on site. Effluents from a mechanical drum filter operating on hatchery RAS were sampled. Sedimentation trials at pilot scale have been performed with the objective of achieving higher concentration of organic substances contained in the filtered wastewater.
- Chemical characterization of the effluents. Fish sludge from RAS of Ittica Caldoli's hatchery (PP9) has been characterized for total solids (TS), ashes, volatile solids (VS, or organic matter), pH, volatile fatty acids (VFA or FOS), total alkalinity (TAC), FOS/TAC, chemical oxygen demand (COD), total nitrogen (TKN), total ammoniac nitrogen (TAN).
- Biochemical Methane Potential (BMP) determination. A laboratory system for carrying out first anaerobic tests has been set up, consisting of an incubation unit where bottles containing samples of 1.0 litre of volume were incubated in anaerobic conditions at a constant temperature (37 ± 1□C in a mesophilic range). A second series of tests were carried out in an Automatic Methane Potential Test System (AMPTS, Bioprocess Control, Sweden). This equipment consisted of an incubation unit where 15 individual glass reactors were incubated at a constant temperature of 38□C. BMP was then expressed as the cumulative methane yield at the end of the test (36 days) in relation to the relative organic content of the substrate (NmL CH4/g VS), at different inoculum/substrate ratios.
- Anaerobic digestion tests on a pilot scale system. A Bioreactor Simulator System (BRS) produced by Bioprocess Control (Sweden) was purchased and installed at the laboratory of the University of Udine. This apparatus simulates the operating behaviour of a full scale reactor, in order to study the optimal process layout, the optimal substrate retention time and the effect of brackish and marine conditions.
- Surveys on energy use in intensive aquaculture for evidencing the most critical points and for the proposal of possible techniques to achieve energy saving. A technical survey was performed at PP9 fish farm and a preliminary report was shared, including economical and technical considerations, feasibility analysis, components choice and design to implement a new rooftop photovoltaic system, and to find solutions to implement energy saving management. Electrical outboard engines for small boat equipped with an integrated high-performance battery rechargeable by a solar panel have been purchased and tested in Friškina fish farm (PP8).

2. EXPECTED RESULTS

At the moment a major result already attained concerning the Activity 3.1 regards **the selection of the most promising feed formulations to be applied in practical cage farming of seabass and seabream.** This result has been partially shared among partners during the meetings and training activities and will be disclosed at the end of the project when the outcomes of the trials at farms will be available. Similarly, preliminary simulations and virtual applications of **the model developed for predicting growth performance and emissions of seabass and seabream farmed in sea cages** have been presented at the project report meetings, but it would be also disclosed at the end of the project when it will be fine-tuned using data generated by the trials performed in the two partners farm sites involved in the project.

Expected results concerning activity 3.2 have been shown regularly during project meetings, but the disclosure of definitive and meaningful results will be performed at the end of the project, after all the steps of experimental activities will be concluded and data will be fully elaborated and analysed. **The completion of the pilot-scale experimental tests** will allow to establish the possible design and operational parameters of the anaerobic reactors and to estimate their performance in real operating conditions.

3. EXPECTED IMPACT

Actions carried out in WP3.1 during the first half of the project had a fundamental impact in helping fish farmers and industrial feed-mill companies as allied partners to develop novel commercial feed formulations and farming management procedures which could **help improving the sustainability of the whole Adriatic farmed fish supply chain.**

Mid-term results of activity 3.2 contribute to the final deliverable at the end of the project, consisting in a technical-scientific report on **the potential of biogas technology applied to fish farm wastewater and the assessment of energy recovery and environmental impact reduction,** in order to reduce greenhouse gas emissions and improve fish farm sustainability. Moreover, preliminary mid-term results will contribute to the draft of a technical-scientific report on **the energy use in intensive aquaculture,** evidencing the most critical points and the techniques which can be applied for a favourable energy saving.

4. PROBLEM(S)

Major troubles in carrying out activities planned in WP3.1 dealt with restrictions due to Covid-Sars2 pandemics that has slowed down laboratory analysis, delayed delivery of samples and goods and limited movements among the two countries and regions. For these reasons certain activities did not follow the original schedule and were postponed to the next semesters. Anaerobic tests on pilot scale treatment system carried out in the frame of activity 3.2, stopped from half of March to June 2020, due to COVID-19 restrictions and the physical presence in laboratory premises. Also, PP9 was not able to send fresh effluent for analyses and for anaerobic reactors loading, due to restrictions on the movement of goods between regions. For the same reasons, the monitoring of power quality and electrical energy consumption in PP9 facilities, which was foreseen in the third semester, have been postponed to the following semester. Also the training programme related to WP 3.3 was postponed to the next semester.

Figure 1
The experimental fish farming facilities of the Department of Agricultural, Food, Environmental and Animal Sciences - University of Udine - (Di4A) at the "AZIENDA AGRARIA - A. SERVADEI" where the lab trials on Gilthead seabream of the AdriAquaNet project are carried out by the research group directed by prof. Emilio Tibaldi.

Figure 2
Biometry measurements on AAN sea bream.

Figure 3,4,5,6
Friškina Farm feeding and testing with new feeds.

Figure 7,8
Friškina Farm feeding and testing with new feeds.

Figure 9
IZOR researchers' team with the AAN sea bream on sea at Friškina farm in Rogoznica, Croatia.

Figure 10
IZOR researchers' team with new feeds at Friškina farm in Rogoznica, Croatia

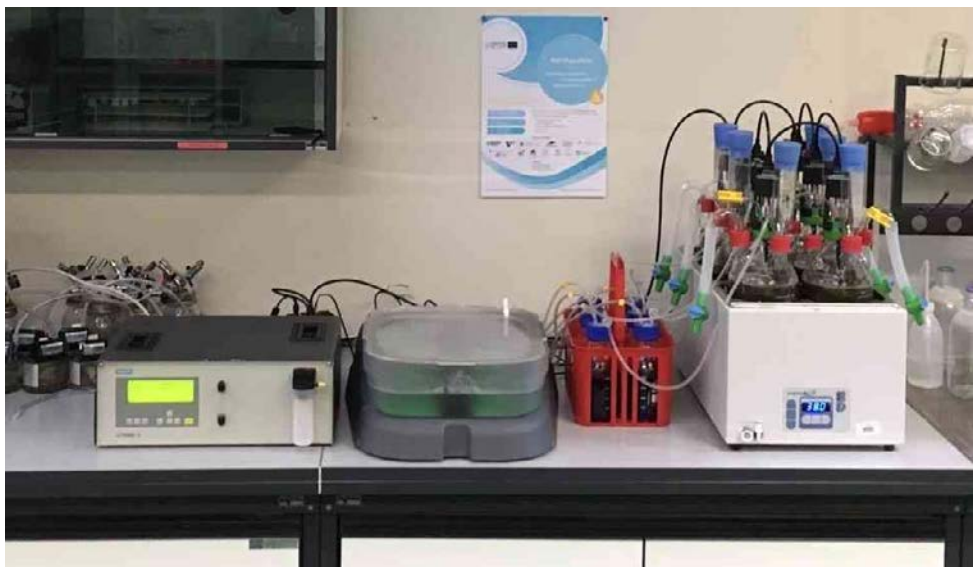
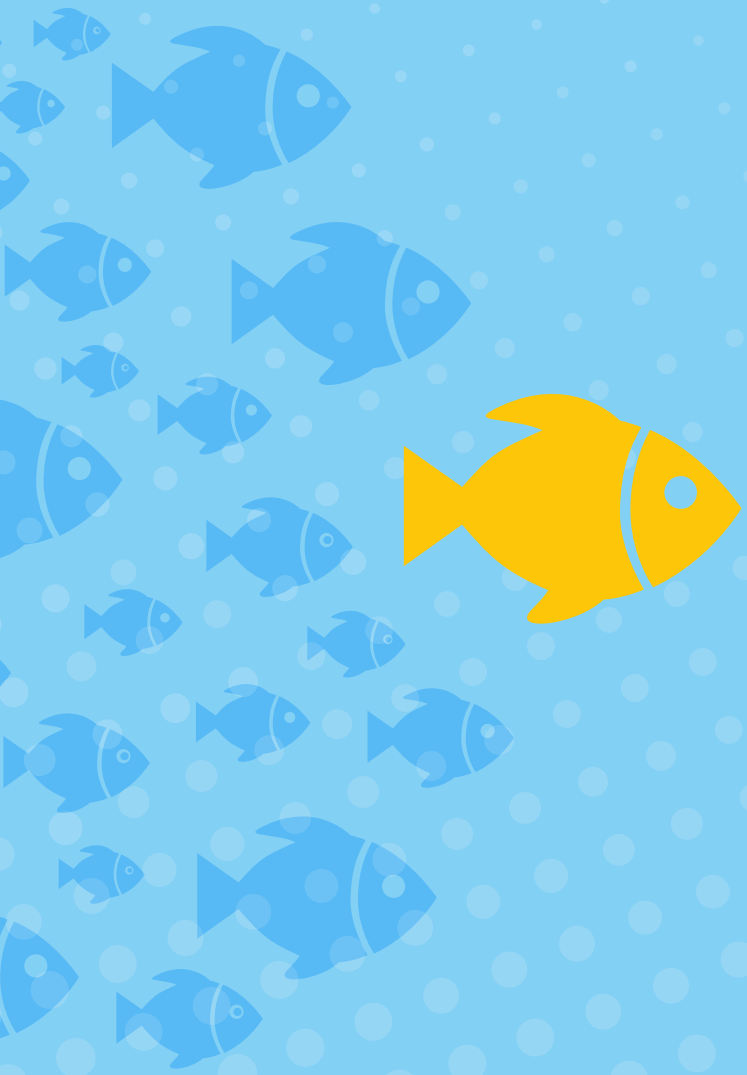


Figure 11
The new pilot scale Bioreactorsystem (BRS, by Bioprocesscontrol) for simulating continuous loading process (Novembre 2019).

Figure 12
The Automatic Methane Potential System (AMPTS, by Bioprocesscontrol) for biochemical methane potential (BMP) determination (September 2019).



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