Baltic Marine Environment Protection Commission

HELCOM Fish Correspondence Group concerning a draft document on BAT/BEP descriptions for sustainable aquaculture in the Baltic Sea region (CG Aquaculture)

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Background

In 2016 the HELCOM Contracting Parties adopted Recommendation 37/3 on “Sustainable Aquaculture in the Baltic Sea Region”. It recommends to develop BAT and BEP measures aiming at sustainable aquaculture in the Baltic Sea region based on guidance as contained in Annex 1 of Recommendation 37/3. The HELCOM HOD 54-2018 (Outcome § 4.57) requested the Contracting Parties to contribute to the work on BAT/BEP for sustainable aquaculture. Germany presented some initial ideas for BAT/BEP to avoid or minimise nutrient pollution at the CG Aquaculture 2 meeting in 2018 (see document 5-2 of CG Aquaculture 2) as well as some considerations on siting of marine finfish aquaculture operations in the Baltic Sea taking account of the eutrophication status (see presentation 1 of CG Aquaculture 2).

After the CG Aquaculture 2 meeting Germany commissioned work on developing BAT/BEP with respect to pollution by nutrients and hazardous substances for sustainable aquaculture operations in the Baltic Sea region. The work was carried out by the AquaBioTech Group in cooperation with EUCC (Küsten Union Deutschland e.V.) and a final report was delivered in June 2020 (see document 6-1 of CG Aquaculture 3).

Based on the requirements of HELCOM Recommendation 37/3, document 5-2 of CG Aquaculture 2, the report of the AquaBioTech Group and some additional considerations the German Environment Agency has developed a first proposal for BAT/BEP to avoid or minimize nutrient pollution from aquaculture operations in the Baltic Sea region. This proposal should constitute the basis for developing BAT/BEP under HELCOM Recommendation 37/3 with respect to nutrient pollution. While it focusses on nutrient pollution the proposal also considers more overarching aspects such as the choice of aquaculture systems and the siting of aquaculture operations.

Action requested

The Meeting is invited to:

-discuss the first proposal for BAT/BEP to avoid or minimize nutrient pollution; and

-decide on further steps to be undertaken to further advance the work.

A first proposal for BAT/BEP to avoid or minimize nutrient pollution from aquaculture operations in the Baltic Sea region

1. Aquaculture systems

There exist different aquaculture systems that differ in their degree of environmental impacts they are causing. In order to minimise such environmental impacts the following needs to be considered:

- Concerning land-based aquaculture Recirculating Aquaculture Systems (RAS) are preferable to flow-through and pond systems since less waste water is discharged and effluent water can be treated (see chapter 2.1)
- The cultivation of marine species in RAS systems is generally preferable to open cage aquaculture in the Baltic Sea; a combined approach is also possible, where fish, e.g. Rainbow trout, could be initially cultivated in RAS until they reach a certain size and are then transferred to net-pens or cages in the open sea
- Semi-enclosed containment systems (S-CCS) and even closed containment systems (CCS) could be used for the cultivation of Atlantic salmon and possibly for Rainbow trout and are preferable to open cage aquaculture, but they cannot yet be considered BAT
- Integrated multi-trophic aquaculture (IMTA) combining the cultivation of organism from different trophic levels are preferable to open cage aquaculture, but they cannot yet be considered BAT

2. General management measures to avoid or minimise nutrient pollution

Siting of aquaculture operations, in particular in the marine environment

Locating aquaculture operations appropriately is very important and strategic planning can avoid or minimize many of aquaculture's environmental impacts. Therefore, the following needs to be considered:

- The area should have adequate current speeds (mean 25-50 cm/s, max 60-75cm/s) to prevent localised nutrient accumulation; while dispersive capacity increases with current speed, aquaculture farms should not be located in areas where the flow rate is too high for optimal growth and FCR, and for the maintenance of good fish welfare and the integrity of the farming infrastructure
- For bivalve cultivation, the current speed must not surpass that at which bivalves are capable of intercepting food items (mean speed of 25 cm/s using long-lines)
- A minimum water depth required for finfish net-pens and suspended shellfish cultivations should be determined to help prevent localised accumulation of solid waste upon the benthic zone below aquaculture facilities as deep water increases the likelihood of dispersion and assimilation
- [New] intensive finfish production and shellfish cultivation should not be established in areas with [severe] eutrophication that are characterised by bottom oxygen deficiency and heavily impacted benthic zones (e.g. high sediment nutrient content, anoxia/hypoxia, sulphide production)
- Site selection should take the assimilative capacity or carrying capacity of the environment into account, which is defined as the amount of pollutants that can be processed without causing high concentrations and non-compliance with water quality standards of WFD, MSFD and HELCOM; to determine the assimilative capacity of the environment models could be used
- Site selection should be supported by using hydrodynamic modelling that allows a prediction about the area of potential impact, considering both near-field and far-field impacts
- Site selection also needs to take into account the "HELCOM / VASAB Baltic Sea broad scale marine spatial planning principles" and the "Guidelines for the implementation of the ecosystem-based approach in marine spatial planning in the Baltic Sea area"

Commented [A1]: To be further discussed. Currently, the whole Baltic Sea is eutrophic

- Fish farms should not be placed in protected areas if they might compromise conservation objectives for which MPAs have been established
- Potential negative impact of aquaculture facilities located outside MPAs on these protected areas (in particular, HELCOM MPAs, NATURA 2000 sites and potential MPAs as designated under MSFD Art. 13 (4)) or other ecologically sensitive areas should be assessed and avoided

Commented [A2]: This is taken from Rec 37/7 and it is still vague and might require further concretisation

General management of nutrient related impacts upon the benthic zones and the water column

- Implement and coordinate fallowing periods, the length of which should be determined based upon the assimilative capacity of the benthic zone
- The most relevant site specific nutrient related impacts have to be defined and monitored on farm level (see chapter on monitoring and reporting requirements, to be drafted later)
- Consideration of suitable waste management practices (see chapter 3) and suitable fish feed type, fish feed composition and feeding practices (see chapter 4)
- Nutrient extracting species, such as bivalves and seaweeds, should be used as part of a mass balance approach to compensate for the nutrient inputs of finish aquaculture

Commented [A3]: This needs to be further discussed. Another strategy could be to "sacrifice" a site rather than moving the aquaculture operation around. This might be a plausible strategy in some areas of the Baltic sea were the benthic zone is already heavily degraded, but might also contradict the "no-deterioration" objective of the WFD

Establishment and operation of aquaculture Management zones

- Aquaculture management zones (AMZs) should be established for aquaculture operations in the Baltic Sea in particular for new aquaculture operations and for the extension of existing ones
- Environmental Impact Assessments (EIA) should be conducted to support the designation and management of AMZs
- The EIA should be based upon site-specific data, accompanied by appropriate modelling approaches and should focus upon near-field impacts as well as far-field impacts, covering the following aspects:
  - Benthic characteristics and water quality
  - Ecological/environmental status of the site according to WFD/MSFD and HELCOM
  - Prevailing surface and subsurface water current direction and velocity
  - Modelling approaches for predicting nutrient dispersion, solid deposition, and assimilative and carrying capacity of the receiving environment (e.g. DEPOMOD)
- AMZs should be located in areas with adequate environmental, production and social carrying capacity
- AMZs for open cage finfish aquaculture should not be located in Marine Protected Areas and should not be located so that the environmental impacts reach MPAs
- The number of AMZs within any given area, and the distances between each AMZ should be defined whilst taking into account carrying capacities
- Th designation of AMZs requires stakeholder consultation and participation as part of local and regional integrated ecosystem management strategies
- Production cycles and harvesting periods between the same or different producers should be coordinated within an AMZ

In addition, the recommendations for the general management of nutrient related impacts upon benthic zones and the water column provided above also apply to AMZs.

Defining maximum allowable production in AMZs

Coordinated production in AMZs should be done within the context of a defined maximum allowable production, as a means of limiting nutrient discharges and reducing the risk of disease outbreaks. This concept replaces the average nutrient discharge limits per live weight (kg) of fish contained in HELCOM recommendation 25/4, since these are difficult to determine, ineffective from the perspective of environmental protection and impossible to enforce or sensibly monitor.

For each AMZ a maximum allowable production should be defined considering the following principles for the open Baltic Sea and for coastal areas:

For the open Baltic Sea (>1 nautical mile)

- If possible, the AMZ should not be established in a Baltic Sea basin that is subject to eutrophication, as assessed by HELCOM
- If an AMZ is managed collectively by different HELCOM Contracting Parties the basis for the definition of the maximum allowable production are the **maximum allowable inputs (MAI)** of nitrogen and phosphorus that have been derived for the basin where the aquaculture operation is based in
- If an AMZ is managed by only one HELCOM Contracting Party the basis for the definition of the maximum allowable production are the **national nutrient input ceilings (NICs)** for nitrogen and phosphorus of this respective Contracting Party for the basin where the aquaculture operation is based in
- MAI or NICs need to be considered so that the prognosed additional nutrient discharge from an aquaculture operation does not lead to an exceedance of MAI or NICs

For coastal areas (<1nautical mile)

- If possible, the AMZ should not be established in a WFD water body that is subject to eutrophication, as assessed by HELCOM or that fails to achieve good ecological status as assessed by the WFD
- The transport of nutrients to the open Baltic Sea basins needs to be considered and should not lead to an exceedance of the national NICs
- The European Union Court of Justice ruling that Member States may not authorise projects that lead to a deterioration of the status of a water body, even on a temporary basis, unless a derogation is granted (the Weser case) should be considered when establishing AMZs in WFD water bodies

Commented [A4]: This needs further careful discussion, since national regulations already exist

Within an AMZ the production can be limited based upon the principle of maximum standing biomass with repeated cropping of desired size classes or on an all-in-all out approach.

If the setting of a maximum allowable production is not possible, defining a maximum allowable content of N and P in feed, or setting a maximum allowable bFCR) (biological Food Conversion Ratios = quantity of feed consumed by a fish that is converted to growth) are second best alternatives.

Commented [A5]: It needs to be discussed whether this is needed or whether limiting biomass is the only approach that is recommended

If limits for feed or maximum allowable bFCRs are used, the following principles apply:

- Limits to feed nutrient content must be defined for feeds intended for specific cultivation types and environments, different life-stages/age and size classes, and different species
- Maximum allowable bFCRs must be defined according to cultivation environment and species
- The differentiated considerations for open Baltic Sea basins and coastal waters detailed above also apply

Stakeholder consultation is the best route towards ensuring that any limits set are realistic, implementable, and effective, whilst reducing stakeholder conflict and increasing cooperation. Producing companies should be consulted to ensure that approaches to limiting biomass production, content of N and P in feed or bFCR satisfy their intended purpose whilst being amenable to efficient and profitable production practices.

BAT/BEP for Recirculating Aquaculture Systems (RAS)

Water filtration prior to its reuse is the defining feature of RAS. However, a fraction of cultivation water is always discharged (e.g. 5-10% of total water volume), so that RAS systems cannot be considered as fully closed, thereby still causing environmental impacts. Such environmental impacts should be reduced by applying the following BAT/BEP:

- Optimised feeding using feeds purposely for use in RAS to reduce nutrient discharges (see also chapter 3)
- Effluent water of RAS should be treated on site by biological denitrification technologies
- Sludge of RAS should be treated on site by mechanical filtration; constructed wetlands could be used as settling ponds
- Sludge (nutrient containing solid wastes) separated from water by mechanical filtration should be considered as a potential fertiliser (e.g. input to compost production or feedstock to biogas production)

BAT/BEP for flow-through tanks and pond systems

- Individual farm permits should define a maximum allowable biomass production (e.g. a maximum biomass allowable on the farm at any one moment, a maximum yearly production) or a maximum allowable quantity of feed used per site depending on site-specific conditions and environmental considerations
- Water discharged from flow-through systems should be treated by mechanical filtration and preferably also by biological filtration

BAT/BEP for nutrient extractive aquaculture

Culturing mussels or seaweeds does not release additional nutrients into the marine environment but reduces nutrients through harvesting of the cultured species. Nevertheless, such aquaculture is not without impacts. With respect to nutrient pollution, mussels excrete faeces and pseudofeaces and their accumulation underneath the farm can cause undesired impacts on benthic habitats (e.g. through oxygen depletion). Therefore, the following principles apply:

- Extractive aquaculture in the Baltic Sea is in general preferable over finfish aquaculture
- Stocking densities of mussels need to consider the assimilative capacity of the marine environment
- Models should be sued to determine the assimilative capacity of the environment as well as further environmental impacts of bivalve aquaculture (e.g. ShellSIM, ShellGIS, FARM)
- It should be avoided that mussels fall off culturing ropes
- Environmental monitoring of the impacts on benthic habitats should be carried out (see chapter on monitoring and reporting requirements, to be drafted later)

3. Waste management practices

Aquaculture activities, such as farming, slaughtering and processing, produce ‘biowastes’ which are particular to the aquaculture sector. Such waste may be a vector of diseases when and if it is disposed directly to the aquatic environment. Proper waste management can contribute to reducing environmental impacts of aquaculture activities in the Baltic Sea through waste recycling as well as valorisation of wastes which may also create an income to the farmer or reduce disposal costs.

BAT/BEP is defined in the following for mortality management, waste underneath open cage farms and aquaculture processing wastes.

Mortality management

- Dead and moribund fish should be collected immediately and regularly to prevent the spread of pathogens, both within the aquaculture and the natural environment
- If mortality cannot be removed immediately from site and transported to a treatment facility, ensiling is preferable, both as a method of storage and partial inactivation of pathogens
- All collected mortality should immediately be stored within sealed containers that need to be thoroughly cleaned and disinfected after use
- In net-cage/pen cultivation, conical shaped bottom nets should be used instead of flat bottom nets, as they facilitate the recovery of dead fish
- Mortality collection systems should be installed within net-pens to facilitate the regular removal of dead fish and reduce dependency upon divers
- The volume of mortality production should be recorded and all stored and transported mortality should be clearly labelled (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)

Waste underneath open cage farms in the marine environment

- Sludge underneath farms could be removed regularly

Commented [A6]: Depending on the removal technique, this might also create additional environmental impacts

Aquaculture processing wastes

- Primary (including slaughtering) and secondary processing should not take place at sea, either upon or adjacent to sea-based farm sites
- When economically and logistically practical, and when regulations allow, aquaculture processing by-products should be utilised or otherwise valorised, rather than disposed
- Wastewater discharges from processing should have minimal solid and dissolved nutrient wastes and have an acceptable biological and chemical oxygen demand
- Discharges should have characteristics that do not exceed the assimilative capacity of the environment
- BAT should be implemented to clean the processing wastes depending upon the case specific characteristics of waste and wastewater produced (e.g. flocculation and coagulation, or flotation methods should be employed to remove fats and oils, use of ozonation to inactive pathogens, biological filtration to remove solid and dissolved nutrients)
- Wastewater quality parameters should be monitored daily and fully recorded

4. Fish feed type and composition and feeding practices

A basic knowledge of aquaculture feed and feeding strategies is important for understanding how nutrient emissions from aquaculture can be minimised. This is because feed type and feeding methods influence the amount of feed that is offered to fish, the amount of feed remaining uneaten, and the proportion of nutrients within the feed that are undigested and ejected as waste. Furthermore, the supply of feed ingredients is associated with environmental impacts. Sustainable fish feed composition should be promoted to reduce the pressure on wild fish and to prevent additional nutrient discharges by optimizing nutritive requirements.

BAT/BEP is defined in the following for feeding strategies, fish feed type and composition and fish feeding practices.

Feeding strategies

- The aim should be to obtain a bFCR of close to 1:1 while considering aspects of the economic viability of aquaculture operations
- Economic food conversion ratios (eFCRs) (bFCR plus mortality and uneaten feed) should also be close to 1:1 while considering aspects of the economic viability of aquaculture operations

Fish feed type and composition

- Only certified quality feeds should be used with formulations that are easily digestible and have a nutrient profile that supports maximum retention efficiency
- The feeds need to be specific to the species being cultivated and the size/life stage of the stock
- Fish stocks should be uniform in size to improve the accuracy of size specific feed types and feeding regimes; periodic grading should be used to enable the sorting of fish into cohorts of similar sized individuals if dominance hierarchies prevent an optimal FCR from being achieved
- Trash fish (forage fish that are fed direct to carnivorous aquaculture species) should not be used as feed
- Handmade or manufactured moist feed should not be used in intensive open cultivation systems
- Fishmeal and fish-oil in the diets of carnivorous marine species should be partially replaced using alternative ingredients under the condition that this does not reduce the performance (growth, FCR) or leads to increased environmental impacts
- ‘Finishing diets,’ with higher inclusion rates of fishmeal and oil, and used for a period before harvesting, can be used if necessary
- The amount of wild fish in fish feed should be reduced and be replaced by alternative ingredients, preferably by mussel meal from mussels cultured in the Baltic Sea
- While efforts to identify novel feed ingredients are encouraged, they should not be used until their efficacy and safety as well as their environmental effects have been demonstrated
- Fish feed should use regionally sourced products as ingredients to decrease the net inflow of nutrients into the Baltic Sea region
- If wild fish is used as an ingredient in fish feed, stocks need to be harvested sustainably and it is preferable to use sustainable sources such as fish processing wastes
- Landed bycatch should not be used for fish feed production since this might counteract the pressure to minimize bycatch in fisheries

Fish feeding practices

- Feed should be stored within an appropriate environment with suitable levels of humidity and temperature to ensure that nutritional quality and palatability are maintained
- Feed bags should not be left open and unattended on fish farms, to prevent birds from eating and spilling their contents
- Feeding decisions should be made by knowledgeable and experienced staff
- While the tables provided by feed manufacturers which estimate the quantities of feed required for optimal FCR and growth rate should be followed, informed adjustments to feeding quantity and rate may be necessary
- Automated systems that improve feeding efficiency and reduce waste should be used and handfeeding should be avoided
- If possible, automated feeding systems should be equipped with underwater video technology enabling observation of feed pellet and fish feeding behaviour; methods for detecting uneaten

feed, such as infrared and doppler sensors, should also be used; video technology and sensors should be used for deciding when to stop feeding

- Integrated feeding and monitoring systems can enhance the efficiency of feeding regimes but are still under development; once they are suitable for an application at commercial scales they should be used

Issues that have not yet been addressed in this document include: certification, permitting regulations, monitoring requirements (lead Estonia) and BAT/BEP to prevent the pollution of hazardous substances, BAT/BEP for biodiversity impacts (alien species and escapees) and litter and reporting requirements for recommendation 37/7.