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

This project has received funding from the European Union Seventh Framework Programme for research, technological development and demonstration under grant agreement n° 613547

Extracts and summary of a deliverable submitted to EC on month November 2014.
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1. Summary of the bibliographic analysis:

The analysis of the preliminary information provided by WP 2 and WP 3 and feed-back from the 1st Stakeholder event in Istanbul 11th -12th October 2014 are summarized in the following key issues related to the current regulation on organic aquaculture.
The presentation: "Presentation of the synthesis of the scientific review process" presented at the 1st stakeholder event in Istanbul is available on the website.
In consideration of fish health, product quality and low environmental impact, a general concern was expressed about the intended **sourcing of feed ingredients** for feed for carnivorous fish (EU Reg. 710/2009 art. 25k). To achieve nutrient balanced diets use of fish meal from whole fish caught in sustainable fisheries, and not commonly used for human consumption, should be prioritized, as well as the utilization of trimmings from these fisheries and trimmings from conventional aquaculture. However, concern was raised about trimmings not being a well-defined product showing great variations in composition and quality (amino acids and phosphorous). Focus should also be on improving the diversity of the raw material basket, i.e. increase the adequate options of ingredients to better match amino acid profiles of feed for organic aquaculture. There is a need for harmonizing limits of pigmentation of organic fish as well as consideration of the use of fish meal and phospholipids in shrimp diets. The exchange of fish oil high in omega-3 fatty acids by alternative sources should be adjusted in accordance to the development of vegetable or other sources producing these healthy omega-3 fatty acids contributing to a good human health.
Sourcing of organic juveniles is a crucial issue. Although organic trout ova are already available, the request for 100 % organic juveniles from 1st January 2016 was assessed not realistic, in particular for marine species like sole, turbot, sea bream and sea bass, due to currently no availability of organic live feed for fish larvae. Specific organic rules are needed for managing the life cycle stage between the hatching and the weaning of juveniles for specific species in fresh water, but particularly marine species. Further, the current regulation is not distinguishing between organic and non-organic hatcheries incl. phyto and zooplankton and larval rearing systems. An option might be to start organic rules from fry stage weaned using dry feed. Due to limited possibilities for composition/limited availability of organic feed ingredients, concern was expressed about the quality of dry feed for fry towards providing essential nutrients.

Recirculation Aquaculture Systems (RAS) and **environmental interactions** are closely related. RAS produce minimal environmental impact; i.e. low water usage, prevention of escapes and prevention of pathogens and biosecurity, recycling of water and collection of waste (P is globally limited) - possibly valorized and similar energy use in most situations versus flow through. The main reason for RAS systems only being acceptable for organic juvenile production seems to be more based on consumer perceptions of RAS as a "high-tech-non-natural" system than on scientific information. The consumer survey (WP 3) showed that for most consumers, the production systems are not included in their definition/perception of organic aquaculture. This is probably due to the lack of knowledge about aquaculture production in general. From producer's point of view, the hatchery should be disconnected from the on-growing phase as for several species it is not economically realistic to produce juveniles in open systems.

Though not the main factor of **fish welfare**, **stocking density** should be considered in combination with other parameters of water quality, environmental conditions and husbandry practices, and possibly behavior of the fish in the wild. Data on optimal stocking densities are conflicting, though farmers need simple parameters, such as stocking density, to apply. However, more studies are needed about the covariation between fish density on one hand and water quality and a multitude of operational behavioral, physiological and morphological welfare indicators on the other.

Fish welfare is related to a range of parameters, e.g. stocking density, nutritious feed, substrates, light regimes, and being species specific, including conditions during **transportation**. The regulation should differentiate between groups of species, as they can be produced in different ways. As for stocking density metrics there is need of measurable welfare parameters/indicators.

In relation to **health and veterinary treatments** there seems to be a conflict between the current and future regulation of VMPs (all kind of Veterinary Medicine Products) and the organic regulation. The substances of preference in EU Reg. 710/2009 art. 25t a/b/c should be considered as feed raw materials or additives. Further, due to a limited market it is suggested that there is a need for more adequate procedure of authorization of relevant substances for aquatic animals according to the new regulation of VMPs. It was also stressed that anesthetic treatment should not be included in the number of restricted allopathic treatments.

Escapees should be prevented. Species-specific distinctions should be made between escapes of fish and escapes of viable gametes. Escapees might be prevented by robust netting materials to resist tearing or biting by fish and curtain-like egg collectors might be used to mitigate against egg escapee from cages with potential spawners (Atlantic cod and gilthead seabream).

For fish s**laughtering** the most humane stunning methods are assessed to be percussive and electric stunning followed by killing with gill cut. However, alternative stunning methods exist, but await further investigations.

Though the organic principles encourage use of renewable **energy** the regulations give no rules for release of **CO2** (Carbon footprint) and global warming potential (GWP). Obviously there are insufficient identified criteria and reference points to characterize an environmental friendly food production in relation to climate aspects. Further, there are limitations of the Life Cycle Analysis (LCA) methodology due to lack of clarification on how the environmental impacts should be allocated between co-products in productions and multiple outputs.

In line with the overall organic principles actions should be taken to **recycle waste** of the production. However, a gap of knowledge and technology for recycling of nutrients from aquaculture exists and hence investigations of solutions for collection, de-watering and re-use of waste from aquaculture production are needed.

Off-shore activities are closely related to environmental impact on the **Sea bottom** and the water body. However, limited information on the environmental impact and interactions in relation to cage farming and the sea bottom is available. Further there is a need of investigations of the ecological impact of cage farming and foraging devices attracting wild fish.

The **consumers' perception** of ECO, organic, fair-trade and sustainable is vague due to lack of knowledge and possibly exposure. Consumers are confused about what organic seafood is, therefore an efficient communication strategy is needed. The image of the EU leaf logo is low in terms of awareness and use, because the label is still new and not broadly marketed yet. There are also large numbers of organic, environmental/sustainable labels on the market, causing confusion among the consumers. There is much higher awareness for the national labels. Further, the EU label implies the lowest requirements for organic certification in EU. Therefore, it is by nature the least demanding in terms of organic farming practices. However, cultural effects should also be taken into account when considering the organic logo, as national labels carry an image of local control, which may be important for developing the organic aquaculture sector. However, transparency, proactive communication and the provision of key information that make sense to consumers may improve the efficiency of the EU leaf logo and the purchase of organic aquaculture products.

A too complex and fragmented management regime seems to be the most important issue of the **institutional framework**, which is aiming at harmonizing the production rules for organic aquaculture in EU. But the uncertainty of the rules and exception deadlines creates a lack of trust and investments. Further the fact that the rules, to a very low extent, are based on scientific and practical knowledge and experience, create constraints for the future development and expansion of the industry. Support policies are particularly needed in this phase of the development for organic aquaculture industry to reach 'critical masses'.

A visible and focused information strategy to get consumers familiar with aquaculture (conventional versus organic) is urgently needed. Hence, it should be clearly communicated on what organic aquaculture is. The revision of the regulation should provide more homogeneous and species specific rules based on scientific and practical knowledge and experience.

The **ethical** analysis and evaluation revealed a range of potential conflicting interests and needs related to the current framework for organic aquaculture.

The classical dilemma in organic standard setting is visible also in Organic Aquaculture; i.e. increase differences to conventional by stricter standards, taking the risk of losing farmers/producers. Or keep differences at a lower level, causing organic farming closer to conventional, in order to keep, or increase, the number of certified producers. However, this will be at the risk of losing consumers who dislike the 'weak' standards. The critical point is to identify the break even with regard to the levels of the three parameters: 1) Standards, 2) Engaged producers and 3) Consumer trust.

A main aim for the revision is to strengthen and harmonize the rules of organic 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 small scale organic production systems in rural areas to fulfil the organic rules.

Another important challenge is that the current regulation is not sufficiently specific and allows different interpretations in different countries, i.e. different conditions of control and anti-competitiveness between the countries.

The reviewing of scientific data so far and the feed-back from the 1st stakeholder event clearly revealed a hampering effect of the lack of research and knowledge in organic aquaculture. As seen in other organic sectors, e.g. agriculture a significant development of the

European organic aquaculture sector will, to a great extent, rely on supporting research in key issues challenging the development of organic aquaculture production.

2. Feed-back from first Stakeholder meeting in Istanbul

The 1st stakeholder event was held in Istanbul on the 11th and 12th of October 2014, as a pre-conference to the 18th IFOAM Organic World Congress.
In a first session, the preliminary results of the analyses and integration (WP 4) of the reviews and the assessments from WP 2 and WP 3 were presented to the stakeholders. Based on this information dialogues were facilitated with stakeholders through round table discussions and dialogues in café format, exchanging views and ideas, identifying challenges and suggestions to improve the regulatory framework.
The following feed-back was received from the stakeholders.

2.1. Sourcing of organic juveniles

Differences between conventional and organic juveniles
• Organic juveniles deviate from conventional juveniles in their origin from organic brood stock; i.e. no hormone treatments of brood stock, no polyploidy/All female, extra cost (higher price) and higher risk in organic juveniles.
• Low availability of organic breeders and juveniles, particularly for new species which are not yet on the seed market.
• Need for differences in regulations/standards (annexes of the regulations) for different species. The current rules for new species are not realistic and difficult to implement in practice, in particular for marine species like sole, turbot, sea bream and sea bass, due to the current unavailability of organic live feed for larvae and to difficulties with the separation of organic and conventional units in RAS hatcheries.
• A separate breeding program for organic juveniles with genetic selection would require starting with new brood stock. The necessary extra cost due to an extra breeding program or to the management of 2 populations for a fish breeding company or hatchery might be difficult to make it profitable or sustainable, at the current scale of organic aquaculture, for most species. If it were possible to use selected breeders from conventional breeding programs, it might prevent loosing genetic selection response. Hence, it could for instance be based on breeders selected for disease resistance in conventional breeding programs. These may be reared according to organic standards for reproduction and juvenile production.
• The use of antibiotics or other allopathic products for larvae and fingerlings are relatively high. In the opinion of one group member, the current regulations for veterinary treatments are good for on-growing but not for hatchery. For example, “with mixobacteria in trout, you must treat the juveniles with antibiotics two times and there are no problems for the rest of the life”.
• In Europe there are 10 hatcheries for sea bream and sea bass, all of them use recirculation systems, where you cannot separate organic from non-organic.
• Organic is not always ecologically sustainable; e.g. European eels where juveniles are wild and this is a protected species.
• Triploids cannot be organic but triploid fish may be good for the environment in some aspects, because it prevents the reproduction of escaped fish
• Organic feed, in particular for juveniles, may have poorer quality, due to limited possibilities for composition/limited availability of organic feed ingredients. Hence, nutritional value may be lower and allow lower production results.

Quality aspects of market sized fish produced from organic juveniles and from conventional juveniles

• Most did not think that a market size fish produced from organic fry will have a different quality from a fish produced from conventional fry – and being reared under organic farming conditions for at least the latter 2/3 of its production cycle (Art. 25e, 2). Only the final price may be different.
• There are no differences from a product quality (filet etc) point of view, but there are ethical differences.
• The main difference in quality characteristics involves the production site, form and system; e.g. diseases and water quality are different depending of the site and the farming.
• Selecting broodstock from breeding program with Genetic selection for resistance to diseases, may allow to produce more robust juveniles, compared to conventional juveniles resulting from breeders selected on growth performance.
• A statement from one group member ”I have the impression that what we are doing in this round table is that we are taking conventional aquaculture principles and moving to organics”
• Chemical treatments and feed must be the main differences and must start from nursery, i.e. not from the hatchery.

Any concerns that juveniles shall be organic from 1st January 2016?

• Most stakeholders do not think that this realistic.
• However, it may be species specific; i.e. big problems for marine sp. (bass/bream), that perhaps do not exist for salmon, trout - and carp.
• It was mentioned that import of organic trout juveniles from Denmark might be difficult due to body shape, feed conversion efficiency, disease resistance!

Boosting the supply of organic juveniles?

• The **market** “forces” will resolve everything; i.e. “*The expansion of the market could give a boost”*.
• Change the rules for marine fish; i.e. 1) Adaptation of the rules to hatchery conditions (sole, turbot, seabass, sea bream,...) 2) No request for separation of organic and conventional in RAS 3) No difference in feeding during live feed feeding phase 4) Differences in feed should only start after end of live feed phase.
• Postpone rules for some species (marine) – and await availability of organic feeds and sufficient scale of production/critical mass and market growth before enforcing.
• Subsidizing (governmental support) of hatcheries and juvenile farmers during the transition period until the market become big enough to accept the extra costs of organic juvenile production.
• Disseminate information about the lack of organic juveniles on the market.

2.2. Feed and nutrition

Does it make sense - in line with organic principles - to source feed ingredients for feed for carnivorous fish from the following sources: 1) Organic feed products of aquaculture origin? 2) FM & FO from organic aquaculture trimmings? 3) FM & FO derived from whole fish and/or trimmings of fish caught in sustainable fisheries? – And in consideration of a) Animal Health; b) High product quality/human health and c) Low environmental impact?

• Use of trimmings from conventional fisheries should be extended (after 31.12.2014).

• Trimmings from conventional aquaculture should still be allowed after 31.12.2014. However, limitations due to forbidding the use FM of trimmings from farmed sp. to feed the same sp.
• Using trimmings was discussed intensively. There are contradictory views on amino acid profiles. Trimmings are not a well-defined product, great variations in composition and quality. Obviously, max. limits on phosphorus content in feed is only a problem in Denmark?
• Allowance for 5 % non-organic compounds to critical life stages.
• FM from whole fish from sustainable sources should be used as supplement.
• What is the classification for sustainable fisheries? Most for human consumption is classified. MSC should go on the fish species not on the fish meal producer. However, do the consumers distinguish ASC from organic?
• Crucial to improve the diversity of available raw material, i.e. increase the potential of adequate ingredients to better match amino acid profiles of feed for organic aquaculture
• No limits of types of raw materials, i.e. PAP, blood products, microalgae, insect meal (however, in-appropriate FA profile), processed vegetable protein (soy protein concentrate). Supplement from fermentation e.g. Histidine (but also other amino acids) should be allowed.
• Jack mackerel could provide the histidine, but they are currently used only for human consumption. However, histidine from FM from South America cannot be used because of the current fishery stop and in general because of using ethoxyquin (preservation).
• Due to limitations in sourcing of ingredients for feed for organic carnivorous fish: Should carnivorous species remain in organic aquaculture? Will the new regulation kill carnivorous aquaculture?
• Need for harmonizing limits of pigmentation of organic fish, i.e. max. amount of astaxanthin concentration in feed. Some national regulations allow 100 ppm, while e.g. Danish authorities have interpreted the EU regulation as max. 20 ppm!
• Need for removing barriers (crosscutting regulations) regarding the use of different feed materials (plant), insects, worms, mussels in organic feed.
• Need for a lower limit value for ethoxyquin, due to analytical uncertainties/deriving from an ingredient. For GMO the limit is 0.9%.

2.3. Health – Veterinary treatments

Will it be realistic/sustainable to farm organic fish without any medical treatments – and will there be a future for herbal medicine in organic aquaculture?
• Anesthetic treatment shall not be included in allopathic treatment limitation.
• There is a conflict between the VMPs (all kind of Veterinary Medicine Products) current and the planned future VMP regulation and the organic regulation: The substances of preference (article 25t a-b-c) should be considered as feed raw material or additives.

2.4. Stocking density

How do you perceive stocking density in relation to fish health and welfare/well-being - implications for growth rate, behavior, aggression, metabolic capacity?
• Stocking density is not the main factor for fish welfare: but should be considered in combination with other parameters as water quality, environmental conditions and husbandry practices. Although farmers need simple parameters to monitor.
• Establishment of a database with specific information among species and rearing systems, in order to set reliable parameters of stocking density for practical use.
• Views were put forward that stocking density of organic and conventional aquaculture should be distinguished as it is in other organic productions. It should be completed by other

indicators of water quality (e.g. water renewal, oxygen content, nitrogen compounds) and fish condition and management practices.
• Contradictory views were put forward, that there should be no differences in stocking density limits between organic and conventional aquaculture. Control of fish welfare (presence of injuries, diseases occurrence, and survival) and veterinary treatments are more important. Stocking density is less important than survival rate, growth and feed conversion rate, which are indicators of fish welfare.
• Use of space and water is also very important and should be considered as a limiting factor. A specific stocking density limit in itself is not sufficient, but the behaviour of the fish in the wild should also be accounted for.

2.5. Welfare

Welfare of organic versus conventional produced fish?
• Welfare conditions are different among species (space, well balanced feed...).
• New production segment with further need to prevent disease – economy is important.
• Max. number of allowed treatments might give welfare problems; e.g. ineffective treatments (homeopathic) – and keeping organic certificate.
• Need for better trained staff in organic (know about careful handling etc.).
• Need for measurable welfare parameters/indicators.
• Welfare is important for the consumer (emotional), the difficulty is that most of them think of fish as humans regarding the respect of animal welfare.
• We shall not mimic nature, because it might not be the best welfare situation for the fish.
•Eyestalk ablation of shrimp breeders should be accepted if there is no other possibility.
• Sea lice problem can be solved with new technologies (laser), and there is a continuous development of new technical solutions.

Relations between welfare and the needs of fish, such as stocking density?
• Transport and harvest of fish has an impact on the quality.
• The perception is different in different countries.
• Needs more study.
• Optimal feed (Histidine) is crucial.
• Regulation should cover group of species, as they can be produced in different ways.

2.6. Environmental interactions (incl. Recirculation Aquaculture Systems (RAS))

RAS produces with minimal environmental impact: low water usage, prevention of escapes and ingress of pathogens, recycling of water and collection of waste (P is globally limited) - possibly valorized and similar energy use in most situations versus flow through.
What is your opinion about the regulation related to RAS knowing the pros and cons?
How many and which articles of the European regulation on organic aquaculture should be amended in order to allow RAS for on-growing farming?
• What is “a closed RAS” definition and what is the renewal rate of a ‘closed’ system (not acceptable for organic label) compared to an open one (accepted)?
• Why RAS systems, that are acceptable for fingerling and juvenile production, are not acceptable for larger fish production? It seems that it is more a problem of acceptability by the consumer than based on scientific information. From producer’s point of view, hatchery should be disconnected from the on-growing phase because, for several species, producing juveniles in open systems is not realistic (economically).

• RAS have important advantages as bio security, water control, protection from escapees, becoming energy efficient.
• The main reasons why RAS are not accepted as an 'organic' system are the high level of technology (very complicated system with a lot of tubes and treatment systems…), which makes it looking like a non "natural" system. The image of 'natural' is very important in the mind of the consumers. Some consumers think organic systems have to be "uncontrolled". The rearing environment (water quality) of the fish (O2, CO2, TAN… concentrations) is the most important concern regarding its welfare condition, as well as the bio security aspects (no diseases). Other items, which are not directly linked to the fish welfare as the environmental impact (footprint, land use, water use, escapees) of the production and the quality of the product (flesh quality) should be included in the certification criteria.
• What is animal welfare and what are the scientifically documented available criteria? There is a lack of knowledge and of communication on the indicators.
• The consumer acceptance of the label is a key question, but the average scientific awareness of the consumers concerning the above questions is very limited. Therefore the information – education process through the popularization and dissemination of the knowledge is a key aspect to consider. It seems that even general knowledge on aquaculture... is missing.
• Why is it such a huge discrepancy between the production methods accepted for vegetal production compared to animal production and more specifically aquaculture productions? Namely, very intensive tomato productions in very intensive conditions in greenhouses are accepted for an organic label, but not RAS; pig or other animal castration is accepted but not shrimp eyestalk ablation…
• In the current regulation for organic products, the rules are absolutely not homogeneous with some very detailed information besides very general concerns.
In the 3 groups participating in the round table, more or less 50% pros and 50% cons RAS as a tool to produce organic fish, which is consistent with the IFOAM survey that was carried out some months ago.

2.7. Consumer perceptions and economics

The EU Logo and the requirements it represents regarding production methods are different to the requirements needed to receive private and national labels. How do you think this may influence the perception of labels by consumers and retailers when choosing which organic seafood products they buy?
Main feed-back regarding the EU leaf logo:
• The image of the EU leaf logo is low in terms of awareness and use because the label is too new. Time will lead to exposure, awareness, familiarity, trust and use of the label.
• Co-branding the EU leaf logo with national labels that certify organic products will assist in increasing awareness and trust.
• The EU label implies the lowest requirements for organic certification in EU. Therefore, it is by nature the least powerful in terms of organic farming practices.
• Retailers and HoReCa (Hotels, Restaurants, Cafes) are very important in the process of promoting the EU logo, because they do not only focus on specific products that carry the logo, but also on total self-branding as a carrier of organic products. They have much impact on consumers and they are the gate-keepers for products to move from production to the consumers.
• A cultural effect should be taken into account when considering the EU logo too. National labels carry an image of local control as well, which is important in EU countries. However, the EU logo does not carry a specific sense of origin for the products that carry it. This issue is related to consumer perception and may not be realistic in terms of actual production origin.

However, if it is perceived by the consumers, it is relevant for a profitable organic aquaculture sector

• Transparency, proactive communication and the provision of key information that make sense to consumers may improve the efficiency of the EU leaf logo.

Main feed-back regarding the consumers' impression that only wild fish can be organic:

- Consumers have a vague perception of what is ECO, organic, biological, fair-trade and sustainable, due to lack of knowledge and linguistic confusion among languages in EU. Therefore, if ECO was consistently used for fisheries and organic for aquaculture, consumers would have less difficulties in gaining a direct understanding of what is organic and what is not,

- Consumers are confused about what is organic, mostly due to information provided from agriculture. The two productions differ significantly and few organic agriculture products are identical in conventional and organic. Therefore, communication about organic food in general should be better coordinated to differentiate between agriculture and aquaculture,

- Some fish species have a natural life that is significantly far from the one they have while being produced in a static fish farm. So, the associations that informed consumers may make between organic and natural (and elements included in the perception of naturalness) may be too weak, once they realize that the standard organic principles are far from what organic production is covering

- Organic aquaculture faces challenges to reach the demands based on the main organic principles. Therefore, organic certified aquaculture products are 'less organic' than agriculture products. This may lead to the confusion regarding organic seafood and could put the image of organic food production in general at some risk of losing the strong connection to the main organic principles.

2.8. Institutional frameworks

The current EU regulation is aiming at harmonizing the production rules for organic aquaculture in EU. The political strategies have anticipated (for long time) significant increases in organic production. Why has the production not increased? Might it be due to:

- **A too complex and fragmented management regime?**
- **Too bureaucratic production rules and control provisions?**
- **Lack of national policy support for achieving a critical mass of organic aquaculture production?**
- **That the regulation is too costly to meet?**

• There are uncertainties of the rules and on exception deadlines, which creates a lack of trust and investments.

• Rules are too ambitious, i.e. the rules have been developed too much and too detailed before sufficient scientific and practical knowledge is available.

• Too general for too many species; i.e. rules are based on knowledge on salmonids and extended to other species, which may have other requirements.

• Lack of specific rules for hatcheries.

• Need of visible and focused information strategy to get consumers familiar with aquaculture (conventional versus organic).

• Need of support from the government for conversion to organic.

• Lack of profitability and high risk for producers (a lot of certified fish is still sold as conventional).

• Organic aquaculture in competition with conventional and with wild fish.

Suggestions for improvements:

- Specific rules for hatcheries and juveniles,
- More technical species-specific rules,
- Allow parallel production (member state issue),
- Support policies for organic aquaculture to reach 'critical mass' (conversion, maintenance investments; certification costs, promotion and marketing),
- More information and education is needed for the consumers,
- The revision of the rules should define and communicate on what organic aquaculture is.

3.0 Conclusion: Recommendations - Research gaps

Based on the analysis of the preliminary information provided by WP 2 and WP 3 and feed-back from the 1st Stakeholder event in Istanbul 11th -12th October 2014 the following issues should be considered to underpin the future growth of the European aquaculture sector.

Nutrition

• Sourcing of feed ingredients for organic aquaculture need to be re-considered and supported by experimental data to secure compliance with the organic principles of fish welfare and environmental sustainability,

• At least until more knowledge is available fish meal and fish oil derived from industrial fish caught in sustainable fisheries and not commonly used for human consumption, might be allowed as ingredients in feed for organic carnivorous fish. 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 fish meal and phospholipids in shrimp diets needs to be re-considered,

• The use of other alternative feed ingredients providing high content of essential amino acids and lipids, when possibly produced organically, might 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 might be considered as ingredients in feed for organic aquaculture,

• 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 when considering ingredients in feed for organic aquaculture.

• Procedures in compliance with organic rules for removal of anti-nutrients in plant sources need to be addressed.

• 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 need to be considered.

• It is important to keep focus on human health related to eating (organic) aquaculture products, including high content of omega-3 fatty acids (HUFAs) currently sourced from fish oil.

• Adjust 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).

• Prioritize research in alternative sources of omega-3 fatty acids (HUFAs).

• Chemically well-defined analogic substances to minerals and vitamins may be considered as ingredients in feeds for organic aquaculture if the natural substances are unavailable.

Organic juveniles

• Except for already available organic trout ova it seems difficult to fulfil the request of 100 % organic juveniles from 1st January 2016, in particular for marine species like sole, turbot, sea bream and sea bass due to the current non availability of organic live feed for larvae,
• Specific organic rules are needed for managing the life cycle stages between the hatching and the weaning of juveniles for specific species in fresh water, particularly marine species.
• The current regulation does not distinguish between organic and non-organic hatcheries incl. phyto and zooplankton and larval rearing systems.
• An option might be to start organic rules from fry stage weaned to dry feed.
• Due to limited possibilities for composition/limited availability of organic feed ingredients concern is raised about the quality of fry dry feed in terms of providing essential nutrients.
• If available, domesticated and unrelated broodstock, preferably selected for relevant robust traits (survival, disease resistance and growth) should be used in breeding for organic seed.
• Need of defining breeding objectives and implementing cost effective breeding strategies that control inbreeding rate at a sufficient low level (<0.5% per generation) to secure adequate genetic material specifically for organic aquaculture.

Recirculation Aquaculture Systems (RAS) – Environmental interactions

• RAS produces with minimal environmental impact: low water usage, prevention of escapes and ingress of pathogens, biosecurity, recycling of water and collection of waste (P is globally limited),
• Similar energy use in RAS in most situations versus flow through systems,
• The main reason for RAS systems only being acceptable for organic juvenile production seems to be more based on consumer perceptions of RAS as a “high-tech-non-natural” system than on scientific information,
• From producer’s point of view, the hatchery should be disconnected from the on-growing phase as for several species it is not economically realistic to produce juveniles in open systems.
• There is a need for more knowledge on fish welfare in RAS,
• Further knowledge is needed about RAS and IMTA and the potential use of these concepts in organic aquaculture.

Welfare

• Data on optimal stocking densities are conflicting. More studies are needed about the covariation between stocking density on the one hand and water quality and a multitude of operational behavioral, physiological and morphological welfare indicators on the other,
• The potential benefits of providing fish with access to nature-like substrates are species specific. More data are needed on type of substrates for specific species. Current knowledge suggests e.g. salmonids and maybe other species (e.g. wrasse) may not have a preference for substrate *per se*, but a preference for shelter that could be overhead, floating or benthic.
• More knowledge is needed on the significance of light regimes requirements on the welfare and performance in organic aquaculture.

Health – Veterinary treatments - Biosecurity

• Anesthetic treatment should not be included in allopathic treatment limitation,
• There is a conflict between the current and future regulation on VMPs (all kind of Veterinary Medicine Products) and the organic regulation as (1) the substances of preference

(article 25t a-b-c) should be considered as feed raw material or additives and (2) a more adequate procedure of authorization of relevant substances according to the new VMP regulation might be considered in relation to organic aquaculture.
• Reconsider the setting of withdrawal period for according to the VMP regulation, i.e. if a withdrawal period is not defined for a species or a product you can multiply by 1.5 the withdrawal period for a similar product registered for another species.
• Herbal medicine should be further investigated as it may play a significant role as immune-stimulant and as treatment tool in future organic aquaculture.

Transport

• Excessive changes in water temperature and pH during transportation must be avoided,
• Smolt densities of up to 70 kg/m3 by road transport for up to 90 minutes did not compromise fish welfare,
• Open-hold well boat transport, densities of up to 150 kg/m3 for more than 10 hours had no significant effect upon salmon welfare,
• Max. density with transportation of fry might be set to 10 kg/m3,
• The loading phase appears to be more detrimental to welfare than the transport phase and well boat transports seemed to have an important recovery function,
• The effects of isoeugenol on large scale transport of smolts need further investigation,
• The potential welfare costs/benefits of large scale live chilling during transport need to be investigated in greater detail for adult fish.

Killing – Slaughtering

• When properly done the most humane stunning methods is percussive and electric stunning. The methods should be followed by killing with gill cut.
• Throughout storage prior to slaughter water quality should be monitored and continuously adjusted according to the fish demand,
• Use adequate pump equipment with care and only trained staff should manage such equipment,
• Personnel in slaughtering should be regularly (annually) trained regarding fish welfare and equipment,
• More investigations are needed to evaluate alternative stunning methods regarding humane slaughter (e.g. CO, alternative anesthetics),
• The use of electric stunning is considered as humane, but today the method is complicated and neither used friendly nor easily applied commercially,
• Alternatives to waiting cages should be investigated.

Escapee

• Species-specific distinctions might be made between escapes of fish and escapes of viable gametes,
• Efforts should be put on prevention of escapees, i.e. putting requirements for the physical design of the installation of net cages, i.e. calculation and design, operating and maintenance requirements,
• Specifications should be put on robust netting materials to resist tearing or biting,
• Curtain-like egg collectors might be used to mitigate egg escapee in cages with potential spawners (Atlantic cod and gilthead seabream). The commercial efficacy needs to be tested.

Energy consumption – CO2 – Life Cycle Analysis (LCA)

• Need of defining criteria and reference points for an environmental sustainable food production.

• Need of more research on LCA methods to evaluate properly environmental impact and carbon foot print.

Recycling and waste

• Need of more knowledge and technology for recycling of nutrients from aquaculture.
• Need of more investigations of solutions for collection, de-watering and re-use of waste from aquaculture production.

Sea bottom

• Environmental impact and interactions in relation to cage farming and the sea bottom needs consideration,
• Ecological impact of cage farming and wild fish attracting device needs consideration.

Consumer´s perception

• The consumer´s perception of ECO, organic, fair-trade and sustainable is vague due to lack of knowledge and linguistic confusion among languages in EU,
• Consumers are confused about what is organic, and hence information about organic food should be significantly focused.
• An efficient communication strategy is urgently needed.
• A cultural effect should be taken into account as national labels carry an image of local control, which may be important for a developing organic aquaculture sector.
• Transparency, proactive communication and the provision of key information that make sense to consumers may improve the efficiency of the EU leaf logo and the purchase of organic aquaculture products. It should be clearly communicated on what organic aquaculture is.

Institutional frameworks

• Too complex and fragmented management regimes seems to be the most important issue of the institutional frameworks, which is aiming at harmonizing the production rules for organic aquaculture in EU,
• Uncertainty of the rules and on exception deadlines creates a lack of trust and investments.
• The rules are not based on sufficient scientific and practical knowledge and need to be differentiated according to different species/groups,
• Support policies are needed in this initial phase for the organic aquaculture sector to reach ‘critical mass’.

Ethics

The ethical analysis and evaluation revealed a range of potential conflicting interests and needs related to the current framework for organic aquaculture. The Following dilemmas and issues need further attention and clarification, when considering future regulation of organic aquaculture:

The classical dilemma in organic standard setting is visible also in Organic Aquaculture; i.e. increase differences to conventional by stricter standards, taking the risk of losing farmers/producers, or keep differences at a lower level, not necessarily minimum, but closer to conventional, in order to keep, or increase, the number of certified producers, but at the risk of losing consumers who dislike the ’weak’ standards? The critical point is to identify the break even with regard to the levels of the three parameters: 1) Standards, 2) Engaged producers and 3) Consumer trust, which includes:

► How to gain consumer trust in organic aquaculture if the differences to conventional systems are low? What to inform consumers about it there are few differences?

►How ensure increase in organic aquaculture if large differences to conventional leads to few producers being interested?

►On the other hand, how to keep or create an interest among those organic producers who strive for a substantial difference and contribution?

• Fish welfare needs to be defined in relation to each species, and welfare indicators are needed,

• Stocking density includes several interconnected rearing parameters (water quality), which addresses welfare as well as other ethical issues,

• Impact of stocking density on fish welfare is difficult to measure, and opens for a range of ethical considerations,

• The definition of 'unnecessary suffering' as related to rearing systems, consumer perceptions and regulations (Organic, EU Slaughter directive as well as Treaty of Lisbon) needs further clarification,

• Stunning followed by slaughtering can be performed without causing (much) stress and pain, but legislation still allows methods that do (CO_2). This needs to be addressed in the organic regulations.

• Regarding farming of species fed on animal protein: Is this the best possible use of global resources? Are arguments in favor of feeding cattle soy proteins that humans could eat instead and feeding carnivorous fish meal convincing? If yes, are they so strong that it also justifies the suffering and stress we cause individual animals? Is there a morally/ethic relevant difference between cows and fish? Are fish less worthy of ethical consideration than other animals? If not, what is the alternative? What is the ideal organic system? Cattle eating mainly grass we can't eat, mono-gastric animals (pigs) mainly eating our waste and fish fed mainly on alternative protein sources? If so, what is the role of organic regulations in promoting such a shift?

A main aim for the revision 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.