	EUROPEAN COMMISSION RESEARCH AND INNOVATION DG	Final Report

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Project Acronym: OrAqua
Project Full Name: European Organic Aquaculture - Science-based recommendations for further development of the EU regulatory framework and to underpin future growth in the sector

Final Report

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PROJECT FINAL REPORT

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Final Report

Please note that the contents of the Final Report can be found in the attachment.

4.1 Final publishable summary report

Executive Summary
Summary description of project context and objectives
Description of main S & T results/foregrounds
Potential impact and main dissemination activities and exploitation results
Address of project public website and relevant contact details

Executive Summary

Organic farming is one of the most dynamic food production sectors in Europe although it still feeds a relatively young market segment. Organic agriculture is based, according to IFOAM, on the four principles of health, ecology, fairness and care. Furthermore, IFOAM defines organic agriculture as 'a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic agriculture combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved'. The Regulation (EC) No 834/2007 establishes analytically the principles guiding the organic farming at the articles 4) Overall principles, 5) Specific principles applicable to farming, 6) Specific principles applicable to processing of organic food, 7) Specific principles applicable to processing of organic feed. These principles can also be applied for organic aquaculture. Organic aquaculture started in Europe with carp and salmon farming in the nineties. In 2000, IFOAM published its first draft of basic standards for organic aquaculture. These became fully accepted basic standards, five years later, and stimulated an increasing growth of organic production of seafood. In consequence, organic aquaculture products have received increasing interest from consumers, as well as from retailers and certifying bodies. In June 2004 the Commission launched the European Action Plan for Organic Food and Farming (COM(2004)415 final), with which the Commission intended to assess the situation and lay down the basis for policy development, thereby providing an overall strategic vision for the contribution of organic farming to the Common Agricultural Policy. In 2009, organic aquaculture was regulated at EU level (EC Regulation 710/2009), after a thorough process spanning several years to streamline a number of different organic standards and national certification schemes in Europe. A common European regulation that created basic standards was highly welcomed, but also brought up many issues, such as fish welfare, feeds and environmental concerns, which are still not resolved.

An Expert Group for Technical Advice on Organic Production (EGTOP) was established by the Commission Decision 2009/427/EC of 3 June 2009 to advance the development of better regulation. The work of EGTOP has been an important contribution to OrAqua, with the latest Commission implementing regulation (EU) No 1358/2014 of 18 December 2014.

Within this framework, the aim of OrAqua is to rapidly advance the science base of organic aquaculture on a pan European scale. OrAqua will provide robust and quantified scientific advice for a possible revision of the EU regulations for organic aquaculture, taking into account different fish species and production systems, animal welfare, veterinary treatments and environmental aspects as well as economic and consumer perspectives. We have prioritised wide dissemination of the project results and meaningful engagement with stakeholders in order to benefit the organic aquaculture industry and society as a whole.

The objectives of OrAqua are to:

1. Reassess the relevance, measurability and applicability of the main technical provisions of Regulation EC 710/2009 for organic aquaculture against the basic organic principles;
2. Generate robust science based recommendations for potential updates of the EC regulation as regards aquaculture of fish species, molluscs, crustaceans and seaweed, based on comprehensive reviewing, research and assessment, in addition to integrating feedback from key stakeholders through a participatory action research approach;
3. Produce executive dossiers on the main technical background behind the recommendations that will emerge from this project. These will follow the structure of Chapter 3 of Annex II to the rules of procedure (final report template) of EGTOP;
4. To underpin consumer demand for organic aquaculture products and development of organic aquaculture industry by giving robust and relevant recommendations, integrating aspects of consumer perceptions, unique competitive qualities as well as production systems, business and market economics and regulatory framework.
5. To propose a model of structure for continuous assessment and advice on the improvement of regulations of organic aquaculture in the future, taking account of new scientific insights and changing competitive market environments.

The flow of information and knowledge generated by OrAqua were utilised within and between seven work packages as indicated in the pert diagram in Figure 1.

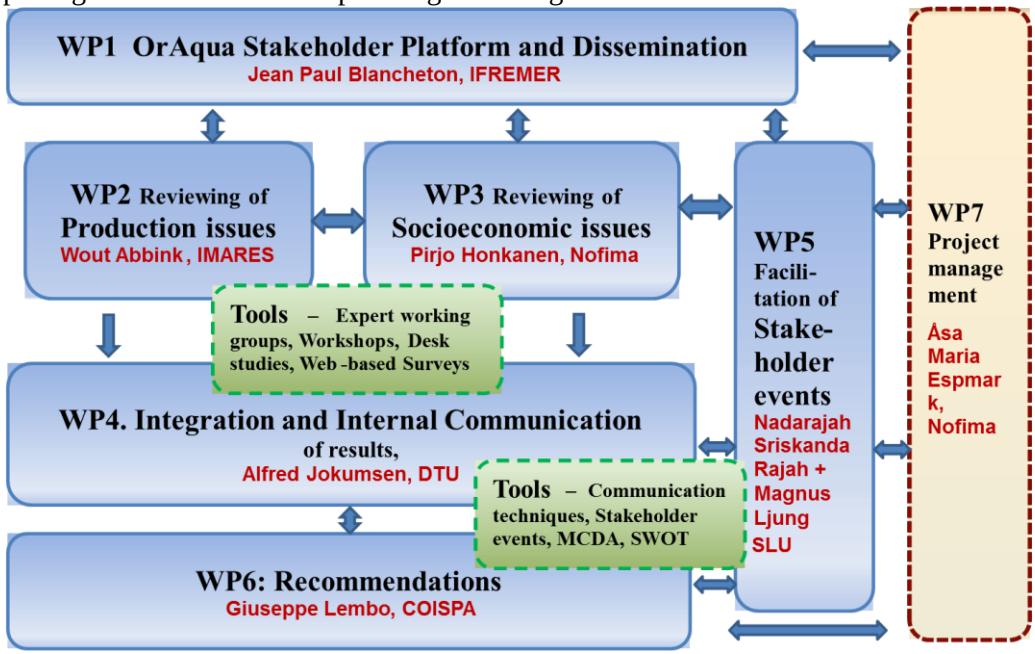

Figure 1. The flow of information and knowledge generated by OrAqua will be utilised within and between seven work packages

The project partners, the participants in the multi-stakeholder platform and the public, were interacting during the project, and this was formally organized and managed (WP7).

The overall aims of WP1 were (1) to coordinate and facilitate the consultation with relevant stakeholders for planning of the 3 stakeholder meetings (WP5) and in between, in order to validate the project results and to receive their feedback and (2) to disseminate the project results (outputs from WP2, 3, 4, 5 and 6) towards the aquaculture industry, policy makers and the consumers, through the OrAqua website and printed documents.

The aim of WP2 was to collate and review the scientific knowledge on production issues in organic farming. The work focused in particular on a comprehensive review of the key aspects of fish feed and nutrition, health and welfare, veterinary treatments, biosecurity, production systems and management,

environmental interactions and sourcing of juveniles. The work were based on the collection and review of the available literature, both scientific and grey, and the elaboration of the available data, metadata and indicators, and presented as an overview of the biological and technical potential on best organic practices. There was a focus on some key species (groups) for the European aquaculture; finfish (Atlantic salmon, rainbow trout, common carp, sea bream and sea bass), shrimp, molluscs and seaweed.

The overall aim of WP3 was to collect and review available information on economic, market and consumer related issues, and regulatory and institutional frameworks related to organic aquaculture. First partial aim was to assess consumer perceptions, sentiments and understanding of organic aquaculture to promote consumer confidence and acceptance of organic farming principles. Second partial aim was to improve understanding of the economics of organic aquaculture production and the competitive position of organic aquaculture products in EU markets. A third partial aim was to explore critical development constraints and potential improvement in the institutional systems, to provide input to regulatory bodies for an increased organic aquaculture production. Finally, WP3 identified socio-economic issues/bottlenecks that needed to be addressed for successful implementation of organic aquaculture.

The overall aim of WP4 was to transform the information from WP2 and WP3 into an easily conceivable format to be communicated to the stakeholders in the European organic aquaculture sector. Further, the feedback on this information from stakeholders (cf. WP1, WP5 and figure 1) were analyzed and incorporated accordingly and up-dated communications were provided for the multi-stakeholder platform (WP1). Overall project perspectives were that the output of WP4 would be up-dated science based information balanced with stakeholder feed-back and interests related to the current EU regulatory framework for organic aquaculture and in line with organic principles and consumer confidence. Using appropriate communication tools, these results were communicated in a readily accessible form to the multi-stakeholder platform (WP1) as well as making the results available to WP6 for a SWOT analysis.

The overall aim of WP5 was to plan and facilitate three events to involve and engage relevant stakeholders within Organic Aquaculture. It was of vital importance to take benefit from different stakeholders' interests, expertise and experiences and thus secure robust policy recommendations. The stakeholder events were conducted in the following sequence;
- Event 1 for supporting the processes of reviewing (WP2 and 3) and integration (WP4) with input from stakeholders' different perspectives.
- Event 2 to survey stakeholders' values, attitudes and prioritise, and to initiate the decision making process generated by MCDA (WP4)
- Event 3 for building consensus on recommendations (WP6)

The overall aim of WP6 was to provide recommendations based on sound scientific evidences, within the framework of the organic principles, for the review of the EU rules for organic aquaculture. Recommendations were based on the principles of the excellence of the technical/scientific knowledge and of the transparency of data, methods and assumptions made.
Recommendations also took into account the objectives and principles laid down in Regulation (EC) No 834/2007.

Summary description of project context and objectives

The overall objective of the OrAqua project is to provide recommendations for the update of EU organic regulation. The recommendations should be based on the current scientific knowledge, in line with the basic organic principles (principles of health, ecology, fairness and care), contributing to consumer confidence. OrAqua will contribute to promote the growth of the organic aquaculture sector in Europe.

The project shall suggest recommendations resulting from the holistic approach of OrAqua as described in the DoW (also see figure 1), including all WPs and the tools (e.g. MCDA, SWOT), organic principles, scientific knowledge, different stakeholder opinions, that includes both outputs from the stakeholder meetings and the scientific method MCDA. The use of different tools for the recommendations are important since the OrAqua Project is based on a holistic approach. For a holistic approach, we emphasize the importance of the whole and the interdependence of its parts. Hence, OrAqua is concerned with

wholes of organic aquaculture and its regulations.

The objectives of OrAqua are to:

1. Reassess the relevance, measurability and applicability of the main technical provisions of Regulation EC 710/2009 for organic aquaculture against the basic organic principles.
2. Generate robust science based recommendations for potential updates of the EC regulation as regards aquaculture of fish species, molluscs, crustaceans and seaweed, based on comprehensive reviewing, research and assessment, in addition to integrating feedback from key stakeholders through a participatory action research approach.
3. Produce executive dossiers on the main technical background behind the recommendations that will emerge from this project. These will follow the structure of Chapter 3 of Annex II to the rules of procedure (final report template) of EGTOP.
4. To underpin consumer demand for organic aquaculture products and development of organic aquaculture industry by giving robust and relevant recommendations, integrating aspects of consumer perceptions, unique competitive qualities as well as production systems, business and market economics and regulatory framework.
5. To propose a model of structure for continuous assessment and advice on the improvement of regulations of organic aquaculture in the future, taking account of new scientific insights and changing competitive market environments.

WP1 – OrAqua Stakeholder Platform and Disseminations

The overall aims of WP1 are to coordinate and facilitate the consultation with relevant stakeholders for planning of the 3 stakeholder meetings (WP5). In between, in order to validate the project results, to receive the stakeholder feedbacks and to disseminate the project results (outputs from WP2, 3, 4, 5 and 6) towards the aquaculture industry, the policy makers and the consumers, through the OrAqua website and printed documents.

Objectives:

Task 1.1. To identify stakeholders and groups relevant to organic aquaculture across Europe and establish the OrAqua stakeholder database and platform.

Task 1.2. To formally invite relevant stakeholders from the database to participate in project meetings and events, or for communication on specific topics.

Task 1.3. To actively and efficiently manage the communication across the Support Action between project partners and (1) platform members and (2) targeted public throughout the project.

Task 1.4. To disseminate project outputs to relevant stakeholders and to the public in order to provide information to improve consumer confidence in European organic aquaculture products.

Task 1.5. To propose a model for how the OrAqua platform could be sustained after the project ends.

WP2 – Reviewing of Production Issues

The aim of WP2 has been to collate and review the state of the art scientific knowledge on aquaculture production issues, in particular on organic farming. The work included a comprehensive review of the key aspects of fish feed and nutrition, health and welfare, veterinary treatments, biosecurity, production systems and management, environmental interactions and sourcing of juveniles. The work was based on the collection and review of the available literature, both scientific and grey, and the elaboration of the available data, metadata and indicators, to present an overview of the biological and technical potential on best organic practices. There was focus on some key species (groups) for the European aquaculture; finfish (Atlantic salmon, rainbow trout, common carp, sea bream and sea bass), shrimp, molluscs and seaweed.

Objectives:

2.1 To build a robust knowledge base for the best organic practices based on a comprehensive review of state-of-the-art scientific data.

2.2 To build an accessible information system on the needs, requirements and tolerances of the target fish species across an array of production systems and the characteristics of conventional and organic production systems to meet these requirements.

2.3 To identify the knowledge gaps on demands raised by science on nutrition, health and welfare,

veterinary treatments, biosecurity, production systems and management, organic juvenile recruitment, slaughtering/harvesting procedures and environmental conditions.
2.4 To identify critical production related issues in the regulatory and legal framework at national and EU level, to provide input to future development of EU regulations, systems and standards for organic aquaculture production.

WP3 – Reviewing of Socioeconomic Issues
The overall aim for WP3 was to collect and review available information on economic, market and consumer related issues, and regulatory and institutional frameworks related to organic aquaculture.

Objectives:
3.1. To assess consumer perceptions, sentiments and understanding of organic aquaculture to promote consumer confidence and acceptance of organic farming principles.
3.2. To improve understanding of the economics of organic aquaculture production and the competitive position of organic aquaculture products in EU markets.
3.3. To explore critical development constraints and potential improvements in the institutional systems, to provide input to regulatory bodies for an increased organic aquaculture production.
3.4. To identify socio-economic issues/bottlenecks that need to be addressed for successful implementation of organic aquaculture.

WP4 – Integration and Internal Communication
The overall aim of WP4 was to transform the information from WP2 and WP3 into an easily conceivable format to be communicated to the stakeholders in the European organic aquaculture sector. Further, the feedback on this information from stakeholders were analysed and incorporated accordingly and up-dated communications were provided for the multi-stakeholder platform (WP1).

Objectives:
4.1. Analyse and integrate the information from WP2 and WP3 and 1st stakeholder event of WP5 (incl. WP1) in order to identify objectives (goals), criteria (interests), different options (alternatives) and priorities to build the methodological basis for Multi Criteria Decision Analysis (MCDA).
4.2. Transform the main output of WP2 and WP3 into a readily accessible form and communicate to the multi-stakeholder platform (WP1) and prepare a MCDA survey to WP5 (2nd stakeholder event).
4.3. Based on the MCDA survey provide input to WP6 for developing SWOT analysis and recommendations for revision and update of the EU regulation on organic aquaculture.

WP5 – Facilitation of Stakeholder Events
The overall aim of WP5 was to plan and facilitate three events to involve and engage relevant stakeholders within Organic Aquaculture.

Objectives:
5.1. Deliver three effective stakeholder events organized and conducted at critical points of time
5.2. Facilitate the process to secure collaborative learning and efficient and effective communication among participants
5.3. Document outcomes from the events for incorporation in WPs 2-4 and towards consensus in WP6.

WP6 - Recommendations
The overall aim of WP6 was to provide recommendations to the EU Organic regulations, based on:

- Sound scientific evidences, within the framework of the organic principles, for the review of the EU rules for organic aquaculture.
- The principles of the excellence of the technical/scientific knowledge and of the transparency of data, methods and assumptions made.
- The objectives and principles laid down in Regulation (EC) No 834/2007.
- The results of the three stakeholder meetings (Istanbul October 2014, Rotterdam October 2015 and Venice June 2016)
- The output of WP4 and WP5.

The specific objectives of this work package were:
6.1. To assess the relevance, measurability and applicability of the main achieved results regarding the different species/life-stages/production systems/environments, to the organic aquaculture EU regulation.
6.2. To generate sound science based recommendations for potential updates of the regulation, which reflect the holistic perspective of the project.
6.3. To facilitate a large diffusion of the recommendations among stakeholders.
6.4. To produce executive dossiers, on the main technical background behind the recommendations, according to the standard/template used by EGTOP to produce technical reports.
6.5. To realize a Policy Implementation Plan (PIP).

WP7 – Project Management
The overall aims of WP7 were to provide high level project coordination, appropriate organisational and financial securities, and project management support in order to secure the timely completion of project deliverables and reports in accordance with the EC Grant Agreement.

7.1. Coordinate and implement the DoW and Grant Agreement in a timely, efficient and successful manner.
7.2 Provide the periodic reporting to the EU for the evaluation of the implementation of the programme ensuring that correct and consistent financial and technical progress reports are submitted by participants, presented to the coordinator and submitted to the European Commission on time and in accordance with relevant guidelines.
7.3 Organize and coordinate the work and exchange of information, among Participants involved in the same or different WPs.

Description of main S & T results/foregrounds

WP1: OrAqua Stakeholder Platform and Dissemination

Task 1.1. and 1.2.

The first lists of possible stakeholder platform participants and of target end-users were established on month 1 of the project and posted on the website: www.oraqua.eu during January 2014 (D1.1). The platform participant lists were regularly updated, in order to obtain a balanced participation of the different types of stakeholders (producers, consumers, organic productions and certification specialists, researchers from various research fields in relation with organic approaches, non-governmental organizations and governance), while keeping, as far as possible, an equilibrated representation of the different countries.

In particular, the participant list of the second platform was adjusted in order to fit the needs of the MCDA survey that was carried out during the meeting. The overall objective was at the same time (1) to include as many of the participants to the first platform meeting as possible (continuity of the project) and (2) to satisfy the necessary stakeholder profiles to carry out the MCDA survey. For all the stakeholder meetings, it was challenging to get a sufficient participation in the categories of consumers and retailers, for reasons not clear for us. However more than 80 stakeholder participants were invited and involved in the platform meetings and their representativeness allowed to get relevant feedbacks and to carry out relevant surveys.

Task 1.3.

The project website, www.oraqua.eu has been regularly updated since it was created on month 1 of the project. Any interested person can find the published documents, as information on the current organic aquaculture regulation, PPT presentations during public meetings, short videos taken during the platform meetings and the project newsletters. The fourth and last newsletter will be posted by February 2017. It will present the main final recommendations of the project. The public project deliverables will be posted on the website as soon as the project officer approves them. The web site also has a restricted site protected with user name and pass word, where information of participants at the meeting are available.

Task 1.4.

All along the project, information was exchanged with professional and specialists during congresses and meetings where the project was presented and discussed (IFOAM, EAS, WAS, EATiP) and through the website. In total eight presentations of the Oraqua project have been held. At the end of the project, the main findings and recommendations are shared with the widest public. The wide dissemination of the project findings and recommendations, based on WP4 outputs, is carried out using:

- Paper leaflets translated in English, German and in the mother tongues of the project partners, in order to reach the largest possible public.
- A short video animation motion widely distributed and available to anyone.

All the information documents are made available on the Oraqua website.

Task 1.5.

The task of proposing the structure of the final multi-stakeholder platform and funding possibilities to sustain its operation after the end of the project was carried out all along the project. Links were created between the project partners and the most relevant existing multi-stakeholder platforms and key players in the field of organic products, through the preparation of the platform meetings and the participations to the EATiP, IFOAM and EAS meetings, were the current outcomes of the project were presented. During the last platform meeting in Venice, it appeared clearly that the OrAqua platform could become a specific thematic platform on aquaculture created inside TP Organics, as no entity dedicated to aquaculture exists yet in the TP Organics Platform. This platform should have to keep very thigh links with EATiP and IFOAM in order to avoid un-useful and costly duplication of activities.

WP2: Reviewing of Production Issues

The aim of WP2 was to collate and review the state of the art scientific knowledge on aquaculture production issues, in particular on organic farming. The work included a comprehensive review of key aspects that were organised into four main chapters (thematic areas); nutrition, health and welfare (including veterinary treatments and biosecurity), production systems and environmental impact (including sourcing of juveniles). The work was based on the collection and review of the available

literature, and the elaboration of the available data, metadata and indicators, to present an overview of the biological and technical potential on best organic practices. For each of the thematic areas, the corresponding EU- regulations are highlighted and linked to the scientific knowledge. When no scientific knowledge about a certain EU-regulation article was found, this was designated as knowledge gap.
There was a focus on some key species (groups) for the European aquaculture; finfish (Atlantic salmon, rainbow trout, common carp, sea bream and sea bass), shrimp, molluscs and seaweed.
WP2 is closely related with WP3 that focusses on socio-economics of organic aquaculture. In addition, WP4 has analysed and synthesized the information provided by WP2 and WP3.

Task 2.1. Organising two workshops with experts of the thematic areas.
Two workshops with experts of the thematic areas were organised. The first one was held in IJmuiden, The Netherlands, in April 2014 and the second one in Vodnany, Czech Republic, in March 2015. The goal of both workshops was to monitor the structure, planning and progress of the review with the responsible partners. The first workshop focussed on the structure of the review and integration of the EU-regulations in the review, and selection of partners that were made responsible for the review of the thematic areas. The second workshop focussed on the progress of the review and remaining work. In addition, possible bottlenecks were discussed and resolved, to facilitate the final stages to complete the review. Minutes from the two worshops are given in D7.1

Task 2.2. Review of state-of-the-art in nutrition, welfare and health, veterinary treatments, production systems and environmental interactions + knowledge gaps (D2.1 + D2.2).
The contributions of the partners were integrated into the four chapters of the review and were edited into one review. The structure of the chapters is similar, although each thematic area has specifics that suit the topics best. However, the chapters are designated in such a way that the review maintains coherence; firstly, the articles from the EU regulation on organic aquaculture that deal with the thematic area are listed, followed by a review of the scientific knowledge and documentation of the knowledge gaps.

Thematic area Nutrition
In line with the organic principles, the animals' need for amino acids and fatty acids should be met primarily through natural feed compounds. Fish meal and fish oil are important components of this, particularly for carnivorous aquaculture animals, which have specific amino acid, fatty acid and other nutritional requirements, including minerals, vitamins and pigments.

Fish meal replacement - needed elaborated scientific knowledge
Sourcing of feed ingredients for organic aquaculture should be supported by experimental data to secure compliance with organic principles of fish welfare and environmental sustainability. Fish meal and fish oil derived from industrial fish caught in sustainable fisheries, should be considered as ingredients in feed for organic carnivorous species until more knowledge is available. This includes feed for fry and brood-stock, as well as for on-growing fish, until sufficient alternative sources of protein and oil are available.
The use of other alternative feed ingredients providing high content of essential amino acids and lipids, where possible produced organically, may be considered to be used in priority to purified or free amino acids as feed supplements/additives. If not available from organic procedures, essential amino acids and lipids obtained by fermentation or other similar procedures more close to the organic principles should be considered. Studies have indicated that not only the overall dietary amino acid profile is important for efficient utilization of amino acids, but also the timing by which amino acids from different protein sources appear in the blood stream after a meal. A significantly higher amount of indigestible carbohydrates have been measured in a diet based on vegetables than in a fish meal based diet, which suggested that the uptake of amino acids was affected by dietary carbohydrates. This issue also needs attention. Procedures in compliance with organic rules for removal of anti-nutrients in plant sources. Development of relevant organic plant sources to optimize the amino acid profile by mixing the protein sources and hence produce an optimum balanced diet for organic fish.

Fish oil replacement - needed elaborated scientific knowledge
It is important to keep focus on human health related to eating (organic) aquaculture products, including high content of long chain omega-3 fatty acids (EPA and DHA) currently sourced from fish oil. Adjustment of regulation on request of exchanging fish oil by vegetable oils in accordance to development of vegetable

or other sources producing omega-3 fatty acids (HUFAs) is advisable. Also, priority should be put on research in alternative sources of Omega-3 fatty acids (HUFAs). The use of cholesterol as raw material in the feed for supplementing the diet of shrimps is in line with the objectives and principles of organic production and should be allowed.
For preference, lecithin from organically certified sources, such as organic soybean, may be used following mechanical extraction. If unavailable, non-organic natural sources may be used provided they are of non-GMO origin.

Mineral and vitamin supply - needed elaborated scientific knowledge
Fish meal and fish oil have to contain necessary vitamins and minerals.
Chemically well-defined analogic substances of minerals and vitamins may be authorised for use if the natural substances are unavailable.

Thematic area Welfare
Among public and governments, there is an increasing interest in the welfare of farmed fish. In addition, among farmers, there is growing awareness that good welfare equates to increased success of production activities. Indeed, from a practical point of view, production efficiency, quality and quantity are often coupled with good welfare. As a result, fish welfare has become a growing area of research. Animal welfare is not easy to define. It is generally referred to as the physical and mental state of the animal interacting with its environment and associated variations. Most animal welfare definitions can be categorised into 'function-based', 'nature-based' or 'feeling-based'.
The primary basis for the concept of 'animal welfare' is the belief that animals are sentient being capable to experience good or bad feelings or emotional states. Stress and stress-related responses should be considered as an adaptive condition of the organism that has the fundamental function of preserving the individual's life. In addition, it is increasingly clear that individuality in stress reactions have to be included in the concept of animal welfare. Such differences often take the form of suites of traits, or stress coping styles (SCS), where traits like sympathetic reactivity, aggression and the tendency to follow and develop routines show positive relationships.
In aquaculture, fish are exposed to a range of industry practices that may act as chronic stressors which potentially compromise welfare. The effects of a wide range of aquaculture practices on the stress physiology of fish are well documented. Some of these practices include frequent handling, transport, periods of food deprivation, deteriorating water quality, and sub-optimal stocking densities and social environments and these important topics are extensively all reviewed for the most important aquaculture species in Europe. Welfare indicators are user to quantify welfare. Normally used welfare indicators are direct (physiological, behavioural, morphological) and indirect (environmental).

Water quality - needed elaborated scientific knowledge
Water quality parameters are pivotal factors that contributes to fish welfare in aquaculture.
The range of different water quality parameters are species-specific, although the first limiting factor is often oxygen.
Fish and shellfish are poikilothermic animals, which means that temperature is the main factor playing on their metabolism and rapid temperature shifts do influence directly and indirectly their welfare.
The location of farms must ensure the water quality, and hydrodynamics ensure compliance with animal welfare.
The use of oxygen in intensive farming seems a much needed factor. The maximal density without oxygen without negative welfare effects is unknown for many species. However, addition of oxygen is not in line with current organic rules for on-growing.

Light and photoperiod - needed elaborated scientific knowledge
Light represents an important environmental factor that could influence severely fish behaviour and physiology. Sudden changes in light intensity from the dark to the light phases of the dark/light cycle can induce behavioural stress responses.
There is evidence of photoperiod influence on changes in the immune system in sea bass, as well as in sea bream, while the welfare consequences of artificial photoperiod treatments in salmonids are not yet fully known. On the other hand, photoperiod is actually considered as one of the most important environmental parameters triggering puberty and reproduction in fish.

Stocking density - needed elaborated scientific knowledge

Rearing density encompasses a complex web of interacting factors, such as water quality, social interactions, fish to fish interaction and fish to housing interaction that can have an effect on many aspects of welfare. Depending on the type of rearing system and species, the recommendations range from 4 to more than 300 kg/m^3.

Such a wide range of recommendations is in part due to a lack of complete understanding of how the different environmental factors interact with each other and with stocking density to affect welfare. Another reason maybe that the effect of density measures on welfare may vary greatly between studies due to the study-specific nature of experiments, e.g. studies vary in experimental duration, water quality, density levels used, feeding method, size of the fish, life history of the fish, level of domestication, type of rearing system used and environmental conditions.

It is worth to highlight that most of the experiments on the stocking density reported in literature are supported by the use of oxygen to adapt the water quality to the increased stocking density, which would be not in line with several principles/rules of the organic regulation.

Concerning shellfish, carrying capacity of the production areas has to be evaluated to defined appropriate stocking density for their aquaculture.

Transport, handling and behavioural interactions - needed elaborated scientific knowledge

The most important issue with transport of live fish is to maintain water quality during the transport. Private standards have set up recommendations.

Water can be cooled during transport to alleviate a fish's need for oxygen and to reduce ammonia production. Freedom Foods Welfare Standard for farmed salmon transport state i) the maximum chilling rate should be 1.5°C per hour, ii) the maximum permitted drop in temperature should be no more than 50% of ambient temperatures at the start of chilling within 24h, and iii) minimum temperatures at the end of chilling should be no less than 4°C.

For shellfish, as organic farms shall minimise risks to species of conservation interest, transfer of shellfish has to be controlled, to avoid the risk of alien, translocated species, or diseases introduction. Risk assessment methodologies could be applied to minimize the impact of transfers and to prevent the introduction of invasive species. An example of a practical plan for shellfish farmers including advice on hygiene, biosecurity and good husbandry practices should be present.

Slaughter - needed elaborated scientific knowledge

When properly done, the most humane stunning methods is percussive and electric stunning. However, percussive stunning may lead to carcass damage, which poses an economical problem. Carcass damage can be avoided by lowering the air pressure in the percussive stunner. However, under the latter conditions it is doubtful that fish are stunned immediately by percussion. Electrical stunning has to be followed by the application of killing method. However, experiments have shown that fish may recover. To prevent this, further studies are needed to develop protocols for stunning and killing that result in an immediate and irrecoverable stun in fish.

In cases where waiting cages are in use, monitoring water quality both with and without crowding should be done. Important to make sure that the water quality in the waiting cage is good at all times. Placing the cage in areas with good water exchange is more important in organic farming as adding of oxygen is prohibited.

Pumping should be done with care. Moreover, pumps should be used that are constructed especially for live fish. Make sure to use the correct pump dimensions for the actual fish size and amount. Make sure that the equipment is regularly checked by service.

Realistic alternative methods to the ice slurry for stunning and killing marine fish needs to be further investigated.

Veterinary treatment - needed elaborated scientific knowledge

Antibiotic use is an integral part of conventional intensive animal agriculture and aquaculture. Increased public concern about antibiotic resistance and the need to preserve the ever-diminishing arsenal of antimicrobials that work in humans for as long as possible, has brought about increased scrutiny of the use of antibiotics – especially for prophylactic and growth enhancing purposes. In accordance with European regulations and to limit the phenomenon of antibiotic resistance, studies are being implemented on the use

of herbal or homeopathic medicine and probiotics, which are administered in addition to the feed.
In recent years increasing experimental evidence of probiotics and herbal medicine in aquaculture have come up, and the first results seem to confirm their effectiveness in the prevention and management of diseases affecting aquatic animals breeding.
The use of these substances is permitted in accordance with article 25(t) of Regulation 889/2008, but the paragraph does not describe in what way and in what quantities they should be administered as they are authorized. It would be appropriate to make a list of microorganisms and plants which can be used in the composition of the feed.
There are initial investigations and tests with regard to the preparation of vaccines derived from the study of genetic engineering, such as DNA vaccines (Regulation 2003/1829 article16), and proteins produced from GMOs. From the first studies it is seen how it is possible to produce new solutions for disease prevention by obtaining vaccines and immunostimulants with low-cost and low environmental impact. It would be interesting to continue to do studies and tests in this direction, since the Regulation 834/2007 article 4 allows for the use of GMOs for Veterinary Medicinal Products.

Biosecurity - needed elaborated scientific knowledge
Good hygiene practices and farm management prevent the onset of diseases. Unfortunately, there is currently no European guidelines on biosecurity in animal husbandry, but there are at national level, in the various countries of the EU, for certain species. It would be appropriate in future years to draft biosecurity measures recognized at Community level.

Thematic Area Production Systems
The different topics considered are:
1) Breeding; 2) Hatchery and Nursery; 3) Phyto-Zoo massive culture; 4) Land based and Cage systems; 5) Recirculation Aquaculture systems (RAS); 6) Mussel and oyster culture; 7) Seaweed culture; 8) IMTA.

Breeding - needed elaborated scientific knowledge
At present it is not clear if the breeding objectives and thus targeted traits are sufficiently different to warrant developing genetic material specifically for organic farmers. Traits like salmon lice and some disease resistance traits are most likely of higher importance for organic farmers, compared to conventional salmon farmers, since organic farmers have strict limitations to the use of chemical treatments.
Considering that for breeding purposes or for improving genetic stock and when organic aquaculture animals are not available, wild caught or non-organic aquaculture animals may be brought into a holding. Conventional broodstock can be used which has been selected based on specific traits. Indeed, some breeding companies offer genetic material, which has a high resistance to IPN, PD or salmon lice.

Hatchery and nursery - needed elaborated scientific knowledge
There are no official data on the number of certified organic hatcheries in Europe, except for some information on a few trout hatchery in Denmark that have recently converted or are in the process of conversion to organic production. Therefore, the present production of organic juveniles seems inadequate to supply the growing demand of the organic aquaculture industry certified according to the European regulation.
There is a lack of specific organic rules for managing the life cycle stage between the hatching and the weaning of juveniles. This lack of organic regulation concerns fresh water species (e.g. stocking density, feeding) and, even more, marine species (e.g. phytoplankton and zooplankton production, essential nutrients in the trophic chain, feeding, stocking density during larval rearing and weaning, husbandry environment).
Production rules for the phase of the life stage between hatching and weaning of juveniles would have a strong influence in determining the characteristics of the adult (e.g. skeletal and pigmentation anomalies, immune resistance, etc.).
For marine fish, there is evidence that juveniles produced with “mesocosm” or “large volume rearing” systems are more similar in behaviour and morphology to their wild counterparts.

Phyto-Zoo massive culture - needed elaborated scientific knowledge
It appears difficult to find characteristics sufficiently different between organic and conventional phytoplankton productions, enough to justify the existence of organically certified phytoplankton as a

separate product. However, in view of the necessity to use phytoplankton in hatchery, its use could be authorized without requiring organic certification, with the sole exclusion of GMO strains of algae.
Unlike phytoplankton, there could be the technical possibility of an organic production of zooplankton, which would differ from conventional zooplankton in several aspects. Rules for organic production would need to be based on use of organic yeast, other microorganisms (e.g. *thraustrochytrids*), and only natural antioxidants, vitamins and emulsifiers. Unfortunately, at moment, there are no organic enrichment diets available and an evaluation whether their production would be commercially viable would be very useful to be explored.

Land based and cage systems - needed elaborated scientific knowledge
A main aim for the revision of the regulations is to strengthen and harmonize the rules of production and to raise confidence of the consumers to organic production. However, EU covers an extensive geographic area, which might impose climatic related challenges for organic production systems in rural areas to fulfil the organic principles.
Another important challenge is that the current regulation is not sufficiently specific and hence allows different interpretations in different countries, i.e. different conditions of control and anti-competitiveness between the countries.

For ponds, the way the aquaculture is managed already has many quasi-organic principles and the shift to organic farming is not as demanding as it is for some other systems. Many common circumstances, which belong among the requirements for organic carp pond farming, fully cope with conventional farming, such as stock density and fertilization limits. Conversion to carp pond organic culture is a process of developing farming practices that encourage and maintain a viable and sustainable aquatic ecosystem. Management techniques, especially when applied to influence production levels and growth rates must maintain and protect good fish health and welfare. Location of land based organic production units must maintain the health of aquatic environment and surrounding terrestrial ecosystems.
The future research activities should be focused on the environmental aspects of organic pond farming to bring and support the arguments about the eco-friendly way of pond production supporting biodiversity of pond ecosystems. In addition, the issues of regular and steady organic feed (cereals) supply are of extremely high relevance. The necessity of avoidance of hormonal preparations for induced carp and pond fish spawning is still questionable because pituitary glands, which are used for these purposes, may also be of organic origin, if necessary. However, current legislation about organic farming principles does not allow this exception.

Recirculation Aquaculture Systems (RAS) - needed elaborated scientific knowledge
Most of traditional organic farms are open-air flow through systems. However, due to the limitations of water resources, national regulations in some countries require that farms are only allowed to take a limited amount of new water from the water reservoirs. In such cases the re-use of water could be a solution in line with the principles of organic production.
Closed recirculation systems (RAS) have several environmental advantages, but require significant input of external energy, high stocking densities (for economic reasons), advanced waste water treatment devices, use of UV radiation and use of pure oxygen. All the above, together with the disconnection of the aquaculture production from the external natural aquatic environment, makes the closed recirculation systems (RAS) not in line with the principles of organic production.

Mussel and oyster culture - needed elaborated scientific knowledge
According to organic legislation, seed from non-organic bivalve shellfish hatcheries may be introduced to the organic production units with 0% by 31 December 2016. This could be extremely restrictive, both for oysters because organic hatcheries are still not really developed, and for mussel as well, because mussel seeds are collected from natural areas.
As defined by the ICES and FAO codes of conduct for responsible fisheries, oyster and mussel sustainable production is linked to the carrying capacity of the environment; shellfish excretion can affect local sediment and associated populations (both animal and macrophyts). Carrying capacity of the production areas has to be evaluated to define appropriate stocking density for shellfish aquaculture.
As organic farms shall minimise risks to species of conservation interest, transfer of shellfish has to be better controlled, to avoid the risk of alien, translocated species, or diseases introduction. Risk assessment

methodologies could be applied to minimize the impact of transfers and to prevent the introduction of invasive species.

Seaweed culture - needed elaborated scientific knowledge
Most seaweed is produced not for direct human consumption and there is not much attention for organic production of seaweeds. In general, seaweed production is seen as environmental friendly and sustainable. Therefore, there is not much research to organic production of algae.
There is sufficient knowledge on the use of seaweeds as bio-filter. However, less information is present on its use as feed for aquaculture products, impact on the environment, biofuel and the use for human (food) products. Production of seaweed is considered to have only a low impact on the environment, so not much research is conducted on this.
There is not much scientific information on harvesting issues and on farm management.
However, many articles in the regulation concern farm management issues (administration, production) and not directly linked to the production systems. Production is mainly linked with IMTA, together with abalone, where the seaweed is cultured in the system growing on nutrients from the abalones, and the macro algae on their turn serve as food source for the abalones.

IMTA - needed elaborated scientific knowledge
It is important to co-cultivate species that are ecologically compatible, requiring similar environmental conditions and do not compete for food and space in an aquaculture system. In addition, it is necessary to assess the oxygen demand of each component of the system. Heterotrophs may increase oxygen demand and decrease the oxygen budget of the fish culture. Respiration by autotrophs may also consume oxygen, although oxygen production during the day may compensate for night time consumption. Bio-deposition rates of each component of the system and the dispersal pattern of particulate and nutrients must be determined to evaluate the efficiency of an integrated system and when evaluating the environmental carrying capacity of a site.
It is unclear how to determine nutrients naturally occurring in the environment and nutrients coming from watershed.
There is a lack of information on co-culture between bivalves and organic fish or seaweed. In addition, there is a lack of information between possible disease/parasite positive and negative interactions between species composing the IMTA system.

Thematic area Environmental impact
The rationale behind organic food production is to minimise the impact of the production on the environment. The global food sector is currently responsible for around 30% of the world's energy consumption and contributes to more than 20% of the global greenhouse gas (GHG) emissions. In addition, land use changes contribute (mainly deforestation) to another 15% of GHG emissions. The Food and Agricultural Organization (FAO) projects that 70% more food need to be produced globally within 2050 to feed a population of 9 billion people and calls for urgent action in developing food systems that uses less energy and emits less greenhouse gases. At present there are few standards or reference/threshold values for what can be defined as sustainable food production. But in recent years there has been increasing interest for developing models, metrics and tools to measure environmental impact. Sustainability indicators are being recognised as a useful tool for policy making and public communication in environmental performance. The main purpose of environmental indicators is to summarise, focus and condense the complexity of our environment to a manageable amount of meaningful information which will provide decision-makers with a tool to determine which actions should be taken to make food production more sustainable.

Energy use and LCA - needed elaborated scientific knowledge
A major problem at the moment is the lack of defined criteria and reference points for determining what an environmental sustainable food production is. Developing methodology for measuring environmental load without allocating environmental effects between products and co-products will benefit organic aquaculture productions such as salmon where trimmings from fisheries are used as a feed ingredient. The current regulations say that energy used in the production should preferably come from renewable energy sources. Most of the energy used for production of salmon is diesel oil used in growing and harvesting of feed ingredients. At the moment there is no alternative that can fully replace this energy source, but biodiesel

may be an alternative in near future.

Escapes from cage culture - needed elaborated scientific knowledge
Species-specific distinctions could be made between escapes of fish and escapes of viable gametes. As the majority of juvenile and adult escape events within Europe are attributable to storm damage or the formation of holes in the net walls of cages, attention should be given to implement something similar to Norwegian technical standard NS 9415, which has led to a marked reduction in the severity of escapes from Norwegian cage aquaculture since 2004.
It has been suggested that to better protect wild fish stocks from the potential detrimental consequences of aquaculture escapes, attention should be focused on preventing escapes. A better understanding of the post-escape dispersal of escaped fish can improve recapture efficiency, as it can help focus and direct recapture efforts. However, a recovery program should be initiated as soon as an escape has been discovered to increase the likelihood of potential recapture.
The efficacy of recapture methods for i) Atlantic salmon, ii) Atlantic cod and iii) gilthead seabream shows some knowledge gaps;
For species that have the potential to spawn within the cages, such as Atlantic cod and gilthead seabream, the use of a curtain-like egg collector may be used to mitigate against the occurrence of an egg escape. An aquaculture site planning and locality policy could also be to limit the farming of large seabream that are viable spawners in areas near wild seabream nursery grounds. The risks of escapes through spawning from cage aquaculture is currently not well documented for all relevant European species.
For escapes involving juvenile and adult fish, the majority of all recapture methods are only partially effective, and focus should be on prevention. However, organic farmers can diligently monitor their farms for escapes via a robust and rapid surveillance of the farm infrastructure and fish e.g. during and after extreme weather events or large-scale fish handling, as the first few hours may be crucial.
Net biting behaviour in Atlantic cod and gilthead sea bream should be investigated further in commercial farm settings, with a particular focus on the efficacy of using environmental enrichment to reduce net biting frequency, which has not been well demonstrated at the commercial scale.

Sea bottom, wild fish feeding and pond water quality - needed elaborated scientific knowledge
The EC regulations regarding environmental impact and interactions in relation to the sea bottom are not very specific. With regard to wild fish feeding there are no EC regulations that apply specifically. Attraction of wild fish to open cage farms is a global phenomenon, and more than 160 species belonging to about 60 families have been detected in the near vicinity of such farms.
Marine fish farms attract wild fish by providing uneaten fish feed, structural habitats and by attracting small prey species. The more ecological consequences of attracting wild fish, and wild fish feeding on waste feed may be regarded as environmental effects, at least in a wider definition; it is well known that farm aggregated species, will achieve different liver size, and different lipid content and fatty acid composition. The amount and composition of fatty acids also affect the quality of the offspring.
The negative impacts of pond aquaculture on the environment are highlighted in particular as:

- Modification of water temperature and flow rate profiles
- Increased concentration of suspended solids, BOD, COD, forms of N (including ammonia) and phosphorus.
- Reduced concentration of dissolved oxygen.
- Alteration of water quality due to the use of chemicals and antibiotics.
- Generation of organic-rich sediments.
- Occurrence of algal blooms in eutrophic waters.
- Modification of the biotic index (based on invertebrate communities) and of the index of biotic integrity (based on fish populations).
- Genetic pollution and escape of undesirable and invasive fishes.
- Increased risk of disease spread.

Recycling and waste - needed elaborated scientific knowledge
At present, knowledge and technology for a near complete recycling of nutrients from salmon farming is not developed. Altering the regulations is therefore not recommended. However, solutions for collection, de-watering and re-use of waste are presently being sought for in non-organic salmon farming. The

technology is therefore expected to be improved during the next years and thus there may be a basis for reconsidering the regulations for organic salmon farming within near future.

Ethics relating to the overall task of the project

Having a revision of EU regulation for organic aquaculture in mind, an important point of departure lies in the Lisbon Treaty (EC 2007) which came into force 2009 and states that *"In formulating and implementing the Union's agriculture, fisheries, transport, internal market, research and technological development and space policies, the Union and the Member States shall, since animals are sentient beings, pay full regard to the welfare requirements of animals* (…) (Part one/Principles, Title II, Article 13). It is also stated in the EU directive 2010/63EU on animals used for research that all vertebrate animals are regarded sentient. Further, specific regulations on aquaculture EC Reg. 834/2007 (production conditions), EC Reg. 889/2008 (slaughter) and EC Reg. 710/2009 (transport) take as their point of departure, more or less explicit, that fish are sentient. Hence it is not a question of whether or not, but rather how to take this capacity into concern given there are other concerns to relate to and balance. Of further relevance for revision of organic regulation is the Article 11 in the Lisbon Treaty: *Environmental protection requirements must be integrated into the definition and implementation of the Union policies and activities, in particular with a view to promoting sustainable development*, as well as Article 12: *Consumer protection requirements shall be taken into account in defining and implementing other Union policies and activities*. These articles not only express a clear intention to ensure the values of sustainability and consumer protection are implemented into all future policies and establish a solid value basis for revision of organic regulation but are also de facto mirrored in the views expressed by some stakeholders.

WP3: Reviewing of Socio-Economic issues

The overall aim for WP3 was to collect and review available information on economic, market and consumer related issues, and regulatory and institutional frameworks related to organic aquaculture. The WP was divided into three tasks: one on consumer perceptions and acceptance, one on farm economics and one on institutional frameworks. The results from the scientific reviews and a survey have been used in the dissemination activities, and the development of the MCDA survey, and finally, in the recommendations in WP6. The results have also been published in deliverables D3.1, D3.2 and D3.3.

Consumer perceptions and acceptance

Relevant scientific literature on organic food was reviewed and a survey was conducted to fill in the gaps found in the literature, related to organic aquaculture. A consumer survey in the UK, France, Germany and Italy was conducted (main markets for organic seafood in Europe), starting with questions about terms and concepts consumers regarded relevant to the official EU definition of organic fish, and how some of them can influence the quality of the fish (including feed, production system characteristics, etc.). The survey also included questions about consumers' barriers and motives for buying organic fish and their familiarity and use of relevant labels. Perceptions (including naturalness, quality, health, sustainability, safety, etc.) about wild, conventional farmed and organic fish were also reported by consumers. Finally, consumers also reported their knowledge about organic fish, their consumption behaviour and socio-demographic characteristics.

The main results from the literature study and consumer survey are reported in D3.1. Main conclusions can be summarized as follows: Consumers are unsure about the concept of organic fish farming due its overlap with several available concepts such as sustainable, biological, ecological, fair trade and environmental friendly. Consumers also show ambivalent impressions about the placement of organic fish between wild fish and farmed fish. This ambivalence originates from the degree of naturalness of farming fish that can vary between species. Some species are naturally living in confined areas, while others travel long stretches. Some species live in fresh water, others in sea, while others in both, introducing several levels of complexity for consumers' understanding of details of production systems. Furthermore, consumers' knowledge about practical details of fish production is limited. Consumers in Europe are generally not aware of how fish is produced, and wild captured fish is perceived to be "natural" and as such may be regarded as organic by many consumers. The lack of knowledge creates a fertile ground for negative reactions to information about production issues such as feed, welfare, production system types and their environmental impact. As shown in previous research, exposing a population with a low knowledge to details about improvements of production system can lead to a negative reaction to the details of the production as such.

Since the attribute "organic" is a credence attribute, which cannot be seen or tasted, there is a need for consumer trust in the organic label or certificate. In addition, consumer attention, awareness and knowledge about the label are important if the label is to have any effect. Our results show that the consumers' familiarity of organic labels is low; especially the Euro-leaf, which is supposed to help consumers to an easy choice in the EU area. In the UK, 85% were unfamiliar with the leaf. The figure for France was 70%, Italy 64% and Germany 60%. Consumer awareness of national labels was higher. In Germany, 48% of the respondents were familiar with the BiO label, in France, 53% were familiar with the AB label. In The UK, 24% were familiar with the Soil Association. ***It is therefore suggested that a well-prepared communication strategy needs to be established to ensure increase of consumer attention and awareness of the label, and knowledge on the key issues related to fish production, including organic fish production***. This overall increase in knowledge will lead to a more fertile ground for interactive communication of production issues in the future too. Consumers also confuse the eco-labels with organic labels. Therefore, a strategy to differentiate the Euro leaf from other Eco-labels like ASC should also be considered.

Furthermore, the consumers' perception of organic farmed fish is heavily influenced by their perception of fish farming in general and influences from agriculture. Aquaculture is by some consumers perceived as negative, "industrial" production, comparable to large agricultural units in Europe. ***However, results from the literature show that some consumers think that aquaculture is sustainable in that it can help protecting wild stocks.*** This could be used in a communication strategy for organic aquaculture as well as conventional aquaculture. The consumer segment with a preference for organic food may increase their fish consumption by buying more fish products that are organic if organic fish and its relevant certification schemes are well documented and communicated. However, total health promoting fish consumption depends on the image of all fish products. Offering wild, farmed and organic fish to specific market segments with particular demands is a way to ensure that health policy targets are met regarding seafood consumption. The fish market in Europe needs to be supported as a whole, to avoid undesirable side effects from image transfer between fisheries, conventional aquaculture and organic aquaculture. In addition, price sensitivity has to be taken into account, as some consumers may reduce the purchased quantity of fish if the price of organic/eco-labelled products is perceived as too high. Indeed, high price together with limited availability were two of the most important barriers to buying organic seafood.

The main motivations to purchase organic seafood are that organic fish is considered safe, of good quality, healthy and good for the environment. However, also conventional farmed fish is considered safe, of good quality, environmental friendly and healthy. Wild captured fish is even more highly ranked regarding these features. A well-designed and pretested communication campaigns for organic fish can extend the total seafood market in Europe and can be used to create awareness about organic aquaculture and build a positive and reliable image of organic certification scheme.

Another question in this research has been to study which benefits the European organic aquaculture sector offers to the society and how they can be further strengthened. With respect to the first part of this question, organic aquaculture contributes to a number of issues. First, organic aquaculture's contribution is based on its care for the environment. Other issues such as supporting local economies, building consumer trust and contributing to consumer choice are also important contributing points.

Capture fish landings will not be able to cover the global demand for seafood, which is forecasted to increase. As such, aquaculture is needed to fulfil worldwide and European demand for fish. However, aquaculture may affect the environment significantly. Therefore, the organic aquaculture will add value to those consumers who are concerned about this.

The philosophy of organic aquaculture addresses consumers who are interested in the origin of food and the production methods. This relates to relevant consumer themes like transparency and consumer trust. In addition to this and like mentioned before, a controlled and certified system is used to prove the way of producing – it is one of the pillars of the organic system.

Organic aquaculture is thus extending consumer choice. It aims at delivering products with a clearly distinctive element for consumers who are looking for something else than products which are somewhat mainstream and widely available. Often produced in large and/or global supply chains. However, as our study shows, organic seafood is not very well known in some countries, so a communication plan is needed to get the attention of consumers. It also provides a healthy option, or as EUFIC promotes "…eating more fish is one way that most of us can help improve our diets—and our health …increasing your consumption of all types of fish and seafood is recommended." So, organic aquaculture products relates positively to the growing expectations from consumers for quality and diversity of food products.

However, organic aquaculture faces some challenges: effectively attracting consumers and strengthening the sector. Finally, many arguments are not only applicable to organic aquaculture, but also conventional aquaculture copes with a number of the issues. But if the organic aquaculture sector manages to work on their challenges, it follows that the organic aquaculture will be able to substantially grow and meet an increasing demand for the organic aquaculture product, and will benefit Europe.

Farm economics

The aim of this research was to improve our understanding of the economics of organic aquaculture production and the competitive position of organic aquaculture products in EU markets. The results are reported in D3.2. This study builds on former studies on farm economics for organic aquaculture and contains to date extensive calculations on organic aquaculture. Costs and benefits analyses were performed for the farm and chain and how these affect the competitiveness of European organic aquaculture. Ample scientific research is available on costs and benefits for organic aquaculture. Only a few studies report quantitative results particularly on the production costs and in particularly feed. There is an urgent need of statistics within organic aquaculture production.

The assessment of **farm economics** in the project is based on the estimated differences regarding costs between organic and conventional aquaculture. Economic farm data for conventional aquaculture are available from several sources: the STECF database for most species, the "Fiskeridirektoratet Norge" provides data for the Norwegian salmon production, "Turkovski" and "Lirski" published the profitability of the Polish carp sector and the "Landesfishereiverband Brandenburg" provides a model for the carp production in Germany. For the three most important producing countries for each specie (as far as data are available), the transition from conventional to organic aquaculture is simulated. The needed price and quantity indices are quantified by three kinds of information sources: literature, expert knowledge and workshop results. The outcomes of the simulation model show that transition from conventional aquaculture to organic aquaculture will raise the production costs with 20% to 50%, depending on specie and production region. Generally, the higher feed costs are responsible for the largest contribution to the higher production costs, followed by the higher costs for juveniles (if available) and the higher costs for the fixed assets. The latter is caused by the required lower stocking density. Consequently, the costs for buildings, installations and machinery (like depreciation, maintenance, and repair financial costs) must be spread over a smaller production volume.

In order to get insight into the costs in the supply chain, fish processors were interviewed and consumer prices were collected for 18 different retailers in 12 European countries. The results show that not only are the costs of organic fish production on farm level higher, but also the margins for processing and retailing. Upon inquiry, representatives of the processing industry, the distribution network and the supermarkets indicated that the slower turnover rate in the supermarket was the main reason for the high consumer prices. In addition, temporary mismatches between demand and supply, smaller selling volumes and extra certification costs were mentioned as explanations. The consumer prices for organic fish appear to be about 50% higher compared to conventional farmed fish products.

The conclusion is that the impact of the concerned EU regulations on the consumer prices is not restricted to the primary sector. It is found that the consumer price of organic aquaculture products is more influenced by extra margins in the following links of the chain than by the effects on farm level.

Competitiveness of European organic aquaculture

Organic aquaculture entails large challenges to deal with public and private standards, issues involved in feed and production, as well to market these products against premium prices. These major hurdles make the threat of new entrants not very likely and development of the branch a more evolutionary process. Especially sourcing organic feed at the national or local level can be a serious obstacle for start-ups in developing countries. Furthermore, local resources are preferred by standard organisations, therefore local knowledge is a necessary asset to deploy organic aquaculture activities. Retailers throughout Europe will play a pivotal role in the development of the market for organic aquaculture products. The extent retailers will be committed to organic aquaculture differs particularly because organic fish is mainly used as an instrument to work on reputation and how it fits with the customer interest. Hence, as the market for certified aquaculture is still developing. Organic standards from outside the EU that have lower security and therefore cost as well as less stringent standards than organic ones are serious competitors as these might fit their customers' needs better or might be better known.

The institutional framework for organic aquaculture – Critical development constraints and the potential for improvement

The aim of this task was to explore critical development constraints and potential improvements in the institutional system for organic aquaculture, and to provide input to regulatory bodies for an increased organic aquaculture production. The organic production and implementation of the Regulation in four European countries (France, Greece, Norway and Czech Republic) was evaluated in the project, with the aim of exploring to what extent the experiences can be used to improve the governmental management systems for organic aquaculture. The work has been based on screening available sources, such as international statistics banks, registers of approved operators, nongovernmental overviews, and relevant literature. However, there has been little data available, especially on national implementation and functioning of the control regime. Information about the latter has therefore been acquired from partners and platform participants in the OrAqua project. The results are reported in D3.3.

The aim of the EU Regulation on organic aquaculture is to set a minimum standard for organic production in (and import to) the EU. The implementation rules on organic aquaculture were developed at a time when European aquaculture was diversified and fragmented, and the production standards differed and sometimes conflicted with each other. The regulation of organic production is an ongoing process and it has been supplemented with more and more detailed rules for production, certification and controls.

Main findings:

There is a lack of relevant statistics and information regarding organic aquaculture production and control, which makes it difficult to have a good understanding of the past and current status of production and the functioning of the Regulation. Collection and publication of consistent EU-wide statistics and updated information on production, market data and national implementation, monitoring and control task would contribute to a better knowledge base and increased transparency.

There seems to be limited national support programs for organic aquaculture production. If the aim is to increase organic aquaculture production, public support should be increased and the use documented.

The regulations and standards are characterised by stakeholders to be devised without reference to economic reality. There is also concerns regarding the cost of certification, especially for small-scale aquaculture producers. Arguments are also put forward that there is little predictability and high uncertainty in production rules and transition periods, and that this slow down the transition to certified production. Increasing predictability and avoiding uncertainty on production rules and transition periods are recommended, as is taking the costs of different provisions and standards into account.

There is limited information about the national implementation of the Regulation, in particular related to control and sanctions of non-compliance. Increased reporting and/or studies of national implementation is therefore needed. A suggestion is to develop guidelines for the qualification of inspection and certification personnel for organic aquaculture to secure harmonized implementation, and hence fair competition.

WP4: Integration and Internal Communication

WP4 has analysed and synthesized the up-dated science based information provided by WP2 on production related issues, and by WP3 on consumer - and socio-economy issues and Institutional Frameworks. This information was presented in review format at the 1st stakeholder event in Istanbul 11th – 12th October 2014. In Month 11 WP4 delivered D4.1: "Extracted and integrated/synthesized information from WP2 and WP3 (1st stakeholder event) within depth review, analyses and synthesis of preliminary information provided as well as feed-back from the 1st Stakeholder event. Further, updated information based on final reviews balanced with stakeholder feed-back, related to the current EU regulatory framework for organic aquaculture and in line with organic principles and consumer confidence, was provided at the second stakeholder event in Rotterdam 19th – 20th October 2015. The information was transformed into condensed and easily conceivable format as "Communication material for 2nd stakeholder event" - D4.3 (M23). The paper provided an extract and synthesis on key issues related to the current regulation on organic aquaculture. It included conclusions, challenges and research gaps identified as basic to the discussions and issues to be addressed at the 2nd stakeholder and to be considered to underpin future growth of the European aquaculture sector.

2nd stakeholder event

WP4 was in charge of organizing the 2nd stakeholder event in Rotterdam 19th – 20th October 2015, i.e. travelling, accommodation, meeting venue logistics. The event was organized back to back to the international aquaculture congress Aquaculture Europe 2015 (AE2015) organized by the European Aquaculture Society (EAS) 20th – 23th October in De Doelen Congress Center in Rotterdam.
The MCDA (please see below for further explanation) required a properly weighted participation of the different categories of stakeholders (e.g. primary producers, aquaculture associations, NGO´s, organic associations and control bodies, consumer organisations, retailers, feed producers, public institutions, researchers). The target number was 80 participants for the event, and a list of 80 participants representing the whole supply chain was established for the first round invitation. The invitations included: (1) A personal letter of invitation explaining purpose and contents of the meeting, as well as practical information, (2) Preliminary program, (3) Registration form, (4) OrAqua 2nd Newsletter and (5) EAS promotion brochure. However, only about 50 invited stakeholders registered for the event at the first deadline. Additional invitations were sent in order to reach the target number of 80 participants at the event. However, though great efforts the final number of participants was 69 stakeholders.

Multi Criteria Decision Analysis (MCDA)
A main issue at the 2nd stakeholder event was to initiate a Multi Criteria Decision Analysis (MCDA). This because anticipating conflicting approaches to the wide range of multidisciplinary and complex organic farming issues, which might challenge stakeholders having different backgrounds and knowledge and maybe conflicting objectives and preferences of specific farming issues (feed, welfare, environment, economic etc.), related to the EU regulation. These challenging issues were addressed using the Multi Criteria Decision Analysis (MCDA) as a tool to facilitate informed decisions of choices among alternatives and hence to balance conflicting approaches to the specific organic farming issues.
Therefore, the aim of using MCDA techniques was to achieve the most optimum balancing of alternatives/trade-offs from feed-back of the stakeholders relating f. ex. good fish health and welfare, environmental interactions, feeding and nutrition, farm economics and competitiveness.
As in the "real world" situations, solutions to alternatives are reached as compromise solutions, resulting from trade-offs between various conflicting objectives of the stakeholders and decision makers, through negotiations to reach a consensus.
The MCDA has shown to be an efficient scientific tool to choose the best alternative from a set of alternatives to balance stakeholder feed-back. The so far compiled review information and added information from the 1st stakeholder event was used to build the methodological basis of the MCDA i.e. identification of objectives (goals), criteria (interests), different options (alternatives) and priorities for preparation of a survey to provide feedback on multi-stakeholders perception on the European regulation of organic aquaculture.

The process was based on the following steps:

- Identifying the objectives or criteria (e.g. stocking density vs. water quality) to be used for influencing the final choice by stakeholders. These should be clearly specified and, as far as possible, mutually independent
- Forecasting, for each option, the hierarchy levels for each decision criterion
- Assigning a preference measure to each of these hierarchy levels for each option. The preference function may be a proportionate score (linear preference function), or a utility value (nonlinear preference function)
- Calculating the measure of overall value or merit to determine the best option using a simplistic weighted average of the scores, with the option providing the highest weighted score being the one that is "best".
- Identify the highest priority issue(s) for stakeholders in relation to the existing EU regulatory framework and based on the state of the art of existing knowledge
- Compare relative performance of different options (e.g. production systems) across a number of competing objectives (e.g. animal welfare, environmental effects, competitiveness) or different stakeholder preferences (e.g. market prices, product quality, naturalness, profitability).

A test of the MCDA tool was performed at the WP2 workshop in Vodnany, Czech Republic in March 2015 using workshop participants as "stakeholder test persons". The experiences and concomitant discussions

were taken into consideration by improving the structuring of the MCDA activities at the 2nd stakeholder event in Rotterdam.
Prior to the 2nd stakeholder event WP4 provided D4.2 (M22): "MCDA survey: MCDA survey for stakeholders to be used in 2nd event of WP5".
The MCDA process looked for the trade-offs between conflicting objectives, which can be associated to economic values or not, such as biodiversity, ecosystem services, ethical values reflecting consumer preferences, consumer sentiments and perception of organic aquaculture products, social acceptability including equity and fairness, needs of minimizing risk and uncertainty, etc. The potential for further development of the European organic aquaculture as a competitive player in the global seafood market were analysed in relation to the EU certification regulation and other certification schemes.
The MCDA survey participation of consumers, retailers, researchers, organic farmers together with experts from the organic certification bodies, the aquaculture associations, the environmental NGOs, the feed industry and the Public Institutions provided a useful feedback on how to improve the European regulation of organic aquaculture.
Based on the results and interpretation of the MCDA: D4.4 "Results and interpretations of MCDA: Report on the results and interpretations of MCDA for WP1, WP5 and WP6" delivered M28 made main information available for WP6 for a SWOT analysis and finally recommendations on the EU regulation on Organic Aquaculture.
Based on the compiled information throughout the project (reviews, stakeholder meetings/feedback, surveys etc.) WP4 provided D4.5: "Easily conceivable communications for dissemination" by M35, which can be summarized:

Analyses and synthesize of the up-dated science based information provided by WP2 and WP3
The OrAqua project provided science based recommendations for possible amendment of the EU organic regulatory framework in line with the organic principles and consumer confidence to support economic growth of the organic aquaculture sector in Europe.
Fishmeal and fish oil are natural ingredients in diets for carnivorous fish and shrimps. However, marine resources are limited and the current art. 25k of the EU Reg. 889/2008 put priority in sourcing of feed ingredients. This includes organic feed products of aquaculture origin and trimmings from organic aquaculture, though only available in very limited quantities. In addition, trimmings are not a well-defined product, and may negatively affect growth performance and environmental impact, and therefore be in conflict with the organic principles.
For ingredients of plant origin the drawback is that supplement synthetic amino acids is not allowed in organic aquaculture feed, except in specific cases, e.g. histidine to prevent the formation of cataracts in salmonids. Further, anti-nutrients in plant sources have to be removed using procedures in compliance with organic rules.
The last option allows using fishmeal and fish oil derived from fish caught in certified sustainable fisheries. However, to fulfil the nutrient requirements of organic farmed fish there is a need of diversifying the basket of available feed ingredients, including e.g. bacteria, fungi, algae, single cell organisms; marine micro algae etc.
Conventional phyto- and zooplankton currently allowed as feed in larval rearing of organic juveniles, as well as fish oil are unique in their content of long chain Ω-3 fatty acids like eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA).
Most organic farms are open-air flow through systems, while intensive RAS systems only are allowed in hatcheries and nurseries or for the production of species used for organic feed organisms. However, re-use of water is clearly in line with organic principles of sustainable and responsible use of resources, and should be encouraged and further explored.
The separation criteria between organic and non-organic specimens as well as between organic and conventional farms should be clearly defined.
Off-shore cage culture is resource efficient compared to other production systems. However, the difficulties to control diseases and the interactions in relation to the sea bottom below the cages have to be taken into consideration, to prevent a long term negative environmental impact. However, farming of mussels, oyster and algae may be integrated as an environmental service.
For breeding purposes and when organic aquaculture animals are not available, wild caught or non-organic aquaculture animals may be brought into an aquaculture facility, but shall be kept under organic management for at least three months before they may be used for breeding.

For on-growing purposes and when organic aquaculture juveniles are not available, with a time-limited derogation, non-organic aquaculture juveniles may be brought into a facility. At least the latter two thirds of the duration of the production cycle shall be managed under organic management.
No specific organic rules exist for managing the life cycle phase between hatching and the weaning of juveniles. However, specific requirements for organic live plankton feed for hatcheries would increase the integrity of production of organic juveniles. The use of hormones and hormone derivate is prohibited.
A database on the availability of organic ova/juveniles produced in each country should be established to ensure transparency on the possibility to use organic/non-organic ova/juveniles.
Fish welfare is species specific and is related to a range of parameters, e.g. stocking density, water quality, nutrious feed, husbandry practises etc. Rearing density per se encompasses a complex web of interacting factors and therefore, a combination of welfare indices (e.g. behavioural and water quality monitoring), together with stocking density requirements, would be a better way to ensure fish welfare in aquaculture, than monitoring just one index.
During transport and storage prior to slaughter proper water quality should be secured.
The most humane stunning methods, when properly done by trained and skilled staff, are currently percussive and electric stunning followed by killing with gill cut.
A transparent and proactive communication and marketing strategy is needed to ensure increasing consumer awareness, confidence, familiarity and knowledge on key issues related to the organic aquaculture production.
The European organic aquaculture market is still below a critical threshold and competing with other better known standards. Therefore, a primary objective of the common policies should be to establish and/or reinforce European and National support actions to programs for developing a more competitive organic aquaculture.
The uncertainty and lack of clarity of the production rules and control provisions i.e. making the regulations a "moving target" creates a lack of trust and investments. Therefore, a simplified and transparent legislative procedure should be looked for in future updating of the regulation to facilitate the organic aquaculture production. Exceptions from the requirements applicable to organic production should be strictly limited to specific exceptional cases.
Therefore, a realistic and transparent legislative procedure with clear control provisions should be aimed at in future updating of the regulation, but also allow for flexibility to incorporate innovations and technological advances to further support economic development of the organic aquaculture sector.

WP5: Facilitation of Stakeholder Events
A multi-stakeholder approach is called upon in policy development in order to support a positive (re-)design of both systems and processes. Applying a multi-stakeholder approach enable actors to develop shared visions and new concepts, in our case within European Organic Aquaculture. Ideally the involvement of different stakeholders has both a guiding, binding, convincing, and uncertainty mitigating function. The outcome can also be an actor network which support further aquaculture innovation and learning. Combining a process of social learning with accessible platforms for ongoing interaction creates preconditions for future development. Nevertheless, multi-stakeholder collaboration does not happen without efforts, facilitation and guided actions, why it might be that we in different projects does not allow potentials to be realized.
We argue that a) implementing new approaches to stakeholder involvement are at the heart of most participatory processes, b) success of innovative multi-stakeholder approaches, including process design and facilitation, depends on an understanding of the institutional context which in turn is unique for each policy sector, and c) the institutional constraints for effective multi-stakeholder processes is crucial to understand and manage when moving from theory/ideal to practice. Within the OrAqua-project we have taken these notions seriously and developed a multi-stakeholder approach which tries to balance between the desirable and the feasible.
European Organic Aquaculture includes many actors; science, industry, media, public, authorities, non-governmental organizations etc. One has to remember that facilitating complex issues, such as science-based policy development of European Organic Aquaculture, always involves a learning dimension. As such, communication between actors becomes a tool to learn more about different perspectives, experiences, attitudes and values, but also to take improved actions. In multi-stakeholder learning processes the actors produce different kinds of knowledge, all of which might be useful in reaching shared objectives. At the very core is social learning, why a multi-stakeholder approach aiming to develop not only science-

based but also socially robust policies for organic aquaculture, is about creating as good preconditions for stakeholders to learn as possible. Therefore the professional practice is in the coal face of future potentials, new challenges, existing dilemmas, conflicting interests, and joint actions, when at the same time trying to reach objectives based on organic principles. Policy content and methods for policy development are intertwined.

The emergence of new approach to manage policy challenges has been beneficial for the OrAqua-project when deciding how to organize stakeholder involvement. But not only as an effective way to reach the project's objectives. Putting the efforts of stakeholder involvement in a larger context we would argue that these trust-building processes has the potential to gradually reform and democratize international politics, in our case European Organic Aquaculture, on a more long-term basis. But this might be easier said than done. Multi-stakeholder approaches that seem promising from a theoretical perspective do not always have sufficient knowledge behind them about what makes these collaborative processes successful, and if they really help us to manage common pool dilemmas and reach shared visions. There is always a bit of trial-and-error in social processes. At the same time we are convinced that there are some guiding principles that are important to follow.

It is not one measure or method that makes multi-stakeholder approaches successful, it is the combination of different initiatives and application of methods. Therefore, we have had the ambition to combine methods in the OrAqua-project in order to develop a promising approach to multi-stakeholder collaboration in larger CSA-projects. It is about creating as good preconditions as possible (collaborative potential), initiating relevant activities, and involving stakeholders depending on where the project is in its development phase. Early in the process the project needs guidance on future directions and prioritize, later on one need to incorporate the many stakeholders' perspectives existing, while at the end of the process the project needs to get feedback on the knowledge developed and on suggested ways forward. From the beginning the agenda is rather open and incorporating, but the longer one work the more specific and narrow the focus gets, which also impact the choice of methods used. However, regardless how you have worked with a multi-stakeholder approach it does not say much about the local or regional sustainability of organic aquaculture in Europe.

To understand the local or regional consequences and the level of adaptability of multi-stakeholder initiatives, other empirical studies on outcomes are needed. Furthermore, to assess the sustainability, that is, the states and trends of economic, ecological, and social dimensions in actual aquaculture, it needs to be linked to how the multi-stakeholder collaboration develops and performs over a long period of time. This has not been the purpose of the OrAqua-project. Instead we have tried to create as good preconditions as possible for long-term stakeholder involvement and collaboration which we believe is necessary in order to develop the organic aquaculture sector in Europe.

A final note here is that stakeholder involvement can be organized during the whole project and the different phases, from planning activities and collecting data to suggesting new policy recommendations and evaluating the outcomes. As for whom to engage, it is also necessary to ask oneself on what issues, when and by what means such an involvement should happen.

The aim of WP5

In the OrAqua-project we believe it to be of vital importance to take benefit from different stakeholders' interests, expertise and experiences and by doing that securing not only science-based but also socially robust policy recommendations. Therefore WP5 was designed to take specific responsibility for three events designed to enable stakeholders to express their views and influence the development of the project's direction.

The overall aim of WP5 was to plan, design, facilitate, document and analyze the outcomes of three events in order to involve and engage relevant stakeholders within European Organic Aquaculture in the development of science-based policy recommendations. In short the objectives were to;

- Deliver three effective stakeholder events organized and conducted at critical points of time
- Facilitate the process to secure collaborative learning and efficient and effective communication among participants
- Document outcomes from the events for incorporation in WPs 2-4 and towards consensus in WP6.

It is important to keep in mind that a multi-stakeholder approach means more than arranging conferences and meetings. The stakeholder events must therefore be seen in the context of the whole OrAqua-project

where different efforts together makes up the multi-stakeholder approach. Especially the stakeholder platform (WP1), the scientific reviews (WP4) and the MCDA-analysis (WP6), and other external activities (participation on conferences, ongoing interaction and dissemination activities, etc.) are all part of the ambition to create a constructive dialogue among stakeholders in these issues.

Activities and outcomes of WP5

Since the beginning of the project WP5 worked with the other WP's in order to plan, design and organize the Stakeholder events. So called "terms of reference" was developed into a document which describes the guiding principles behind the approach and methodology chosen. "Working guidelines" was developed into a detailed checklist, which also became a living document that helped us plan, manage and facilitate each event in relation to the specific preconditions and objectives. The stakeholder events was conducted in the following sequence;

- Event 1 for supporting the processes of reviewing (WP2 and WP3) and integration (WP4) with input from stakeholders' different perspectives.
- Event 2 to survey stakeholders' values, attitudes and prioritise, and to initiate the decision making process generated by MCDA (WP4).
- Event 3 for getting feedback and hopefully building consensus on recommendations (WP6).

The first Stakeholder Event was designed as a pre-conference event to the IFOAM World Congress held in Istanbul on the 11-12th of October 2014. We had 56 external participants at the event, representing a broad range of stakeholder groups, resulting in a constructive and engaged discussion. WP5 was responsible not only for facilitating the event, but also to draw conclusions and suggest action points based on experiences made at the Stakeholder events. There were two kind of action points; one directed towards the content of the forthcoming review process, another focusing on possible improvements in stakeholder interaction and forthcoming stakeholder events.

Consequently, the action points developed at the first Stakeholder event provided feedback into the design of the second Stakeholder Events. The outcomes were also discussed and analyzed by the Project Management Board, and three deliverables were submitted: D5.1 "Terms and guidelines for stakeholder events"; D5.2 "Reported Facilitation of Stakeholder events"; and D5.3 "Conclusions and actions points from the first Stakeholder Event". These deliverables have been seen as living documents and complemented after the second Stakeholder event.

The main purpose of the second event was to survey the different stakeholder groups' attitudes and values to central issues for organic aquaculture using a MCDA-methodology. As a complement to this, the aim was to arrange dialogue sessions which focus on some of the issues raised by stakeholder at our first event as well as identified by initiating an open question to core stakeholder on what they perceive as key issues to be elaborated at the meeting. This was a strategy used to ensure a higher degree of participation.

When planning the second Stakeholder event the checklist was modified and adapted to the new pre-conditions and objectives. WP4 was in charge of organizing the 2nd stakeholder event in Rotterdam 19th – 20th October 2015. The second Stakeholder event was organized back to back to the International Aquaculture Congress Aquaculture Europe 2015 (AE2015) organized by the European Aquaculture Society (EAS) 20th – 23th October in De Doelen Congress Center in Rotterdam. A main issue at the second Stakeholder event was to initiate a MCDA survey with the aim of assessing multi-stakeholders' goals, interests, alternatives and priorities among key issues for a sustainable development of organic aquaculture. The MCDA requires a properly weighted participation of the different categories of stakeholders (e.g. primary producers, aquaculture associations, NGO´s, organic associations and control bodies, consumer organizations, retailers, feed producers, public institutions, researchers). As the OrAqua budget only allows participation of max. 80 participants in the second Stakeholder event great effort was made to select and make a balanced list of stakeholders representing specific categories within European Organic Aquaculture. However, despite great efforts to reach this goal we ended up having 69 stakeholders attending the second Stakeholder event. Besides the inputs to the MCDA, additional outcomes and action points resulting from the discussions was integrated in the deliverables D5.2 and D5.3.

Our third and final Stakeholder Event took place in Venice the 21-22nd of June 2016. At this point of our work, preliminary recommendations had been developed and these were the main theme to deliberate and discuss at the Event. As for earlier Stakeholder Events the planning process involved the whole PMB and started already in the beginning of 2016. One important insight made at earlier Events had been that the

stakeholders want to spend more time in dialogue sessions. Therefore the design of the third Stakeholder Event included short inputs from the project which then were discussed by the participants in more detail and in facilitated group sessions.

Evaluations of the Stakeholder events

The stakeholder events have been important for many reasons. First of all the results and documentations from the research and review processes (WP2 and WP3) was presented and discussed, making the final recommendations not only scientific but also as socially robust as possible. Secondly, the stakeholder events were designed in a way so that they supported the development of a communicative culture across "language" barriers among stakeholders and between stakeholders and researchers. By a strong focus on deliberation, dialogue and discussion the development of shared understanding among stakeholders was supported. Finally, the events had the role to help disseminate the final results from the OrAqua-project, supporting increased societal impact. This last point was reflected in a will to keep the OrAqua-platform alive and active also after the project had ended.

The main reason that we chose to organize the first Stakeholder event in Istanbul, Turkey, instead of Montpellier, France, as listed in the DoW, was that we wanted to create synergies with the IFOAM World Congress and enable more participant to attend. Similar reasons made us decide that the second Stakeholder event were to be held in Rotterdam, the Netherlands, as a pre-conference to the EAS Congress Aquaculture Europe, instead of in Hirtshals, Denmark, as suggested in the DoW. The final and third Stakeholder Event took place in Venice, Italy. One reason for this was to enable interesting study visits in Organic Aquaculture in adjacent to the event. Another reason was to enable more participants to attend due to lower costs for accommodation.

Our conclusion is that the first Stakeholder Event fulfilled its purposes and that it in an early phase strengthened the stakeholder platform in OrAqua. It is important to keep in mind that it takes time to build strong relations, to explain and create acceptance for the delimitations of our project, and to show how inputs from stakeholders are taken care of and processed, why it is the experiences made over the whole project period which will tell us if we succeeded or not. Nevertheless, already at the first event a good platform was created for future dialogues.

The documentation of the first Stakeholder event is presented in D5.2. The feedback sheets and the evaluation form gave us important information regarding organizational, procedural and participation related issues. The outcomes from the round tables and café dialogues became inputs to the scientific review process. Thus, some contributions were integrated in the scientific review (D4.1), and became part of the processing for D4.2 (the MCDA survey) and D4.3 (communication material before the second stakeholder event).

The evaluation of the organization, facilitation and participation of the first event shows that the participants in general were satisfied with the design of the event and the general level of stakeholder participation. Improvements were possible in areas such as access to materials beforehand, event logistics, quality of facilities, and the use of a broader variety of facilitation techniques. The diversity of stakeholders (perspectives, pre-understanding, engagement, etc.) makes it hard to satisfy all individual needs. Nevertheless, the expressed interest in continuing the dialogue with OrAqua and the willingness to contribute to it shows that the participants already at the beginning valued the OrAqua-initiative and that the event enabled stakeholders to have both voice and influence on the future of organic aquaculture.

The evaluation of the organization, facilitation and content of the second event shows that the participants in general were satisfied with the design and facilitation of the event and the general level of stakeholder participation. Improvements were suggested in areas such as making the stakeholder surveys beforehand, the lack of some stakeholder groups at the meeting (especially consumer interests), and too little time for informal group discussion. In addition, this time there was a clear interest in continuing the dialogue with OrAqua, an interest in both influencing and learning from the suggested recommendations, that is, a general willingness to contribute. What we learned at the second Stakeholder event from a process perspective, was integrated in the next planning phase. One organizational change in WP5, which took place after the second Stakeholder event, was that one of the facilitators (Professor Nadarajah Sriskandarajah) retired from his position at the Swedish University of Agricultural Sciences, and left the OrAqua-project. Thus, the second facilitator (Principal Extension Officer Magnus Ljung) took sole responsibility for the third event.

As said, the third Stakeholder event was organized in Venice, Italy, 21-22nd of June 2016. The day before the event, study visits were arranged to discuss issues of general interest in Organic Aquaculture. As for the other two events, the third was developed in a collaborative planning process, this time by liaising especially with WP6. As the aim for the third event was to give input to preliminary recommendations developed in WP6 this was a natural cooperation. Before this event, the PMB-group worked even harder to get a broad representation of stakeholder groups, avoiding a situation where important perspectives on recommendations were missing. In general we were successful in getting relevant participants to the table.

The third Stakeholder event was from an organizational and process perspective the most successful. The local arrangement, the general organization of the event and the strong focus on facilitated dialogues was perceived as highly successful. The fact that the preliminary recommendations that were to be discussed had been sent to the participants beforehand, made the discussions constructive and efficient. A few number of stakeholders were not as satisfied as the others, but when looking closer to the reasons for this, we could in the evaluation see that this could be explained by that these stakeholders perceived that their specific issues and needs had not been covered enough or taken into consideration in the preliminary recommendations. This is a common phenomenon in multi-stakeholder approaches, where some participants feel that their interest is not in focus as much as they expect or want. Nonetheless, the overall conclusion is that the third Stakeholder event became a very good endpoint of the Stakeholder events in the OrAqua-project. This was manifested in the general will among the participants to support similar open, dialogical spaces and meetings among stakeholders in the future. There is a continuous need for multi-stakeholder collaboration in European Organic Aquaculture.

The importance of stakeholder events in the development of OrAqua
The overall aim with WP5 is to facilitate three events to involve and engage relevant stakeholders, recruited mainly from the multi-stakeholder platform, along with researchers and other project partners throughout the process. By this the consortium could take into consideration and benefit from stakeholders interests, expertise and experiences and secure robust recommendations. The events were designed and delivered in a way that supported efficient and effective communication and exchange of feedback among participants and with the OrAqua-consortium. Each event was followed by reporting of outcomes and potential action points, to be used by other WPs and to further develop the project. The experiences made at each Stakeholder Event also became input for the planning of the next, which resulted in slight but important improvements of design and focus.

We have been able to fulfil the specific aims of the events and have had a broad participation of most relevant stakeholder groups. Some stakeholder groups have been harder than other to engage, such as retailers and consumer organizations, but with great efforts from the whole PMB-group the Stakeholder Events became well balanced and successful as the evaluations also showed. The conclusion of WP5 being that the objectives have been achieved, without deviations, and has contributed to the OrAqua-project outcomes as anticipated.

What can we learn from the OrAqua-experience?
The multi-stakeholder approach implemented in the OrAqua-project has been successful. We have been able to live up to the ambitious objectives, and the stakeholder themselves have perceived our efforts as valuable and contributed to strengthen the European Organic Aquaculture by creating stronger bonds, improved communication, and network building among key stakeholders. By that OrAqua has created a platform for future collaboration, which many involved believe is important to cherish.

The OrAqua-experience illustrates the importance of combining different measures and activities in a multi-stakeholder approach; traditional dissemination activities, an online platform, informal network building, and facilitated spaces for dialogue across traditional boundaries. Furthermore, our work shows how a consciously designed approach, making the stakeholders participate and contribute in different ways along the development of the project, is both desirable and feasible. By letting the stakeholders getting involved early in the process, as well as giving input to preliminary recommendations at the very end, we have shown that participatory approaches is possible to manage throughout the whole project. And perhaps most importantly, the multi-stakeholder approach applied in OrAqua has created better preconditions for

successful and cost-effective implementation of the science-based recommendations developed within the project.

WP6: Recommendations

The overall aim of WP6 is to provide recommendations based on sound scientific evidences, within the framework of the organic principles, for the review of the EU rules for organic aquaculture. Recommendations will be based on the principles of the excellence of the technical/scientific knowledge and of the transparency of data, methods and assumptions made. Recommendations will also take into account the objectives and principles laid down in Regulation (EC) No 834/2007.

After the second stakeholder meeting held in Rotterdam on October 2015, the WP6 activities started by collecting all the output of WP4 (i.e. Deliverable D4.2 Multi Criteria Decision Analysis - MCDA survey; Deliverable D4.3 Communication material for 2nd Stakeholder Event) and WP5. Such documents, together with the results from the WPs 2 and 3, were scrutinized in order to progress with the task 6.1. Assessment and recommendations.

The following section further will summarize the given recommendations. For details, we refer to D6.1 (SWOT + Recommendations), executive dossiers (D6.2), and policy implementation plan (D6.3), and the documents listed above.

The institutional framework & societal expectations

Organic aquaculture was regulated at EU level in 2009 after a thorough process spanning several years to streamline a number of different organic standards and national certification schemes in Europe. A common European regulation that created basic standards was highly welcomed, but also brought up many deeply problematic issues which are still not resolved.

The EU Member States are not allowed to apply stricter national regulation (specifically for the organic sector) than the rules set out in the EU organic regulation, but they are allowed to develop and apply national regulation in fields not (yet) covered by the EU organic regulation. Private national or international organic standards can be applied in the EU Member States, besides the EU organic regulation. As a minimum, the private organic standards shall fulfil the EU organic regulation but, contrary to the national regulations, the private standards may apply extra, as well as stricter rules than the EU organic regulation, also within fields that the EU organic regulation already covers. This means that organic aquaculture farmers may need to be certified not only according to the EU organic regulation but also to one or more private organic standards, depending on the market requirements, which in turn represents an increase of costs.

It is worth to mention that the current status of the EU Organic Regulation is an ongoing process of review, which was started by the Commission in late 2011 with a proposal for a new organic regulation that, following the recently implemented Lisbon Treaty rules, needs to be agreed by the so-called Trilogue (Parliament, Council and Commission).

The labelling of organic products became mandatory in July 2010. The main objective of the European logo (Euro leaf) is "to make organic products easier to be identified by the consumers. Furthermore it gives a visual identity to the organic farming sector and thus contributes to ensure overall coherence and a proper functioning of the internal market in this field". The majority of EU consumers are, however, unaware of the organic logo. They are also unsure about the concept of organic fish farming due its overlap with private standards and several available concepts, such as sustainable, ecological, environmental friendly, etc. This is partly a consequence of the Euro-leaf not been promoted sufficiently, thus it has to compete with other eco-labels with more targeted communication strategies. Consumers also show ambivalent impressions about the placement of organic fish between wild fish and farmed fish.

The certification and control system in the European regulation on organic farming, including organic aquaculture, is quite complicated and implementation differs between Member States, which may apply one of the following three types of certification systems: a) private approved inspection bodies; b) designated public inspection authority(ies); c) mixed system between the two. This complex certification and control system may have had a negative impact on the free exchange of organic products in Europe. Furthermore, the related accreditation and certification costs may be quite expensive, especially where the market requires certification according to one or more private standards in addition to the EU organic regulation certification.

Organic imports from third countries represent an important part of organic products consumed in most EU member states. This is true also for organic aquaculture products. The import regime has undergone several changes over time. Currently, the following two options are provided by the regulation to import

organic products from third countries to EU:
The EU Regulation on Organic Agriculture is applied in the third country exactly as in the EU member states, i.e. the products are "compliant" with the European Regulations. The Commission will establish a list of recognised "compliant" control bodies authorised to carry out inspections and issue certificates in third countries. But, this option has not yet been implemented by the EU Commission.
The production standards and control measures in the third country are "equivalent" to the European Regulations. In this case, the EU has established a list of recognised third countries and a list of recognised control body issuing the certificate.
However, following the on-going process of revision of the EU organic regulation the imports system could undergo further modifications, which implies the persistence of a situation of uncertainty on the exchange of organic products.
Price is one of the major barriers for increased consumption of organic fish. Cost prices for organic aquaculture production can rise by about 20% to 50%, depending on species and production region. Generally, the feed costs are responsible for the largest contribution to the higher cost price of organic production, followed by the costs for juveniles (if available) and the costs for the fixed assets. A cost analysis of the supply chain showed, however, that the consumer prices are influenced not only by the costs of organic fish production on farm level, but also by the margins for processing and retailing. Retailers throughout Europe could play a pivotal role in the development of the market for organic aquaculture products. To what extent the retailer chains are willing to foster organic aquaculture differs significantly among countries and groups. As long as the European organic aquaculture market will not exceed a critical threshold, other standards, which are better known or have lower costs, will continue to be serious competitors of the organic aquaculture.
Recommendations
The organic aquaculture should be considered as a food production method in line with the preference of certain consumers for products produced using natural substances and processes. The organic aquaculture thus should play a dual societal role,: on one hand it provides for a specific market, responding to a consumer demand for organic products, and on the other hand it delivers public goods, contributing to the protection of environment and animal welfare.
Establishing and/or reinforcing European and National support actions to programs for developing organic aquaculture is important to facilitate for organic production and marketing.
A targeted communication strategy to ensure an increasing consumer awareness, familiarity and knowledge on the organic aquaculture product qualities should be part of the support actions, in order to develop and maintain consumer confidence in organic products.
A further development of the risk based inspection systems, by supporting a weighted approach to the risk of occurrence of non-compliances, in relation to the impact severity on the market and on consumer trust, would be highly recommendable.
A further harmonization of terms and definitions used in the EU organic regulation, as well as types of non-compliances and appropriate sanctions to be given at different levels of non-compliances, would enhance the transparency and the strengthening of the organic system.
Collection of relevant statistics, exchange of information and knowledge regarding organic aquaculture production, should be promoted in order to reach a good understanding of the functioning of the regulation and hence identify successes and decide on policies to promote organic production.
Situations of uncertainty or questionable interpretation, regarding production rules and control provisions, which may create a lack of trust and investments, should be kept to a minimum and resolved in the shortest possible time.
Production systems
According to the Commission Regulation (EC) 834/2007, art. 11, a holding may be split up into clearly separated units or aquaculture production sites which are not all managed under organic production. As regards animals, different species shall be involved. As regards aquaculture the same species may be involved, provided that there is adequate separation between the production sites. This chance, granted only to aquaculture, has been much debated among stakeholders, who were very concerned about the possible repeal or modification of this opportunity. The justification for this alarm lies mainly in the considerable length of the production cycle and in the high average dimension of the aquaculture farms, which would not allow a full conversion without bearing excessive production and market risks.
According to the Commission Regulation (EC) n° 889/2008, for on-growing purposes and when organic aquaculture juvenile animals are not available non-organic aquaculture juveniles may be brought into a

holding. At least the latter two thirds of the duration of the production cycle shall be managed under organic management. However, the maximum percentage of non-organic aquaculture juveniles introduced to the farm has been subject to a phasing out until December 31, 2016 [Reg. (EU) n° 2016/673]. The phasing out of non-organic aquaculture juveniles has generated alarm among organic aquaculture farmers, moreover it was judged inopportune by the International Federation of Organic Agriculture Movements (IFOAM) and by the Federation of European Aquaculture Producers (FEAP) (cfr. Deliverable D6.3 Policy Implementation Plan), and has also raised the perplexities of some national authorities. The alarm and the perplexities are motivated primarily by the scarcity and/or absence of organic juveniles, as well as by the absence of an institutional procedure to ascertain the availability and amount of organic juveniles of the different species. Actually, it is not clear why there are so few hatcheries permanently converted to organic production, since it does not appear to be significant barriers to the acquisition of organic certification. Indeed, the Commission Regulation (EC) No 889/2008 seems to overlook specific organic rules for managing the early life stages of fish, apart from some issues related to the preparation of weaning feeds, particularly for marine species. Some further insight about this topic are reported in the Executive Dossier "Breeding practices and origin of organic aquaculture animals" (D6.2).

As stated above the Commission Regulation (EC) No 889/2008 seems to overlook specific organic rules for managing the early life stages of fish, which was considered a shortcoming by some national authorities and by IFOAM. If it is deemed appropriate to overcome these gaps, then the recommendations outlined by the Expert Group for Technical advice on Organic Production (EGTOP) are to be considered a reasonable solution (cfr. Final Report on Aquaculture - Part B). It is worth noting that, in this case, the problem of shortage and/or lack of juveniles would see a further exacerbation.

According to the Commission Regulation (EC) n° 889/2008, art. 25g, closed recirculation aquaculture animal production facilities are prohibited, with the exception of hatcheries and nurseries or for the production of species used for organic feed organisms. Even this issue has been widely-debated between stakeholders, up to register an irreparable division within the CODEX Committee meeting held in Ottawa in May 2016. Compliance with this rule is considered a non-derogable principle, especially in Europe. However, an alternative strategy may be envisaged in the "re-use of water" which, to some extent, combines the advantages of both flow through systems and recirculation aquaculture systems (RAS), without compromising organic principles (cfr. Executive Dossier Production systems).

Recommendations

The rearing of organic and non-organic fish, of the same species, in the same production units should continue to be allowed, even though separation criteria might be further detailed in the Regulation.

The ban on using hormones is an important principle of organic farming, in order to maintain consumer confidence in organic products.

A database should be established in each country for recording information on the availability of eggs and juveniles produced under organic management. The database might be centralized or might be managed by the competent authority of each Member State or by a body designated for this purpose by the competent authority.

Operators must use the database if the species they require is listed in such database. Exceptional permissions to use non-organic juveniles should be granted by the competent authority of each Member State when organic aquaculture juvenile are not listed in the database. In this case, at least the latter two thirds of the duration of the production cycle shall be managed under organic management.

Pros. *No farmers will be forced to give up the organic production, taking on significant economic and reputational damages.*

Cons. *There is a risk of slowing down the process towards establishment of a suitable number of aquaculture farms producing juveniles under organic management.*

The promotion of specific breeding programs for organic aquaculture would be highly recommendable for the purpose of a more efficient selection of key traits, such as growth, feed conversion and disease resistance, which allow to obtain family lines more adapted to organic aquaculture conditions. This, in turn, would also enhance the actual applicability of the organic principle for which the whole production cycle should be run under organic management.

The life stage between hatching and weaning should take place, preferably, in "mesocosm" or "large volume rearing" that means low intensity systems more close to nature, with the initial eggs/larvae density lower than in the intensive systems (Technical details can be find in the Executive Dossier Breeding practices and origin of organic aquaculture animals).

Pros. *A shortcoming in the EU Regulation will be overcome.*
Cons. *The problem of shortage and/or lack of juveniles might be further exacerbated.*
Systems fully in line with the organic principles are "polyculture", where two or more species, usually from different trophic levels, are reared together. A further system, which is based on the same concept, is the so called Integrated Multi-Trophic Aquaculture (IMTA), where fish farming is carried out in combination with molluscs and/or seaweed and/or other invertebrates.
According to the organic principles, production shall be based on the appropriate design and management of biological processes based on ecological systems using natural resources, which are internal to the system. Therefore, closed recirculation aquaculture animal production facilities should continue to be prohibited, with the exception of hatcheries and nurseries or for the production of species used for organic feed organisms.
However, due to the limitations of water resources, the reuse of water is a desirable ecological practice in organic aquaculture and a responsible use of resources. The re-use of water is an alternative strategy which, to some extent, combines the advantages of both flow through systems and RAS, without compromising organic principles. Such re-use of water means a kind of non-intensive recirculation, in out-door systems.
Artificial heating or cooling of water shall continue to be permitted only in hatcheries and nurseries.
The use of oxygen shall continue to be permitted only in specific exceptional cases, for animal health requirements and critical periods of production or transport. Under no circumstances will it be used to support higher stocking densities than those allowed by the natural environment.
In the organic aquaculture, the production cycle cannot take place entirely in indoor facilities. The on-growing phase should take place in outdoor facilities.

Environmental impacts

The rationale behind organic food production is to minimise the impact of the production on the environment. The global food sector is currently responsible for around 30% of the world's energy consumption and contributes to more than 20% of the global greenhouse gas emissions. However, in recent years there is an increasing interest for developing models, metrics and tools to measure environmental impact. The main purpose of environmental indicators is to summarise the complexity of our environment, providing a manageable amount of meaningful information, which would allow decision-makers to take actions in view of a more sustainable food production.
The Commission Regulation (EC) n° 889/2008, in order to reduce the impact of the organic farms on the surrounding environment, for all new operations, require an environmental assessment proportionate to the production unit, which is based on Annex IV to Council Directive 85/337/EEC. Furthermore, the operators shall provide a sustainable management plan proportionate to the production unit for aquaculture and seaweed harvesting. The plan shall be updated annually and shall detail the environmental effects of the operation, the environmental monitoring to be undertaken, and list measures to be taken to minimise negative impacts on the surrounding aquatic and terrestrial environments, including, where applicable, nutrient discharge into the environment per production cycle or per annum.
Environmental assessment and sustainable management plan are considered an effective way to minimize the environmental impacts. Whereas, the obligation to perform a periodic LCA would result in excessive bureaucracy and economic burden. What, however, should be strengthened are the quality checks on these documents, as well as the competences of the staff of the control bodies.

Recommendations

The provisions set out in the Regulation n°889/2008, art. 6b(5), about renewable energy sources, re-cycle materials and waste reduction schedule should be reinforced. In addition, specific rules on the use of biodegradable materials and sustainable packaging should be introduced in the regulation.
In order to achieve the objective of reducing the impact of the organic farms on the surrounding environment, it is relevant to identify suitable diets in which the protein component is less dependent on trimmings.

Feed requirements

According to Commission Regulation (EC) n° 889/2008, feeding regimes shall be designed with the following priorities: a) animal health; b) high product quality, including the nutritional composition which shall ensure high quality of the final edible product; c) low environmental impact.
It is a fact that fish meal of high quality provides a balanced amount of all essential amino acids, minerals, phospholipids and fatty acids in the normal diet of fish, and hence secure high utilization by the fish and minimum discharge of nutrients to the environment.

The art. 25K of the EU Regulation n° 889/2008 states that fish meal and fish oil from trimmings should be prioritized as ingredient for feed for aquaculture animals. However, sourcing fish meal and fish oil from trimmings might conflict with national environmental legislations, because of the higher phosphorus concentrations and the lower content of protein in comparison with high quality fish meal. Furthermore, replacing fish meal in diets for salmonids and marine species is not straightforward due to their unique contents of protein, excellent amino acid profile, high nutrient digestibility, high palatability, adequate amounts of micronutrients, as well as general lack of anti-nutrients. Moreover, compared to salmonids, protein requirements of sea bass and sea bream are higher, reflecting their highly carnivorous nature. Indeed, high replacement by plant proteins is challenging due to problems related to the anti-nutrient factors, altered patterns of amino acid uptake and impairment of immune competence. High replacement ratios would require that anti-nutrients factors are efficiently removed from alternative plant protein ingredients and that the dietary amino acid profile is optimised, for example, by adding free amino acids. However, it is also important to keep focus on human health related to consuming (organic) aquaculture products, including high content of long chain omega-3 fatty acids (EPA and DHA), currently sourced from fish oil.

There are several other potential feed ingredients, such as microbial organisms (bacteria, fungi, microalgae), terrestrial animal by-products (PAP, blood meal), wild-harvested and/or cultured annelid worms, insect larvae/pupae, gastropods (e.g. golden apple snail). A special aspect of some of these products is that they can be produced with different kinds of waste as raw material, and thus contribute to recycling of valuable nutrients.

Although, over the last decade, a number of studies on the replacement of fish meal with other sources of protein in the diet of fish have emerged and the results are encouraging, it is still necessary to intensify efforts in research and experimentation to overcome technical drawbacks and legal barriers for the use of alternative protein feed.

For further insight, see the Executive Dossier Feed for fish and crustaceans.

Recommendations

In the larval rearing of organic juveniles, conventional phytoplankton and zooplankton may be used as feed, until better alternatives have been developed.

The items listed in the art. 25K of the EU Regulation n° 889/08 should not be intended as an order of priority but as a list of priorities.

The need for protein and lipids in the diet of fish and shrimps depends on their life stages: the early life stages are much more demanding in protein and lipids. Therefore, the limits introduced by the EU Regulation n° 889/08 to the amount of proteins and lipids should be considered appropriate only for the grow-out stage.

Histidine produced through fermentation may be used in the feed ration for salmonid fish when other feed sources do not provide a sufficient amount of histidine to meet the dietary needs of the fish and prevent the formation of cataracts.

Essential amino acids produced through fermentation may be used in the feed ration for carnivorous fish when other feed sources do not fulfil the qualitative dietary needs or are not available. Operators shall keep documentary evidence of the need to use amino acids.

In relation to the point V above, and to overcome shortcoming related to feed for weaning marine species, the art. 22 (2)(b) of the Reg. CE n° 834/2007 might be activated.

Research and experimentation about alternative sources of protein and lipids for organic aquaculture feed should be promoted and prioritized.

Fish health, welfare, veterinary treatments and biosecurity

Among public and governments, there is an increasing interest in the welfare of farmed fish. In addition, among farmers, there is growing awareness that good welfare equates to increased success of production activities. Indeed, from a practical point of view, production efficiency, quality and quantity are often coupled with good welfare.

According to Commission Regulation (EC) N° 889/2008, the husbandry environment of the aquaculture animals shall be designed in such a way that, in accordance with their species specific needs, the aquaculture animals shall be kept in water of good quality with sufficient oxygen levels; shall be kept in temperature and light conditions in accordance with the requirements of the species and having regard to the geographic location. Furthermore, in considering the effects of stocking density on the welfare of farmed fish, the condition of the fish (such as fin damage, other injuries, growth rate, behaviour expressed and overall health) and the water quality shall be monitored.

Rearing density in aquaculture has raised preoccupation with respect to welfare, due to public concern about the welfare of farmed fish. Indeed, rearing density encompasses a complex web of interacting factors, such as water quality, social interactions, fish to fish interaction and fish to housing interaction that can have an effect on many aspects of welfare. Therefore, a combination of welfare indices (e.g. behavioural and water quality monitoring) would be a better way to ensure fish welfare in aquaculture than monitoring just one index.
The stocking density is a parameter that can be documented and controlled. However, it is considered only an indirect indicator of fish welfare. Therefore, the compliance with stocking density threshold values in combination with the relevant water quality parameter, e.g. oxygen and carbon dioxide concentrations would make the fish welfare conditions more reliable in the rearing environment (cfr. Executive Dossier Welfare, disease prevention and veterinary treatment).
In case of fish transport from farm to farm, in order to minimize the stress condition, threshold values should be established for the oxygen and carbon dioxide concentration. The optimal duration of transport, between the change of water, should be further investigated, species by species.
In recent years experimental evidence and studies of probiotics and herbal medicine is increasing, and the first results seem to confirm their effectiveness in the prevention and management of diseases affecting aquatic animal breeding. The use of these substances is permitted in accordance with article 25(t) of Regulation 889/2008, but does not describe in what way they are to be administered and whether they are authorized. Therefore, it might be appropriate to make a list of such microorganisms and plants, which can be used in the composition of the feed, for example, as shown in the register of animal feed additives of the Annex to Regulation 2003/1831 (extracts and microorganisms).
Plants and plant bio-actives might be proposed in aquaculture primarily as feed additives or immuno-stimulants, rather than therapeutics, because the registration of herbal remedies to be used in this field is a time-consuming process and implies higher economic costs.
The extracts of several plants have been tested to prove their effectiveness against diseases, particularly if they are effective against bacteria, such as Aeromonas sp., Vibrio sp., other microorganisms, viruses, fungi and parasites. The main plants tested are: Solanum trilobatum, Andrographis pani culata, Psoralea corylifolia, Astragalus membranaceus, Portulaca oleracea, Sophora flavescens, Zingiber officinale, Allium sativum, Origanum vulgare, Azadirachta indica, marine algae, Rhodophyceae, Achyranthes aspera, Angelica sinensis, Cynodon dactylon, Echinacea purpurea, Massa medicated, Punica granatum, Solanum nigrum, Whitania somnifera, Zataria multiflora.
The most tested probiotics which have given the best results in the trials were microalgae (Tetraselmis), yeasts (Debaryomyces, Phaffia, Saccharomyces), Gram-positive bacteria (Bacillus, Lactococcus, Micrococcus, Carnobacterium, Enterococcus, Pediococcus, Lactobacillus, Streptococcus, Weissella) and Gram-negative bacteria (Aeromonas, Alteromonas, Pseudomonas, Vibrio).

Recommendations

Stocking density, oxygen concentration, and husbandry practices are set out in Annex XIIIa, of the Commission Regulation (EC) No 889/2008, by species or group of species. In considering the effects of stocking density and husbandry practices on the welfare of farmed fish, the condition of the fish (such as fin damage, other injuries, growth rate, behaviour expressed and overall health) and the water quality shall be monitored.
Precautions shall be taken to reduce the fish stress during transport. Stoking density, concentrations of oxygen and CO_2 during the transport should be detailed in the regulation.
Threshold limits of oxygen concentration should be set out in Annex XIIIa as follows: marine fish above 80% saturation; salmonids above 70% saturation; carp above 50% saturation.
Threshold limits of oxygen and carbon dioxide concentration, during transport, should be set out in Annex XIIIa as follows: all species in the range 100-130% O_2 saturation; marine fish less than 10 mg/l CO_2; salmonids less than 8 mg/l CO_2.
Because the use of oxygen, in organic aquaculture, is permitted only in specific exceptional cases, for animal health requirements and critical periods of production or transport, stocking density should rely only on the water quality, an appropriate flow rate and the aeration provided by mechanical aerators, under the condition that they are, preferably, powered by renewable energy sources.
Plants and plant bio-actives might be proposed in aquaculture primarily as feed additives or immuno-stimulants. It would be appropriate to make a list of such microorganisms and plants, which are authorized and can be used in the composition of the feed.
The development of non-antibiotic and environmentally friendly agents is one of the key factors for

health management in organic aquaculture. As natural products, probiotics have much potential to increase the efficiency and sustainability of aquaculture production. Therefore, comprehensive research to fully characterize the intestinal microbiota of prominent fish species, mechanisms of action of probiotics and their effects on the intestinal ecosystem, immunity, fish health and performance holds great potential. However, when despite the measures for preventing diseases a health problem arises, chemically synthesised allopathic veterinary medicinal, including antibiotics, may be used under strict conditions. In such case, allopathic treatments are limited to two courses of treatment per year. In the case of a production cycle of less than a year the limit of one allopathic treatment is applied.
Good hygiene practices and farm management prevent the onset of diseases. There is currently no European guidelines on biosecurity in animal husbandry, but some are set at national level for certain species. It would be appropriate to recognize biosecurity measures at European level.

WP7: Project Management
A successful kick-off meeting was organized during early January 2014 (8^{th} – 10^{th}) at Nofima (Ås), Norway with all project partners represented. Project management board (PMB) meeting and workshops for WP2 and WP3 were also organised during these three days. Furthermore, PMB meetings have been organized in connection with the workshops of WP2 and WP3 in Ijmuiden (The Netherlands) in late April 2014, during the WP2 work-shop in Vodnany, Czech Republic, March 2015, and during the three organised stakeholder events in Istanbul 2014, Rotterdam 2015 and Venice 2016. The rest of the PMB meetings have been virtual. Minutes from the meetings and work-shops are given in D7.1. In total 39 PMB meetings, 3 AC meetings (Ijmuiden, Istanbul and Rotterdam) and 4 PGA (Project General Assembly) meetings (Ås, Istanbul, Rotterdam and Venice) have been held. The last AC and PGA meeting were held in Venice, June 2016 in connection with the third stakeholder event.
The work and progress of the project has been according to the plans, and the good cooperation, motivation and spirit in the consortium has been important for a successful implementation of the project.
The WP partners updated the work progress every 3 months in a short internal report of Deliverables, until December 2015. The progress and eventual deviations from the plan were reported in a "red-amber-green" system. Due to inefficient administration of this reporting system, the Coordinator has taken over the progress updating of Deliverables. In addition, an internal interim report is delivered every 6 months. The format of the internal 6 month report is equal to the present M18 report.
D7.1 had its due date January 2014, but since the Deliverable will progress through the entire project, an updated D7.1 is sent to the Project Officer after every approval of meeting minutes (PMB/AC/PGA), that is done at each PMB meeting. The progress report was also submitted as Deliverable 7.2 (M18) (even though it is stated in chapter 3 that periodic reports should not be Deliverables, defining D7.2 was approved in the application). D7.3 is submitted in M36 + 60 days.

Changes in plans
There have been some changes in the consortium and deviations from the DoW. All of them approved by the Project Officer:

- April 2015 – The coordinator of OrAqua, Prof. Ingrid Olesen (Nofima) was replaced by Dr. Åsa Maria Espmark, Senior Research Scientist in Nofima.
- February 2015 – WP2 leader Marnix Poelmann was replaced by Wout Abbink, both from DLO-IMARES.
- The partner DLO-FBR faced major internal changes in the staff, resulting in that they no longer had a role in the project. Their project task 3.1.4 are successfully dealt with by DLO-LEI, WP3 partner.
- After the second stakeholder event (October 2015), Professor Nadarajah Srikanarajah (WP5 leader) retired from his position at SLU, and gave his colleague and also OrAqua PMB member, Magnus Ljung 100% responsibility of WP5.
- The chair of the advisory committee (Deborah Brister) did not attend the two first meetings where AC was invited. As we lost contact with her and she is no longer the international coordinator of aquaculture in IFOAM, Deborah Brister were replaced with Stefan Bergleiter. The IFOAM representative and chairperson of AC, Stefan Bergleiter was appointed by IFOAM. Chris Atkinson was appointed as a vice president, and is also replacement for Stefan Bergleiter in the AC.

- The AC group also lost Stephanie Cottee, June 2015, when she announced that she no longer could participate due to working load and long travel distance (United States). A question was sent to PO, whether we had to replace her or if AC could continue with one member less. The PO approved that we were allowed to continue with one less AC member. Stephanie has not attended the two previous AC meetings.
- Moving the locations of the stakeholder events from what was originally planned in DoW:
  - The 1st SH event was originally planned to be organized in Montpellier (France), instead it was held in Istanbul (Turkey). This was because the event was organised in association with the IFOAM conference right after, in the same place. Many stakeholders participated in both, and it was more successful to reach the preferred stakeholders by merging the two events.
  - The 2nd SH event was originally planned in Hirtshals (Denmark), but was instead held in Rotterdam (The Netherlands) in association with the EAS2015 conference, in the same place. The reason for this change in place is the same as for the 1st event. Many stakeholders also attended the EAS conference and trade show.
  - The 3rd SH event was planned to be organised in Brussel (M33) and we wanted to move it to Venice (Italy) last part of June 2016 (M30). The reasons for this was:
    - M33 is in September 2016. We could have organized the event in association with EAS 2016. However, for the progress of OrAqua, September was too late. OrAqua ended in December 2016, and the aim for the 3rd event was to present OrAqua recommendations to the regulations to the SH, and to have their feedback. From September to December, we considered it too short time to process the data from the event and to make the final report.
    - We wanted to be able to inform participating stakeholders without direct experiences and knowledge of organic fish farming, by visiting organic producers. The organizer of the 3rd event, Dr. Giuseppe Lembo (COISPA) has knowledge about and contact with organic producers in Northers part of Italy. We wanted to extend the event with one day to visit organic producers and to taste organically locally produced seafood. This was also requested from some of the stakeholders and AC members during the 2nd event in Rotterdam.
    - OrAqua did not have a large budget for the stakeholder events. We were afraid that to organise the event in Brussel would have been too expensive with the budget (expensive travels and accommodation). For each event, we promised to offer 80 participants travel and accommodation (DoW). This we managed during the first two events, but we had serious doubts that we would have managed this in Brussel. Additionally, according to Giuseppe Lembo, it was possible for us to apply local Italian government for extra funding for the planned extra visiting day during the 3rd event.
    - By managing the 3rd event in Italy we would have some stakeholder funding left. We have discussed the possibility to use some of these resources on project-associated handouts (e.g. pens, printed newsletter and leaflets) to promote the project and its main output and increase the impact of the project. This has also been done with success in other EU projects.
      - The change was approved by the PO, with the compensation that members of the PMB met central EU personnel to inform about the project and results in December 2016, in Brussel
        - A meeting with PMB, PO and members from DG AGRI, DG MARE and DG RTD took place in Brussel 13th December:

Agenda:

Time	Title	Presenter
09:30 – 09:50	Welcome address: • OrAqua general introduction, structure of project, WP`s and aims • What is organic aquaculture? Approx 15 minutes presentation + 5 minutes discussion	Åsa Espmark (Nofima and Coordinator)
09:50 – 10:35	A summary of WP2 (Review of Production issues) and WP3 (Review of Socioeconomic issues)	Alfred Jokumsen (DTU and WP4 leader)

	Approx 30 minutes presentation + 15 minutes discussion	
10:35 – 11:00	Stake holder events • How were they facilitated? • Role of the events in relation to the project aims • Outcome and feedback Approx 20 minutes presentation + 5 minutes discussion	Magnus Ljung (SLU and WP5 leader)
11:00 – 11:45	Recommendations for up-dated regulations for organic aquaculture • Why is an up-date necessary? Approx 30 minutes presentation + 15 minutes discussion	Giuseppe Lembo (COISPA and WP6 leader)
11:45 – 12:05	Dissemination activities and stakeholder platform • Dissemination activities • Continuation of Stakeholder platform after OrAqua Approx 15 minutes presentation + 5 minutes discussion	Jean Paul Blancheton (IFREMER and WP1 leader)
12:05 – 12:15	OrAqua final report – discussion with the commission	All

Potential impact and main dissemination activities and exploitation results

One motivation behind OrAqua was to promote the growth of organic aquaculture. Results from the literature show that some consumers think that aquaculture is sustainable in that it can help protecting wild stocks. This could be used in a communication strategy for organic aquaculture as well as conventional aquaculture. The main motivations to purchase organic seafood are that organic fish is considered safe, of good quality, healthy and good for the environment. However, also conventional farmed fish is considered safe, of good quality, environmental friendly and healthy. Wild captured fish is even more highly ranked regarding these features. A well-designed and pretested communication campaigns for organic fish can extend the total seafood market in Europe and can be used to create awareness about organic aquaculture and build a positive and reliable image of organic certification scheme. The philosophy of organic aquaculture addresses consumers who are interested in the origin of food and the production methods. This relates to relevant consumer themes like transparency and consumer trust. In addition to this, a controlled and certified system is used to prove the way of producing – it is one of the pillars of the organic system. Organic aquaculture is thus extending consumer choice. It aims at delivering products with a clearly distinctive element for consumers who are looking for something else than products which are somewhat mainstream and widely available. Often produced in large and/or global supply chains. However, as our study shows, organic seafood is not very well known in some countries, so a communication plan is needed to get the attention of consumers. It also provides a healthy option, or as EUFIC promotes "…eating more fish is one way that most of us can help improve our diets—and our health …increasing your consumption of all types of fish and seafood is recommended." So, organic aquaculture products relates positively to the growing expectations from consumers for quality and diversity of food products.

WP2 and WP3 provided an up-to-date review on the existing knowledge about organic aquaculture productions and products. Combined with the results of the surveys and of the multi-stakeholder platforms, it allowed to identify:

- the knowledge gaps and research needs to strengthen further the development of the organic aquaculture productions and the confidence of the consumers,
- the controversial questions about organic aquaculture which will have to be discussed inside multi stakeholder groups in order to find compromises,
- the information needs towards the wide public and the consumers in order to contribute to raise their awareness about the organic principles and productions.

The project has collaboration with different organizations; such as IFOAM during the organization of the 1st stakeholder event as a pre-conference to the 18th IFOAM organic world congress in Istanbul October 2014. Also, the 2nd stakeholder event were organized as a pre-conference to AE2015 in Rotterdam in October 2015, in collaboration with EAS (European Aquaculture Society).

Because the scope with OrAqua is to provide science based recommendations to the EU regulations, the project has tight contact with the EU expert organ EGTOP (Expert Group for Technical Advice on Organic Production). The purpose of EGTOP is to provide the Commission with technical advice on the authorization of products, substances and techniques for use in organic farming and processing, to develop or improve organic production rules and, more generally, for any other matter relating to organic production.

Links have been created between the project partners and some already existing multi-stakeholder platforms, in particular the EATiP platform. Given the current situation and organization of the organic sector, the OrAqua platform could become a specific thematic platform on aquaculture created inside TP Organics, as no entity dedicated to aquaculture exists yet in the TP Organics Platform. This thematic platform should maintain tight links with EATiP, for which it could even act as a sub-platform specialized in organic aquaculture. In order to avoid duplication of activities, the Links with IFOAM should be as tight as with TP Organics, as it is a key actor in the field of organic food. This organic thematic, in order to ensure the widest dissemination of the project findings and recommendations.
The multi stakeholder platform meetings created a dynamics of fruitful exchanges between all the stakeholder categories (positive feedbacks from the participants after each meeting) that will be continued

with the ‘adoption’ of the platform by TP Organics/IFOAM as a specific aquaculture platform.

The dissemination documents of the project will provide an easily accessible information on organic aquaculture products and productions to a wide public. This information will be available in English, German and the mother tongues of all the project partners, which covers most of EU. It should contribute to raise the awareness of EU citizens on organic and increase their confidence into organic products.

In total, 23 Deliverables have been submitted in the period M1-M36, and 16 Milestones have been fulfilled. The project has also disseminated results at different meetings and conferences, besides the disseminations given at the three stakeholder events:

Oral presentations with abstracts:

1. Abbink, W., Lembo, G., Jokumsen, A., Spedicato, M.T., Espmark, Å.M., Sæther, B.S., Noble, C., Manfrin, A., Fiocchi, E., Adámek, Z., Röcklingsberg, H., Olesen, I. (2015). The relation between EU regulations on organic aquaculture and scientific knowledge of different welfare issues. EAS Rotterdam, October 2015.
2. Abbink, W., Lembo, G., Jokumsen, A., Sæther, BS., Noble, C., Nielsen, HM., Adámek, Z. (2016). The relation between EU regulations on organic aquaculture and knowledge on fish production systems. EAS Conference Edinburgh, 21st September 2016
3. Adámek, Z, Mössmer, M., Bauer, C., Pardo, MA., Gracík, J., Hlaváč, D., Dulić, Z. (2015). Current issues and principles of common carp (Cyprinus carpio) organic farming in Europe. An overview. In: Water and Fish, Belgrade: 56-59. (Conference Water and Fish, Belgrade, 10-12 June, 2015)
4. Adámek Z., Gracík J., Hlaváč D., Anton Pardo M, Mössmer M., Bauer C. (2015). Současný stav a principy organického chovu kapra (Cyprinus carpio) v rybnících a jeho perspektiva pro Českou republiku. (Current status and principles of organic carp (Cyprinus carpio) farming in ponds and its prospects for the Czech Republic) In: 3rd Carp Conference, Vodňany: 13-16. (3rd Carp Conference, Vodňany, 3 - 4 Sept, 2015) (In Czech)
5. Adámek Z. (2014). Využitelnost poznatků z organického chovu kapra v Dolním Rakousku pro jihočeský region (The applicability of experience in organic carp farming in Lower Austria for South-Bohemian region). Conference "Transfer of experience in fisheries and pond farming in Waldviertel (Austria) - South Bohemia (Czech Republic)", Vodňany, 29 Oct 2014
6. Adámek Z., Gracík J. (2014). Bioproduktion in der Karpfenzucht in Europa – aktueller Stand und Ausblick (Organic carp production in Europe - current status and prospects). Conference "Transfer of experience in fisheries and pond farming in Waldviertel (Austria) - South Bohemia (Czech Republic)", Vodňany, 29 Oct 2014.
7. Adamek, Z., (2016). Water quality and biotic variables in carp (Cyprinus carpio) ponds: Organiv vs conventional management, EAS Conference Edinburgh, 21st September 2016
8. Altintzoglou, T., Honkanen,P. (2015). Organic Aquaculture: Factors relevant for consumers. 5th TAFT Conference, 12th – 15th October 2015. Nantes, France.
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Address of project public website and relevant contact details

The web-site www.oraqua.eu was published on M1 of the project, and is constantly being updated. The headings on the web-site offer information such as: "About OrAqua". "WP OrAqua organisation", "platform meeting", "Newsletters" and "Links", which include the main current organic regulation documents and the website addresses of the partners and platform participants. Three newsletters have been posted on the site (April 2014, April 2015, and February 2016). The last and 4th will be posted by February 2017 and will present a summary of the final recommendations of the project. The program, presentations and videos from the platform meetings are in the three platform meeting sections. The public deliverables and final recommendations of the project will be posted as soon as available and approved by the project officer.
In addition to the public available information, the site holds also a zone with a restricted access to stakeholders and project partners. This restricted site provides information such as:

- Names, organization and e-mail addresses of all participants at the stakeholder events
- Conclusions and action points from the first stakeholder events
- Information and feedback from the stakeholder platform meetings.

The reason for keeping this information restricted is to secure the anonymous status of the stakeholders, as they contain personal information of identity.
The Oraqua website will be kept active after the end of the project, in order to ensure the widest dissemination of the project findings and recommendations.

OrAqua Partners with main contact information

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2. COISPA Tecnologia & Ricerca
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3. DTU – Technical University of Denmark
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4. Ifremer – French Research Institute for Exploitation of the Sea
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5. USB – University of South Bohemia in Ceské Budejovice
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13. IZSVe – Istituto Zooprofilattico Sperimentale delle Venezie
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