European Organic Aquaculture - Science-based recommendations for further development of the EU regulatory framework and to underpin future growth in the sector

Deliverable D4.5

Easily conceivable communications for dissemination

Due date of Deliverable: M31

Submitted to EC: M35 Actual delivery date "approved from Project Officer" 05.05.2016

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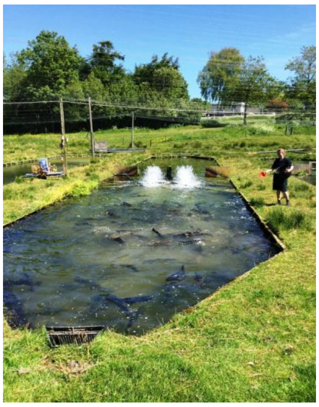
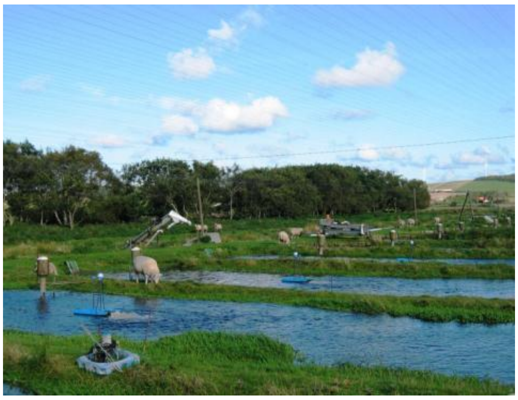

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Coordinator: Åsa Espmark. Funded by the EC **(Grant No: 613547)**
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1.0 Introduction

The overall vision of the OrAqua project was to contribute to economic growth of the organic aquaculture sector in Europe through science based recommendations for possible amendments of EU organic regulatory framework in line with the organic principles and consumer confidence.

The recommendations delivered by the OrAqua project are based on reviews of relevant scientific knowledge within organic and conventional aquaculture production and economics, the institutional framework, as well as consumer perceptions and confidence in organic aquaculture products. A stakeholder platform was established to ensure interaction with all relevant stakeholders. 3 stakeholder meetings have been held to present results and have feedback. A Multi Criteria Decision Analysis (MCDA) was performed among stakeholders to be able to formulate the most balanced recommendations, based on the principles of excellence of the technical/scientific knowledge, the transparency of data, methods and assumptions and rely on the stakeholder's opinions/experiences, as well as on the objectives and principles laid down in the Regulation (EC) No 834/2007.

2.0 Feed

Feed for organic aquaculture production must comply with organic principles as well as fulfilling nutrient requirements of the specific species. This means that the diet must be well-balanced to secure optimal performance, fish health, high product quality, and low environmental impact. However, EU organic regulations restrict origin and processing of feed ingredients.

Fishmeal and fish oil are natural ingredients in diets for carnivorous fish and shrimps as they provide required dietary nutrients for all life stages, i.e. essential amino acids and in particular long-chained Ω-3 fatty acids, cholesterol and phospholipids, vitamins and minerals. However, fishmeal and fish oil are limited resources and their use as feed ingredients is restricted.

Accordingly, the current art. 25k of the EU Reg. 889/2008 put the following priority in sourcing of feed ingredients for carnivorous specimens:

1. Organic feed products of aquaculture origin
2. Fishmeal & fish oil from organic aquaculture trimmings
3. Fishmeal & fish oil derived from trimmings of fish caught in sustainable fisheries
4. Organic feed material of plant origin or animal origin
5. Feed products (e.g. fishmeal, fish oil) from whole fish caught in certified sustainable fisheries.

However, organic feed products of aquaculture origin (1) and trimmings from organic aquaculture (2) are only available in very limited quantities. Further, trimmings (2 & 3) are not a well defined product, i.e. variation in contents of protein (amino acids), lipid (fatty acids), minerals (high P) and trimmings can not be used in feed for the same species (2). In addition,

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using fish meal and fish oil only from trimmings, may negatively affect growth performance and environmental impact, and therefore be in conflict with the organic principles.

For ingredients of plant origin (4) the amino acid profile is also a challenge as supplement with synthetic amino acids is not allowed in organic aquaculture feed. However, if needed and not provided from other feed sources in sufficient amounts, histidine produced through fermentation may be used in the feed ration for salmonid fish to meet their dietary needs and prevent the formation of cataracts. Finally, anti-nutrients in plant sources have to be removed using procedures in compliance with organic rules.

The last option (5) allows using fishmeal and fish oil derived from whole fish caught in certified sustainable fisheries. However, to secure optimal performance, fish health, high product quality, and low environmental impact this option should get, case by case, a higher position on the list, which implies that art. 25k is not intended as an order of priority, but a list of priorities.

Shrimp species have different feeding habits and hence specific needs of animal protein and lipids in their diets, including phospholipids (e.g. lecithin) and cholesterol. Although the shrimps in aquaculture are all benthivore, their feeding habits cover the range from being omnivorous benthivore (e.g. *M. rosenbergii*) to carnivourous benthivore (e.g. *P. monodon*), which is reflected in the types of enzymes in their digestive tract.

Accordingly, for species farmed in aquaculture systems such as ponds or lagoons, when natural feed resources are not available in sufficient quantities, shrimp diets may be supplemented with max. 25 % fishmeal and 10 % fish oil. Finally, to fulfill dietary needs, organic cholesterol may be supplemented; or if not available, non-organic cholesterol derived from e.g. wool, shellfish to facilitate moulting.

Phytoplankton and zooplankton are used in hatcheries (mainly marine). As “organic plankton” is not available, conventional phytoplankton and zooplankton has been allowed as feed in larval rearing of organic juveniles. However, specific requirements for organic live plankton feed for hatcheries would increase the integrity of production of organic juveniles.

Phyto- and zooplankton 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). Carnivorous fish have very limited innate capacity for converting short chain Ω-3 fatty acids into EPA/DHA.

Obviously, to fulfil the nutrient requirements of organic farmed fish there is a need of diversifying the basket of available feed ingredients. This includes e.g.

- Bacteria, fungi, algae, single cell organisms and implicit recycling of nutrients
- Marine micro algae ⚡ EPA, DHA etc.

3.0 Production systems

The philosophy behind organic production is mainly based upon a holistic vision of natural processes. Hence, most of the traditional organic farms are open-air flow through systems.

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According to the EU regulation on the organic production, closed Recirculation Aquaculture System (RAS) are not allowed, with the exception of hatcheries and nurseries or for the production of species used for organic feed organisms. Indeed, RAS have several environmental advantages, i.e. low water usage, prevention of escapes and ingress of pathogens, biosecurity, recycling of water and collection of waste (P is globally limited), but require significant input of external energy, high stocking densities (for economic reasons), advanced waste water treatment devices, use of UV radiation, pure oxygen and artificial light. All the above, together with almost disconnection of the production system from the external natural aquatic environment, makes the closed recirculated systems not in line with the principles of organic production. 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 in e.g. out-door exstensive recirculation systems.

Aquaculture production facilities may be split up into clearly separated units, which are not all managed under organic production. But the separation criteria between organic and non-organic specimens, in the same operation, as well as between organic and conventional farms, should be clearly defined.

Integrated Multitrophic Aquaculture (IMTA), which is a synergistic cultivation of various species, occupying different trophic levels, such as extractive macroalgae and/or invertebrate (e.g. mussels and oyster) with commercial finfish (e.g. salmon or seabream), is considered a sustainable system. Effluents from the fish rearing are used as nutrients for other species, creating a symbiotic natural ecosystem with maximum use of all farm waste and making IMTA an excellent food production system in terms of efficient use of water, energy and nutrients.

Off-shore cage culture, i.e. organic and conventional production fish in cages is increasing globally. Thus, the largest proportion of European aquaculture production takes place in cages as this is the prevailing production system in the salmonid, sea bass and sea bream aquaculture. The main benefits of cage culture are relatively low investment costs, low energy costs, utilising environmental resources and efficient use of space, and a low carbon footprint compared to other production systems. However, environmental impacts on the surroundings, the difficulty to control diseases (e.g. parasites), fish escapes and the interactions with the sea bottom below the cages have to be taken carefully into consideration, to prevent a long term negative environmental impact. Hence, farming systems at sea shall be located where water flow, depth and water exchange rates are adequate to minimize the impact on the seabed and the surrounding water body.

Locally grown species shall be used and breeding targets shall aim at selecting robust strains adapted to farming conditions and efficient utilisation of feed resources. The use of hormones and hormone derivates is prohibited.

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 ended in 2016, non-organic aquaculture juveniles were allowed to be

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brought into a facility, provided that at least the latter two thirds of the duration of the production cycle shall be managed under organic management.

Although there are no official data on the number of certified organic hatcheries in Europe, there are informal information on some hatcheries (mainly for trout) that have recently converted or are in the process of conversion to organic. Nevertheless, the present production of organic juveniles seems inadequate to supply the growing demand of the organic aquaculture industry. Furthermore, it appears necessary to specify production requirements for organic juvenile production from hatchery through to the grow-out stage. To this end, the creation of a database on the availability of organic ova/juveniles, produced in each country, would ensure transparency on the possibility to use organic/non-organic ova/juveniles.

Artificial heating or cooling of water shall only be permitted in hatcheries and nurseries. Natural borehole water may be used to heat or cool water at all stages of production.

The use of mechanical aerators is permitted, while the use of pure oxygen is only permitted, in specific exceptional cases, for uses linked to animal health requirements and critical periods of production or transport.

4.0 Fish health, welfare, veterinary treatments and biosecurity

It is generally acknowledged that there is a link between fish welfare and production performance but above all, proper water quality is pivotal to all kind of aquaculture production, as well as for fish health and welfare. However, fish welfare is species specific and is related to a range of parameters, e.g. stocking density, water quality, nutrious feed, substrates, growth rate, fin damage, behavior, light regimes, considering the geographic location.

Stocking 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 (e.g. oxygen saturation, temperature, ammonia), 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), together with stocking density requirements, would be a better way to ensure fish welfare in aquaculture, than monitoring just one index.

Light represents an important environmental factor, which impacts fish behaviour and physiology including puberty and reproduction. Hence, sudden changes in light intensity and of the dark/light cycle can induce behavioural stress responses and affect the immune system, though still a need of knowledge for certain species.

During **transport** of live fish proper water quality and fulfilling the physiological needs of the fish shall be secured, including sufficient oxygen saturation, adequate stable temperature, adequate starvation period prior to transport dependant on water temperature and fish size, i.e. the stomach shall be empty.

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In case of transportation by boat, exchange water shall be pumped from a distance of at least 500 m from possible sources to pollution. Excessive fluctuations in water temperature and pH (CO_2 should be removed) during transportation must be avoided.

During storage, including waiting cages, prior to **slaughter,** water quality e.g. oxygen, temperature) should be monitored and continuously adjusted accordingly. When properly done by trained and skilled staff, the most humane stunning methods are currently percussive and electric stunning followed by killing with gill cut.

The development of non-antibiotic and environmentally friendly agents is one of the key factors for **health management** in aquaculture. Hence, the use of probiotics, i.e. a bacterial supplement of a single or mixed culture of selected non-pathogenic bacterial strains, is a viable alternative for the inhibition of pathogens and disease control in aquaculture species.

Regarding **cleaning and disinfection** only limestone and dolomite were originally allowed to use in presence of aquatic animals. However, as this limitation showed to be a crucial challenge for sustainable performance of organic aquaculture, the list has been extended with the following substances that are assessed to be in line with objectives, criteria and principles of organic farming: Hydrogen peroxide, sodium percarbonate, peroxyacetic acids, peracetic acid, and peroctanoic acid.

Homeopathic veterinary medicinal products are veterinary medicinal products prepared from homeopathic stocks in accordance with a homeopathic manufacturing procedure. It would be appropriate to make a list of authorized non-allopathic substances, including vegetable extracts, as well as procedures for their inclusion in the feed, in compliance with the current regulation on this issue.
However, in case the use of phytotherapeutic, homeopathic and other products is not feasible, chemically synthesised allopathic veterinary medicinal products including antibiotics may be used, under strict conditions, to treat diseased fish under the responsibility of a veterinarian.

Good hygiene practices and farm management prevent the onset of diseases. Unfortunately, there are currently no European guidelines on **biosecurity** in animal husbandry, though at national level for certain species. It would be appropriate to identify biosecurity measures recognized at Community level.

5.0 Environmental impacts

The rationale behind organic food production is to minimise the impact of the production on the environment. Environmental impact from aquaculture has been an area that has been addressed for decades through research and development in water recirculation technologies and waste recycling. For the on-growing organic production, a main focus is to reduce environmental impact through low-impact's biological processes based on ecological systems using natural resources.
Hence, in line with the overall organic principles, actions should be taken to recycle waste from organic aquaculture production, as well as using less/recyclable packaging for organic aquaculture products.

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Though the organic principles encourage the use of renewable energy, the regulations give no rules for release of CO_2 (carbon footprint) and global warming potential (GWP), which is closely related to the use of fossil energy. Currently, most of the energy used for production is fossil energy for growing, harvesting and processing of feed ingredients.

To minimize environmental impact, a sustainable management plan proportionate to the production unit shall be provided. 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.

6.0 The Institutional framework and societal expectations

The organic aquaculture should be considered as a food production method in line with the preference of consumers for food produced using natural substances and processes. Hence, the organic aquaculture should play a dual societal role, where on one hand it supplies a specific market, responding to a consumer demand for organic products, and on the other hand delivers public goods, contributing to the protection of environment and animal welfare. The results of a survey among consumers in four European countries showed that, related to fish welfare and environmental impact, most consumers consider “Good water quality”, “No use of medicines” and “No use of toxic chemicals” as defining features for organic aquaculture. Related to feed and production systems, most consumers mentioned “Natural living conditions”, “Synthetic additives prohibited” and “Organic feed”.

However, consumers are unsure about the concept of organic fish farming due to its overlap with several other concepts such as sustainable, ecological, environmental friendly, fair-trade, etc. In general consumers have low knowledge about organic labels and in particular the EU organic label. This is partly a consequence of the Euro-leaf not being communicated to the consumers sufficiently. The main aim of the Euro-leaf is “to make organic products easier to be identified by the consumers”. Obviously, given the low consumer awareness, this aim is not achieved. Thus there is a need for a clear communication strategy towards the consumers. However, cultural effects might also be taken into account when considering the EU organic logo as national labels carry an image of local control.
Given the consumer confusion about the different environmental concepts, the EU logo has to compete with other eco-labels with more targeted communication strategies. Consumers also show ambivalent opinions about the origins of organic fish between wild fish and farmed fish. But, the production system as such is not strongly emphasized by the consumers – natural living conditions are the main concerns when it comes to consumer perception of organic fish.
So there is a need for increased knowledge about aquaculture and organic aquaculture practices. Further, the EU logo needs more power to be differentiated from other eco-labels to enable consumers to identify the EU organic label in the EU markets.

Furthermore, consumers’ knowledge about practical details on aquaculture production is rather limited. Therefore, 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.

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Additional issues that positively influence the acceptance and consumption of organic fish are the health benefits of organic, the naturalness of the production, that the production is local or at least domestic and the food safety associated with such a production method.

Additional costs for organic aquaculture production can be about 20% to 50% above costs of conventional production, depending on species and production region. Generally, the feed costs account for the largest contribution to the higher cost price of organic production, followed by the costs of juveniles (if available) and the costs for the fixed assets, but relatively lower production volume, lower stocking density and relatively more labour cost does also influence the organic farm economy.

Retailers throughout Europe play a pivotal role in the development of the market for organic aquaculture products, though differing significantly among countries and retailer groups. As long as the European organic aquaculture market is below a critical threshold, other standards, which are better known or have lower costs, will continue to be serious competitors of the organic aquaculture sector. Therefore, a primary objective of the common policies should be to establish and/or reinforce European and National support actions to programs for developing organic aquaculture.

The institutional framework within organic aquaculture seems to be a complex and fragmented management and control regime. Lack of clarity in the regulation has resulted in uncertainty about production rules, control provisions and exception deadlines, creating a lack of trust and investments; i.e. impeding the transition to organic production. Regulations and standards need to be tuned with practical and economic realities. Failing to do so might result in low predictability and uncertainty, making the regulations a “moving target”. The lack of relevant statistics on production makes it difficult to have a good understanding of the past and current status of production and the functioning of the regulation.

Harmonization among countries and certification bodies of the control systems applied both on the organic farms, raw materials and organic products is needed to facilitate the organic aquaculture production. New provisions should be in line with practical and economic realities. Exceptions from the requirements applicable to organic production should be strictly limited to specific exceptional cases, where the national competent authority may permit temporary derogations regarding the application of specific production rules.
Therefore, a realistic and transparent legislative procedure with clear control provisions should be aimed 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.

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7.0 Summary

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 resouces 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

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least the latter two thirds of the duration of the production cycle shall be managed under organic management.

However, still 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 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.

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