# Guidance document

# on Environmental Performance

**Input received from the AAC members**

The Aquaculture Advisory Council (AAC)'s members wish to bring inputs from individual members to the current Commission's work to draft a **guidance document on Environmental Performance.** This addition of contributions does not constitute an AAC position.

These comments are based on the draft presented in June 2024. The AAC would welcome the opportunity to contribute to any other preliminary draft of the guidance documents that the European Commission could be sharing with us.

**Contributions listed below:**

- ✓ **Fédération Européenne des Fabricants d'Aliments Composés (FEFAC)**
- ✓ **COGECA**
- ✓ **Federation of European Aquaculture Producers (FEAP)**
- ✓ **Comité national des Pêches Maritimes et des Elevages Marins (CNPMEM)**
- ✓ **European Fishmeal and Fish Oil Producers (EFFOP)**
- ✓ **Compassion in World Farming Europe**
- ✓ **Eurogroup for Animals**
- ✓ **ROMFISH**
- ✓ **Associazone Mediterranea Acquacoltori (AMA)**
- ✓ **Danish Aquaculture Producer Organisation**
- ✓ **Comité National de la Conchyliculture (CNC)**

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## • FEFAC

- In Section 1.2., FEFAC believes that feed production should be added since the next sentence excludes this step from the scope of the document in this paragraph in page 7: "While aware of the need, for the full assessment of the environmental footprint of a product presented to the final consumer, of a full life cycle analysis covering other steps (**Feed production**, transport, processing, distribution), the objective at this stage is to limit the identification of environmental indicators to the activities "on farm"."
- In the first paragraph of Section 3.2. on page 11, this paragraph mixes up two issues that should be distinguished: the question of uneaten feed (high solubility, improper feeding ration/frequency, diseases) and imbalanced and/or low digestibility feed, that result in higher excretion of undigested nutrients. These two topics should be handled separately as the

solutions will be very different even though the targeted environmental impact should be the same.

- The Feed Conversion Rate (FCR) is indeed not an ideal indicator of sustainability but it can still be helpful since a high FCR may not just reflect a poor nutrition quality of the feed but also poor conversion linked to other elements such as genetics. Combined with other indicators such as nitrogen use efficiency, it provides useful information and is relatively easy to measure.

- **COGECA**

- A remarkable contradiction can be found in the document, investigating the environmental indicators of different segment of aquaculture. It is declared in the chapter 2 which sectors of aquaculture are included into the examination (all of them). In the following (chapter 3) section also can be found statements both on marine and inland aquaculture, although marine ones considerably more highlighted.
- However, in Chapter 5, which deals with environmental indicators, inland aquaculture, in particular pond aquaculture, which has a complex relationship with its environment, is not mentioned at all. For this reason, I think it is important to stress that this issue lagged behind painfully and it is urgent to define the proper special environmental indicators for inland aquaculture, including pond farming. Without it is not possible to understand the environmental performace of inland aquaculture.
- In Section 2.1.2. on Land-based production systems, COGECA mentioned that extensive pond systems are manufactured mostly in constructed wetlands and which provide several benefits and services to the natural ecosystem.

- In Section 3 on Environmental impacts on page 11, the aim of this chapter should be to describe the impact that aquaculture activities may have on the biotic and abiotic elements of the ecosystem. It must be stated that the impact can be both negative, neutral (in some aquaculture technology for some environmental elements) and positive on the ecosystem.
- In Section 3.1. "Physical impacts, including impact on seabed and water flow", water bottom and water regime should be added to the title. On page 11, when the installation of land-based facilities is mentioned, ponds should be added next to flow-through systems and recirculating aquaculture facilities (RAS). Furthermore, when talking about the impact of water abstraction due to these installations, it mentions "an impact on the course of the river (e.g. water flow) and the landscape", when it should mention "an impact on the surrounding surface and ground water regime as well as landscape". But, they agree with the fact that ground water is affected by RAS and should be included in this paragraph.
- On page 11, when talking about ensuring that an aquaculture activity does not cause any significant harm to the biodiversity or protected species or habitats, the effects on abiotic and biotic environmental elements should be divided.
- About the title of 3.2 "Benthic impacts and nutrients, including water quality and effluent management (excess feed, faeces), nutrients/eutrophication", they believe that it is quite a marine cage focused title. They suggest the following title: "Impact on nutrient cycling and natural food wed, including water quality and effluent management (excess feed, faeces), nutrients/euthrophication".

- Concerning Section 3.2, these are all valid findings, but above these, the effluents may cause alteration in the nutrient cycling of receiving surface water bodies, both for their abiotic and their abiotic elements. So the indicator should focus on this alteration. The impact, especially determine the impact of ponds is a complex issue, because these operates as an integrated part of natural ecological processes, so their nutrient balance also can be negative with nutrient retention.
- In Section 3.3, it should also be mentioned with regard to inland waters that the effect of fish stocking to natural waters as well as transport of live fish among different river basins or sub-basins can cause spreading of alien and invasive species (unwanted fishes and other organisms). The invasion that can be connected to fish farming can seriously modify the natural aquatic ecosystems, which is amplified by climate change.

- Section 4 is a coherent part, but they would mention here at least in one sentence that for complex biotic environmental issues (e.g ecological status of receiving waters, or fish ponds) other scientific approach can be adopted, especially, which were used in WFD, such as integrated biological indices. These indices would be urgent to develop for better understanding the environmental performance of pond aquaculture in the EU.
- Finally, in Section 4.3 concerning PEFCRs, it must be mentioned that it was developed only for marine aquaculture. Inland aquaculture, especially pond aquaculture, due to its complexity needs special PEFCR to determine its impacts on the natural ecosystem.

- **FEAP**

- Concerning Section 2.2. on "Non-fed aquaculture: filter feeder and algae", there is a need to be careful with the use of the term shellfish, as crustaceans are also shellfish and are "fed-aquaculture". It would be better to use molluscs in this paragraph.
- On page 11, FEAP believes that RAS should not be included in the following paragraph: "The installation of land-based facilities such as flow-through systems and recirculating aquaculture facilities (RAS) imply water abstraction, which could have an impact on the course of the river (e.g. water flow) and the landscape".
- FEAP would add the two words in bold in the following paragraph in page 11: "For this reason, to ensure that an aquaculture activity does not cause any **significant** harm to the biodiversity or protected species or habitats, according to the EU regulation (Birds and Habitats Directives), the authorities perform a habitat screening/assessment for all activities, and aquaculture can only get permission if the activity does not **significantly** adversely affect any protected area, and species."

- Concerning the following paragraph in Section 3.2., "Uneaten feed, faeces and excretion, mostly due to poor quality feed (e.g. high solubility, less digestibility) and or inappropriate feed management systems (e.g. improper feeding ration and feeding frequency) as well as diseases cause low Feed Conversion Ratio (FCR).", even the best-performing feeds require the fish to expel faeces. This should be rewritten to express that better feeds produce less faeces and excretion. In the following paragraph in Section 3.2., the words "low FCR" should be changed to "high FCR".

- The word "entering" should be added to the following paragraph in Section 3.2 in page 11: "Organic matter and nutrient pollution may lead to hypoxia (low levels of dissolved oxygen) and eutrophication due to the excessive growth of phytoplankton, which also reduces the transparency of the effluents **entering** receiving water bodies."
- Concerning the following paragraph in Section 3.2. in page 13, "Under the net pens or in their surroundings, organic and nutrient enrichment could be also harmful to the life on the seabed. They could affect the physicochemical compositions of the sediment and affect the **benthic communities** (Martinez et al., 2012).", this can also happen beneath intensive shellfish production rafts. Pseudofaeces accumulate below them and cause similar sediment nutrient enrichment problems.
- The words "not measurable" should be replaced by "imperceptible" in the following paragraph in Section 3.2. in page 12: "It is worth mentioning that, in well-managed marine aquaculture net pens, sited in well-flushed waters, the impacts on water quality as well as the benthic effects are usually not measurable at thirty and one hundred meters beyond the cages, respectively (Price et al., 2013)". The mention of "thirty and one hundred meters beyond the cages" is a too prescriptive remark.
- In page 12, the words "managed by" should be replaced by "decantated and passed through" in the following paragraph: "Similarly, in land-based aquaculture facilities where the effluents are managed by drum filters (e.g. recirculating aquaculture systems, RAS) and settlement tanks (e.g. ponds and flow-through systems) the environmental performance of the farms is improved."
- In Section 3.3, the following paragraph is difficult to interpret: "Locally absent species can be introduced from aquaculture facilities when fragments from the aquaculture structures are accidentally lost in the wild water body and reach a new area spreading the fouling fauna from the original site."
- Concerning the following paragraph in Section 3.3, "Thus, locally absent species can be seen in the surroundings of the facilities, and their presence has two main impacts: i) breeding with the native species producing hybrids, and ii) competing over the natural resources (space and food) and replacing the native species.", there is some confusion here. "Locally absent species" are "native species". They just happen to be there anymore for whatever reason. But they are not exotic.
- In the following paragraph in pages 12 and 13, FEAP would add the two words in bold as well replace "released" by "escaped": "Marine fish farmers are obliged to report escaped fish in some countries (e.g. Norway), while in the Mediterranean countries, this is in general not mandatory. However, farms in possession of certain certifications register and report voluntarily and regularly the number of fish released from the facilities."
- In Section 3.5 on page 14, the words in bold should be added to the following sentence: "According to the EU, up to 85% of marine litter is made up of plastics, being 27% of this formed by fishing-related items **mainly from capture fisheries".**

- In Section 4, when mentioning the Environmental Impact Assessment, reference to the legislation is missing. Concerning Section 4.1 on the Life-Cycle Assessment (LCA), LCA is not used today in aquaculture. The PEFCR rules are still in development.

- Concerning Section 4.2 on page 16, the Product Environmental Footprint is the EU recommended Life Cycle Assessment (LCA) based methods to quantify the environmental impacts of products, so there is a question around the need to separate this from the previous point.

- **CNPMEM**

- In Section 3.1 "Physical impacts, including impact on seabed, and water flow", concerning the installation of land-based facilities and the example of RAS, RAS systems do require water withdrawal, but like all land-based fish farms. The aim of RAS is to optimise the use of water through recirculation. This may not be the best example here.
- In Section 3.2. on page 12, concerning drum filters, most RAS systems also use bacterial filters and UV filters.
- In Section 3.3, it would be useful to include a paragraph on pathogens, which can also have an impact on biodiversity in the vicinity of fish cages. Sea lice are a real problem. Its spread is due to the high densities of salmon in the cages. It attacks farmed salmon but also has an impact on wild populations, whose numbers have been falling sharply for several years.

- Concerning Section 6 and the indicators, it would be relevant to add an indicator on pathogens: number of pathogens and density of pathogens per m3.

- **EFFOP**

- In Section 3.2. on page 11, when mentioning feed management systems, feed selection should also be included such as selecting feeds with protein content that exceeds the species' nutritional requirements or using ingredients that do not synergize well with the animal's health.
- FCR has many nuances, it is not the be all end all but many of these impacts listed feed into the FCR. If protein is too high for the species, then the investigator would see that in the FCR, same for protein conversion etc. Since feed is often about 50% of fed aquacultures footprint, understanding it is quite important to have a metric that represents the feeds performance in the production system. EFFOP agrees with the comments about conversion efficiencies that can be measured as part of digestibility such as protein digestibility, lipid digestibility etc but this would go into a section more tailored for feed impact and not benthic impact.
- In Section 3.3 on page 13, concerning the modelling of the Life Cycle Assessment (LCA) to assess the impact of the fishing and not an indicator of the fish farm activity, and that this is out of the boundary of the gate-to-gate scope of the environmental performance guidance document, it just tied to the feed 2018 PEFCR.

- In Section 4.1 concerning the Life Cycle Assessment, it is also worth mentioning the different forms of allocation and burdens that are used to monitor PEF in LCAs, mass balance, economic balance, energy balance etc and the confusion it can generate.
- On page 15, EFFOP agrees with the following sentence "Challenges by applying the LCA-methodology is the complexity and lack of standardisation of the models used in the

calculations". That is why for feeds at least, they should follow the EU PEFCR rules to level the playing field. There are similar standards for marine ingredients that can be added to this section: https://www.marinefishpefcr.eu/. The second updated version is due to be released soon.

- In Section 4.2. on page 16, the segregation is confusing between Section 4.1. on Life Cycle Assessment and Section 4.2. on the Product Environmental Footprint.

- In Section 5.3. on page 19, it is suggested the update the section on the call for volunteers of DG ENVI and DG GROW to present projects to develop PEFCR for specific products groups of 2019 since the second stakeholder consultation just ended in 2024.

- Concerning the indicators in Section 6, there are many nuances concerning FCR and EFFOP thinks that an additional indicator to cover the suggestions can be nutrient digestibility. Concerning feed production, it is tied to the Feed PEFCR. The second consultation period just ended where biodiversity impacts were discussed. So if it is tied they would suggest to leave this aspect out as the marine fish PEFCR has the guidance to "add" whatever the feed PEFCR registers in its performance.

- **Compassion in World Farming Europe**

- Concerning Section 3.2. on Benthic impacts and nutrients, FCR is an inaccurate measure of environmental performance and efficiency since it misses the impact of nutrient concentration eg protein, nitrogen or phosphorus concentration in the feed. Ideally we should have a measure of nutrient efficiency, eg protein conversion ration etc. If an additional indicator is the concentration of key nutrients in the feed, this can be worked out automatically from the FCR. Ideally the yield of fish from the carcass is also factored in so you get a measure of nutrient efficiency in relation to actual human food. Again, the calculation can be automatic if the right data is fed in.

- Concerning Section 6, this list of indicators is most appropriate for caged systems and perhaps raceways and very much less so for pond and molluscan shellfish systems. RAS systems may also need a different list. If the intention is to produce one common list, then those other systems need looking at separately and gaps filled. Then a piece of work is needed to work out the indicators needed for each system and perhaps for each species in each system. Earlier sections would then need to be edited as appropriate.
- Concerning the indicators, impacts of feed production are a really important aspect of environmental performance, though they understand this may be covered separately.

- **Eurogroup for Animals**

- In Section 5.3. in the Table 4, the kilograms of dead fish to quantify mortalities is a key indicator as part of protein conversion efficiency and the impacts of wasted feed.
- In Section 5.4.1. in the table on the Physical Impacts, one of the most practical and important indicators to be regularly monitoring is the following "Monitoring the physical footprint of

aquaculture activities on the seabed, including the extent of sediment disturbance, can be done through underwater photography, video transects, and side-scan sonar".

- Concerning Section 5.4.2. and the Feed Conservation Ratio, it is a poor indicator. FCR is not an indicator of environmental impacts due to not taking account of the content or sourcing or manufacturing of the feed, which varies significantly between feeds. As an alternative to FCR, an indicator using trophic level of the farmed species as a proxy for their reliance on fishmeal and fish oil could be used, as suggested by the JRC (https://op.europa.eu/en/publication-detail/-/publication/e4cc8c00-a11c-11ed-b508-01aa75ed71a1/language-en). The indicator would be the following: (Trophic level of each species * total production of this species) / total production.
- In Section 5.4.5. in the table on Waste Management, the following indicator "the volume of mortality should be recorded and all stored and transported dead fish should be clearly registered (including information on the date when the dead fish are put into storage, the destination, date of collection and relevant details of the receiving entity) and the number of dead fish (tonnes) generated yearly" is critically important at the core of protein conversion efficiency and the large impacts from feed.

- In Section 6, indicator 28 on the mortalities produced is critically important relevant to protein conversion efficiency and the largest environmental impact category of feed.

- **ROMFISH**

- All the following comments concern Section 6 on the Proposal of a single set of environmental indicators.
- For the indicator on freshwater use, "tonnes produced" is not equal with tonnes sold. We have to consider that a production cycle is not equal with a year. Hardly applicable for pond aquaculture in this form as in pond aquaculture the water is turned back to the river. Some farms are placed on the river course so what goes in goes out except the volume of the pond minus natural processes such as evaporation, transpiration, infiltration.
- Siltation is a parameter which should be monitored by Water Management authorities, not by the farmers.
- The following indicators are good for pond aquaculture:
    - Space dedicated to enhancing biodiversity**:** It is a good indicator for pond aquaculture, but it is a quantitative indicator if you measure it in % dedicated for biodiversity of total aquaculture area
    - Density of fish
    - Feed Conversion Ratio : This indicator also need to consider biomass sold during the year too
    - Biochemical oxygen demand
    - Accumulation of Organic Matter (AOM): We have to subtract the organic matter in the source for pond aquaculture
    - Number of days of fallowing (Qn)
    - Plastic into the sea
- The following indicators are not relevant/not applicable for pond aquaculture:

- Seabed impact footprint (not relevant)
- Number of days with oxygen depletion (not relevant)
- Phytobenthos and zoobenthos (not applicable)
- Benthic communities (not applicable)
- Turbidity (not applicable)
- Potential to change the gene pool of the native community (not relevant)
- Antifouling
- The number of eggs used yearly (Qn) (not applicable)
- Juveniles used yearly not relevant
- The amount of oxygen (tonnes) used (Qn)
- Amount of formic acid used (Qn).

- The indicator on the introduction of new invasive alien species should mention Regulation 708/2007. The indicator on the pollution by heavy metals is not an indicator for the farmers but for the authorities. The indicator on sludge produced would be difficult to assess in pond aquaculture.
- Concerning the efficiency in the use of energy, it is only referring to energy as electricity. Point 31 described an extended list of energy. This indicator should include not only the farm gate production as some of the fish is not yet at market size, but its production consumes also the energy in a pond farm. The indicator on the proportion of renewable energy is for the energy supplier not for the farmers.
- Finally, the indicator 37 on the mass of products delivered from the farm could be the following: Yearly mass of products delivered/total area of productive capacity and Yearly Biomass produced/total area of production capacity (or on the available production area, because in pond aquaculture some ponds are left empty for one or two years).

- **AMA**

- Concerning Table 1 of Section 2 "A summary of the species, environmental parameters, and production systems that most characterise the aquaculture sector in the EU", the category "Species" should be changed to "Species Groups". The category "Environmental Parameters" should be changed in "Environmental Conditions". Warm water and cold water are not relevant.
- Concerning the list of production systems, it could be modified to the following list:
  - Offshore cage systems - Marine water
  - Lagoon or sheltered areas cage systems - Marine-brackish water
  - Flow-through land-based farms - Earth Ponds - Fresh water
  - Flow-through land-based farms - Raceways - Fresh water
  - Recirculating aquaculture systems (RAS) - Fresh water
  - Recirculating aquaculture systems (RAS) - Marine water
  - Shellfish on-bottom cultivation systems
  - Shellfish off-bottom cultivation systems
  - Shellfish suspended cultivation systems

- Macro algae cultivation systems

- Raceway would be erased from the list.
- Table 1, as well as the following sections, are not exhaustive. A clear list of the "production systems" with related definition must be made. In the following chapters, environmental impact, environmental impact assessment method and indicators should be systematically referred to these "production systems".

- Concerning Section 3 on "Environmental Impacts", each section should be divided in sub-sections for the concerned "production systems". It should also mention the "production systems" that are not concerned.

- In Section 6 about the proposal of a single set of environmental indicators, for each indicator it should be mentioned the "production systems" that are concerned/not concerned. For this purpose, one table for each "production system" with all the related specificities (where, when, how, who, etc.) should be added at the end of this list. A table should be made for each "production system" as detailed in Table 1.
- For instance, tables for shellfish on-bottom cultivation or off-bottom cultivation would be different from the one on suspended offshore cultivation. Here is a table as example for suspended shellfish cultivation – offshore:

| **Suspended shellfish cultivation - Offshore** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Indicator | Unit | Where | Automated | Sampling | Farmer | External | Lab | Reliability |
| Sediment | presence/thickness | cultivated area | - | yes | - | yes | - | very low |
| Benthos biodiversity | Species/ha | cultivated area | - | yes | - | yes | - | medium |
| Water biodiversity | E-DNA | cultivated area | - | yes | - | yes | - | ?? |
| Shading | surface | cultivated area | - | - | Project data | - | - | high |
| Phytoplankton | mg Chla/m3 | cultivated area | Satellite | - | - | data provider | - | medium |
| Phytoplankton | composition | cultivated area | - | yes | - | sampling | yes | low |
| Environ. Footprint | LCA | cult. area/arround | - | - | Prod. data | elaboration | - | To be assesed |
| Carbon Footprint | LCA | cult. area/arround | - | - | Prod. data | elaboration | - | To be assesed |

- Considering the importance of these indicators and the complexity of the aquaculture systems, experts should be involved to make this document clearer and technically reliable before any further consultation/workshop. At least two representatives for each "production system" should be involved. The involved experts should be present at the consultation/workshop planned in Section 7.

- **Danish Aquaculture Producer Organisation**

- Concerning the indicators, the Danish Aquaculture Producer Organisation would like to include an indicator concerning greenhouse gases (GHGs).

- The following indicators are not applicable/environmentally relevant for Danish farmers:
    - 2. Siltation
    - 5. Space dedicated to enhancing biodiversity
    - 6. Density of fish
    - 18. Changing alfa-biodiversity
    - 21. Introduction of new invasive alien species
    - 22. Potential to change the gene pool of the native community
    - 24. Pollution by heavy metals
    - 32. Proportion of renewable energy
    - 33. The number of eggs used yearly
    - 34. Juveniles used yearly
    - 35. The amount of oxygen used
    - 36. Amount of formic acid used
    - 37. Mass of products delivered from the farm

- **CNC**

**Feedback from Shellfish farmers to the environmental indicators**

- We would like to recall that the identification of environmental indicators and more largely, being able to monitor and assess the environmental performance of aquaculture production, is not an end in itself.
- As part of the Strategic guidelines, it is a means to ensure a further development of aquaculture in the EU that contributes to the Green Deal's growth strategy; a means towards an aquaculture that is competitive and resilient.
- We therefore ask the Commission to take into consideration the following general comments:
    - A lot of "non-fed-cultures" are not included in the 2.2 part. Especially the bottom cultures are not identified. You might find some details in the following regulation : https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009R0710. Algae, holothurias are not mentioned either.
- We find it regrettable not to have this "fed/non fed" distinction in the indicators while they are clearly distinguished in the description of the different production systems.
    - Indicators must be applicable to all aquaculture productions or at least, most of the European productions. As you could see in the Annex below, most of the current indicators are not relevant for shellfish. Consequently, given the time available, we would like to reiterate our request for clear guidance on whether this document will be followed by a complementary document for shellfish or whether we will ensure that for shellfish,

the scores associated with these indicators are automatically those reflecting minimal impact because of not concerned by many identified impacts.

- Indicators must also be able to reflect the positive contribution of aquaculture production systems to the environment (e.g. do not consider only emissions of N and P, but also absorptions; do not only consider (renewable) energy use but also production on farms), etc…
- Even on a voluntary basis, the number and complexity of environmental indicators must be limited to a few key and relatively easy to use indicators. It is crucial to build on data / parameters / criteria that producers are already required to evaluate in the framework of the licensing and renewal of licences for example.
- The monitoring of additional environmental indicators would also be favoured if such indicators can be used as an added value towards the customers.

**Annex 1: Analysis of the Compatibility and Measure Capacity for shellfish farmers per indicator:**

| INDICATORS | SHELLFISH COMPATIBILITY | COMPATIBILITY EXPLANATION | SHELLFISH FARMER CAPACITY TO MEASURE THE INDICATOR |
|---|---|---|---|
| 1. **Freshwater use**: $m^3$ or $m^3$ / tonnes produced. Waterflow measured using a current meter on site for 24 hours at the start, medium, and end phases of the culture (Qn). | NO | Shellfish production neither uses nor consumes water. Moreover, the water filtered by molluscs is completely returned, and in better quality. | |
| 2. **Siltation**: (load of total suspended inorganic solids in source water – load of suspended inorganic solids released in effluents) / mass or units produced (Qn). | NO | Shellfish participate in mineralising the organic and inorganic solid | |
| 3. **Seabed impact footprint**: extent of sediment disturbance (Ql/Qn). | YES | If there may be sediment disturbance, positive impact on sediment do exist. | ADDITIONAL IMPORTANT COST FOR CONSUMERS |
| 4. **Shading**: light attenuation (Ql). | NO | Shellfish clarifies Water because of their filtration system. | |
| 5. **Space dedicated to enhancing biodiversity**: identification of means to provide habitats to enhance biodiversity at the site level (such as the greening of land area or maintaining | YES | | YES IF THE AREA CORRESPONDS TO PRODUCTION AREAS. |

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|---|---|---|---|
| non-commercial stocked ponds for migrating birds) (QI). | | | |
| 6. **Density of fish**: Kg fish / $m^3$ & number of fish / $m^3$ (Qn). | NO | Metric must be adapted to shellfish productions | |
| 7. **Feed Conversion Ratio**: feed delivered (kg) / final biomass - initial biomass during time interval (kg) (Qn). | NO | There is no food for shellfish | |
| 8. **Biochemical oxygen demand** ($BOD_5$): ($BOD_5$ in source water – $BOD_5$ released in effluents) / mass or units produced (Qn). | NO | There is no oxygen added in Shellfish cultures | |
| 9. **Number of days with oxygen depletion** (below 4ppm) per year (Qn). | NO | See above | |
| 10. **Accumulation of Organic Matter** (AOM): mass of organic matter released in effluents / mass or units produced (Qn). | NO | Shellfish participate in mineralising the organic solid into inorganic matter. | |
| 11. **Emission of Nitrogen**: (load of nitrogen in source water - load of nitrogen released in effluents) / mass or units produced (Qn). | NO | Shellfish sequestrate Nitrogen | |
| 12. **Emission of Phosphorus**: (load of phosphorous in source water - load of phosphorous released in effluents) / mass or units produced (Qn). | NO | Shellfish sequestrate Phosphorus | |

| | | | |
|---|---|---|---|
| 13. **Phytobenthos and zoobenthos**: At three levels (surface, middle, bottom) of the water column (Ql/Qn). | YES | | IMPOSSIBILITY FOR A PRODUCER ALONE TO GIVE THE INFORMATION |
| 14. **Benthic communities**: habitat complexity, substrate composition, and macroinvertebrate abundance (Ql/Qn). | YES | | IMPOSSIBILITY FOR A PRODUCER ALONE TO GIVE THE INFORMATION |
| 15. **Turbidity**: At three levels (surface, middle, bottom) of the water column (Ql). | YES | Shellfish participate in the clarification of waters. Conditions are also very different depending of the area. | POSSIBLE BUT TIME CONSUMING FOR PRODUCERS |
| 16. **Number of days of fallowing** (Qn). | NO | Not relevant for shellfish farming because when you do not produce, you do not have the positive impacts of the synergies associated to this culture. | |
| 17. **Biodiversity surveys** (Ql). | YES | | IMPOSSIBLE FOR CONSUMERS TO MEASURE IT ALONE |
| 18. **Changing alfa-biodiversity**: 100*(S-Wd – S-Ws) / mass or units produced, in which: S-Wd = Shannon-Winner diversity index obtained in a similar place not impacted by the farm S-Ws = Shannon-Winner diversity index obtained surrounding the farm. | YES | | ADDITIONAL IMPORTANT COST FOR CONSUMERS |

| | | | |
|---|---|---|---|
| 19. **Number of escapees**: Records of all escaped (Qn), number of escapees / tonnes of fish (Qn). | NO | There are no "escapees" of shellfish. | |
| 20. **Endangered species**: Number of lethal incidents / ha (Qn), number of mammals killed / tonne of production (specify species as well as accidental versus deliberate animal removals), number of birds killed / tonne of production. | NO | If "authorisation" is not associated with "incident" there is no single incident for mammals or bird to declare for shellfish production, especially regarding the "accidental versus deliberate animal removals" mentioned) | |
| 21. **Introduction of new invasive alien species** (QI). | NO | It does not concern shellfish | |
| 22. **Potential to change the gene pool of the native community**: classification of farmed animals according to a set of defined characteristics and culture conditions, and their potential impact on the native species of the surrounding environment (QI). | NO | For more than 60% of shellfish productions, the producers collect the seeds directly in their environment. The juveniles which have been bought to hatcheries are also very close to the "native species" pool. Furthermore, the impacts of shellfish production on their | |

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|---|---|---|---|
| | | environment are most of the time very positive (Biodiversity enhancer, Clarification of water/ Sequestration of Nitrogen, etc. etc.) | |
| 23. **Load of applied chemical products**: mass of herbicides, insecticides, anti-algal, antibiotics, and other chemicals applied / mass or units produced (Qn), number of antiparasitic, antibiotic treatments (total and by disease) (Qn), emission of chemicals (Qn). | NO | Shellfish productions require not to use chemicals in their production. | |
| 24. **Pollution by heavy metals**: load (mass) of heavy metals applied / mass or units produced. | NO | Shellfish farmers do not use heavy metal pollutants. Shellfish farming already suffers significantly from heavy metal pollution originating from land sources. | |
| 25. **Pollution by hormones**: load (mass) of hormones applied / mass or units produced | NO | Hormones are not used in shellfish cultures | |
| 26. **Antifouling**: list of products name and antifouling agents included | YES BUT | Shellfish productions require not to use | MEASURABLE |

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| (equipment and vessels) (QI), mass of the chemicals / production (Qn), Statement (expert judgement) on the end-of-life of the antifouling paints (QI). | | chemicals in their production. This indicator must be adapted for shellfish farming | |
| 27. **Plastic into the sea**: number of plastics lost into the sea (Qn), number of gears and weight of ropes and floats (Qn), abandoned nets and ropes (Qn), lost nets and ropes (Qn). | YES | | POSSIBILE APPROXIMATIONS |
| 28. **Mortalities produced**: dead fish (tonnes) generated yearly (Qn), Kg of dead eggs/juveniles (Qn). | NO | Impossible to count and not relevant to count. Indeed, the shells are a very interesting support to enhance biodiversity. | |
| 29. **Sludge produced**: amount of sludge (tonnes) generated yearly (Qn), Kg of sludge treated and disposed (Qn), amount of sludge (tonnes) used directly as fertiliser yearly (Qn), amount of sludge (tonnes) sent to biogas yearly (Qn), amount (%) of nitrogenous in the dry matter of the sludge (Qn). | NO | Shellfish production neither uses nor consumes water. Moreover, the water filtered by molluscs is completely returned, and in better quality. | |
| 30. **Efficiency in the use of energy**: total electricity used for farming (kWh) / tonnes of fish (Qn), energy consumed | YES BUT | must be adapted for "SHELLFISH" | DIFFICULTLY MEASURABLE |

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| (MJ) per tonnes of farmgate production (Qn). | | | |
| 31. **Energy used**: electricity and fuel used by the fish farming company (Qn), total fuel used for transport (L) / tonnes of fish (Qn), transport distance (km) of inputs (eggs, juveniles, oxygen, feed) to the fish farm (tonnes*km) (Qn). | YES BUT | must be adapted for "SHELLFISH" | DIFFICULTLY MEASURABLE |
| 32. **Proportion of renewable energy**: amount of renewable energy / total amount of applied energy (Qn). | YES | | DIFFICULTLY MEASURABLE |
| 33. The number **of eggs used yearly** (Qn). | NO | | |
| 34. **Juveniles used yearly**: weight (tonnes) of 5-80, 81-200, 201-500, and 501-800 g. | NO | Not a relevant metric for shellfish regarding that shellfish cultivation do not necessitate to count the quantity of the "juveniles" . Cf Bouchot cultures | |
| 35. **The amount of oxygen** (tonnes) used (Qn). | NO | Shellfish production neither uses nor consumes water. Moreover, the water filtered by molluscs is | |

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| | | completely returned, and in better quality. | |
| 36. **Amount of formic acid** used (Qn). | NO | Shellfish production neither uses nor consumes water. Moreover, the water filtered by molluscs is completely returned, and in better quality. | |
| 37. Mass of **products delivered** from the farm (Qn). | YES | | YES |