How to turn payments for the Ecosystem Services provided by Baltic Blue Mussel farms into reality

1. Introduction

Despite severe efforts and a decrease in nutrients flowing into the Baltic Sea, almost all of its waters are still assessed as having a bad eutrophication status. To solve this issue, **more measures are needed, which reduce nutrient inflow from non-point sources as well as nutrient content**. One option would include water-based measures such as mussel, seaweed or ascidia cultivation.

As shown throughout numerous studies, these are proven methods to effectively reduce nutrient content in the water body. Besides other positive properties, **mussels naturally filter considerable quantities of the water, consequently extracting nutrients (e.g. nitrogen and phosphorus) and hazardous substances**. With this function, mussels contribute to mitigating eutrophication and prevent harmful blooms of toxic algae.

Even though other sea-bed nutrient extraction methods are being researched (such as oxygenation of bottom sediments); **mussel farming is currently the only existing measure, which can deal with nutrient content**.

Mussel farms, which are not installed for the purpose of providing mussels for human consumption and/or as a compensation measure for nutrient load caused by fish farms, but mainly with the aim to take up nutrients in the Baltic proper, need to receive payment for this ecosystem service. As such, they just equal with other land-based measures, which are also financed through public bodies (e.g. water treatment plants; wetlands, etc.).

Such mussel farms do not only need investment support, but also long-term ongoing payments to be provided on the basis of the actual amount of nutrients taken up by them. These payments may be provided by regional, national or private actors. So far, no such operational payment scheme exists.

To fill this gap, the **EU-funded Baltic Blue Growth (BBG)** project has undertaken a study to assess possible funding sources and how they can be used to provide the necessary payment to mussel farm operators, which focus on nutrient uptake services.

"At least one benefactor paying an ecosystem service provider for the provision of the service, and there needs to be an outcome. "
Definition of Ecosystem service payment schemes
(Wunder, 2005)

2. Who should / could pay?

When talking about establishing a payment scheme to reduce eutrophication by mussel farms and to understand "who should pay", three different sources can be considered:

1. The use of public funding
2. The ''polluter pays'' principle
3. Payments by beneficiaries of the ecosystem service provided.

Public Funding Programmes

Within the European Union, several funding programmes are in place to reach the goals of the regulations and conventions.

The European Maritime and Fisheries Fund

The EMFF (2014-2020; total budget of EUR 6.5bn) provides funding for aquaculture. In particular, the EMFF aims at supporting new farmers entering the sector, as well as farmers converting to eco-management schemes.

The money can be spent on issues like innovative investments in equipment, management and advisory services, training education and certification of staff. However, **it is up to each EU Member State how to use the EMFF funds.** In Sweden, no mussel projects have so far been funded through the EMFF, despite a national priority towards increasing investments in sustainable aquaculture. In Denmark, mussel and seaweed cultivation is seen as an opportunity to reduce nitrogen, as well as being used in innovative food sectors in their operation programme.

Natural Capital Financing Facility

NCFF (2014-2021) is a financial instrument that combines financing from the European Investment Bank with EU Commission funding under the LIFE programme. With a total budget of EUR 125m, the facility provides loans ranging from EUR 2 to 15m as

well as grants for up to EUR 1m for project preparation, implementation and monitoring.

The following types of projects can be funded:

- Payment of ecosystem services;
- Green infrastructure projects;
- Pro-biodiversity and pro-adaptation businesses;
- Projects involving biodiversity offsets.

Hence, the facility could also be used for mussel farm projects.

The NCFF is so far mainly designed for larger projects and is therefore not suitable for small-scale singular mussel farm projects, but could be used in the future in for larger blue catch crop initiatives.

Other EU Funding Programmes
Other EU Funding programmes are less suitable. The European Regional Development Fund could only be used in relation to the regional development aspect, but cannot cover an on-going ES payment. Contrary, the nutrient flow reduction measures covered under the European Agricultural Fund for Rural Development are suitable, but are only open to agri- and not aqua-culture.

Polluters paying

The polluter pays principle is the general framework for internalising environmental externalities. It requires polluters (e.g. farmers using fertilisers) to take measures to reduce pollution, measure pollution and in some cases pay taxes or charges for pollution and compensate for pollution impacts.

However, for **mussel farming it is a problematic scheme to apply**: even if it seems desirable to make those who pollute, pay for measures to be taken, it may be **difficult to implement the polluter pays principle from a political point of view** as it may put an extra burden on sectors, who already have problems to compete on international markets. Moreover, it is difficult to identify all sources and polluters, so any payment scheme would probably not reach all polluters and thus be unfair. **Most importantly, it bears the danger of being understood as a replacement to the important point-source nutrient inflow reduction measures**. Polluters may simply pay for their emissions instead of changing their behaviour.

As such, it is not in line with the concept of mussel farming as an additional measure for reducing eutrophication in the Baltic Sea.

Beneficiaries paying

Another approach regarding who possibly pays for ecosystem services is to look at the different **beneficiaries of such provided ecosystem services**. With regard to mussel farms providing ecosystem services in the form of a cleaner sea, several beneficiaries can be targeted:

- **Private Philanthropic foundations** (e.g. the John Nurminen Foundation, the VELUX Foundation, the Zennström philanthropies and campaigns such as “adopt a mussel” and “oysters for life”).

- **Crowdfunding** (e.g. the Nutribute Platform, see Figure 1) which can connect nutrient abatement projects with voluntary financiers who are interested in lowering their footprint.

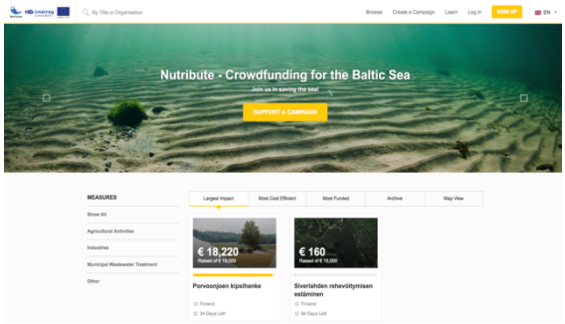

Figure 1: Homepage of the Nutribute platform.

- **Companies,** financing mussel farms **as** part of their Corporate Social Responsibility strategy or which are self-interested in lowering eutrophication to protect or improve their business, such as the tourism sector/feed industry. As such companies may also regain expenses made to mussel farms by being able to sell ‘eco’ products at a higher price.

To use beneficiaries as payers seems to be a promising approach, but requires careful design. Foundations, private persons or companies need to be convinced that mussels are indeed the best measure they can invest in, in order to receive the ecosystem services, they want.

3. Willingness to Pay

Willingness to pay surveys are a good indicator for politicians on whether the society is ready to bear the costs for services provided by mussel farms. Numerous studies have shown that there is **high willingness to pay among the general population to for the services provided by mussel farming**; especially when it comes to achieving cleaner water, avoiding algae blooms or improving fish species composition.

Motivation Tools

Additional mechanisms can be applied to motivate stakeholders to pay for ecosystem services provided by mussel farming:

- **Ecolabelling & Certification schemes**, e.g. creating a label for feed produced from mussel meals

- **A Nutrient Emission Calculator**, as established by the Finnish Environment Institute, whereby individuals can estimate their nutrient footprint and are in the following not only instructed on how to reduce emissions; but can also purchase offsets for emissions you cannot avoid. The funds thereby generated can in turn be used for offset projects.

In the United States such system has already been successfully applied at the Chesapeake Bay.

4. How much to pay for mussel farming Ecosystem Service?

As known there is a correlation between mussel growth and salinity levels: The higher the salinity level, the bigger the mussels. However, the new figures generated from the BBG pilot farms show, that mussel farms in lower salinity level; e.g. the Baltic Proper, remove only 36% less nutrients per hectare mussel farm than those situated in higher salinity level, where mussels grow up to the size suitable for human consumption. Thus, **mussel farms situated in areas where nutrient removal is most important are much more effective than previously expected**.

Farm	Location	Salinity	N / per hectare	P / per hectare
St. Anna Sweden	Baltic Proper	Moderate	1.1 t	0.045 t
Musholm Denmark	West Baltic	High	1.9 t	0.1 t

Nevertheless, costs for nutrient removal differ in view of varying investment and operational costs of mussel farms depending on their location and size. Current costs are still too high, but **costs are expected to drop substantially with more farms being installed** due to knowledge gains and better possibilities to establish a market for mussels as a resource for the feed industry.

But even under current conditions as shown in table 1 the amount which would need to be paid for a mussel farming operator, who is mainly focused on nutrient removal, is **within the range of other land-based measures**.

Measure	Costs (€/kg reduced N)
Catch Crops	0,3 – 41,6
Intercrops	7,5 – 13,7
Reduced Fertilization	15,7 – 27,1
Buffer Zones	9,9 – 34,9
Set Aside Farmland	20 – 69,7
Mussels	13 – 42

Table 1: Comparison of mussels with other measures for nutriments reduction.

But as can be seen from the table, not only costs for mussel farming vary, also costs and benefits for land-based abatement measures are not linear. They depend for instance substantially on the variable 'land availability'. As shown in Figure 2 below the costs for land-based measures used to reduce nitrogen and phosphorous increase exponentially the closer one gets towards achieving BSAP goals. Thus, mussel farming may in certain areas also be the more viable cost-effective option compared to any other measure.

This is even though the table compares land-based with mussel farming as the only sea-based measure. Other sea based nutrient extraction methods may in the long run be more cost effective. However, all of them are at experimental stage only; any costs associated are highly speculative and possible negative impacts are not yet fully known.

It is reasonable to consider mussel farming as an additional measure for nutrient extraction also from a cost-effectiveness point of view.

5. How to provide the ecosystem services payment to mussel farms?

The related ES payment scheme for mussel farms should consider the following aspects:

Responsibility: Chose the right policy level (EU/National vs Regional/Local)

Criteria for Payments: Reward for providing the ecosystem service needed; e.g. payment should be related to the calculated average amount of nutrients taken out of sea – measured through an agreed monitoring system.

Different schemes for different costs:

- Investment costs: Provide support for the set-up of farms; development of equipment, site selection, payment systems, e.g. through EMFF, private foundations or crowdfunding

- Operational Costs: but ensure an ongoing outcome-based payment system for mussels harvested
- Downstream (mussel processing, storage and transportation) costs: To be covered by "users" of mussels.

Ways of covering operational costs:
The following methods may be used for covering the cost for mussel farmers

- **General subsidy**: The funding agency determines the maximum amount each farmer receives.
- **Scored Subsidy**: Scores are provided for various characteristics such as location, biodiversity or growth rates. The service provider with best scores is ultimately chosen (see above varying costs of abatement measures).
- **Reverse auction with fixed cap**: The sellers of mussels related ecosystem services "bid" on a per unit price for e.g. nutrient removal, with the maximum payable amount determined by buyer.

The reverse auction system may be the best in view of distributing the risk of the actual ES delivery between buyer and seller.

6. Conclusions

To ensure good environmental status in the Baltic Sea, we highly recommend considering mussel farming as an additional measure. Existing international or EU directives and regulations do not prohibit mussel farming. Mussel farming operators should receive a payment for the provision of the ecosystem service.

The analysis of existing public funding sources identifies the EMFF as most promising fund so far. However, the national operational programs decide for what measures the funding will be used, so the actual support for mussel farming needs to be decided on a national/regional level. The EMFF rather provides project funding and no institutional funding. **The EMFF may therefore be the right source to be used for further investments** into mussel farms, site selection schemes, training as well as testing of payment schemes.

To safeguard the necessary ongoing ecosystem services payments a scheme based on payments by beneficiaries seems most appropriate.

One possibility to motivate beneficiaries to pay, is to **install ecolabelling or certificates to buy the products produced in the mussel farm**. Another means to raise awareness is the **nutrient emission calculator, to make the user aware of his/her own nutrient footprint** and to **suggest paying for ecosystem services afterwards**.

Any schemes based on the polluter pays principle holds the risk of mussel farms being used to limit other nutrient point source reduction measures. **Only schemes, where mussel farming is seen as an additional measure or only possible further measure, should be supported**.

The **payment should be based on the effective ecosystem service that mussel cultivation and harvest provide.**

Based on the finding of the BBG project farms, the **cost-efficiency of mussel farming for nutrient uptake is on a medium level compared to other measures** depending on the location factors. The nutrient uptake efficiency of farms being based in low salinity levels is only 36% less as compared to those based in high salinity levels.

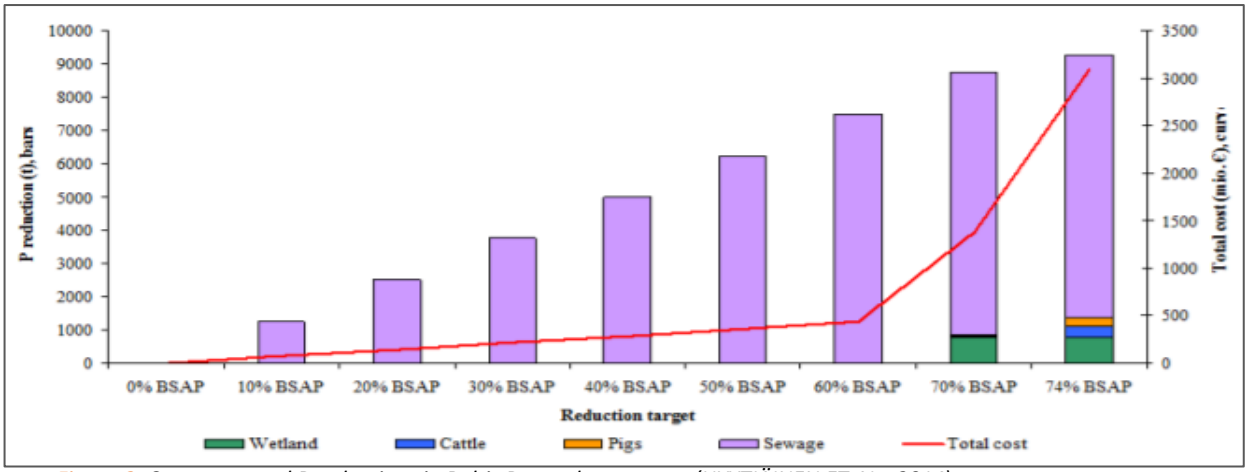

Figure 2: Cost-curve and P reductions in Baltic Proper by measure (HYYTIÄINEN ET AL., 2014).

There is currently a good time to induce policy change – showcase BBG results

- Refer to UN SDG 14 "Conserve and sustainably use the oceans, seas and marine resources for sustainable development"; explicitly mention that mussel farms are a contribution to both living seas and coasts.
- Some EU-wide operational programmes are currently under revision: now is the time to influence decision-makers and for them to take actions. This does not only relate to Directives such as WFD or MFSD, but also the funding programmes. Here not only the EMFF is relevant, but also the restructuring of the European Agricultural Fund for Rural Development.
- Baltic Region programmes and strategies such as the HELCOM Baltic Sea Action plan, the EU Strategy for the Baltic Sea region and BONUS & INTERREG are currently reviewed and updated; sea-based measures dealing with nutrient content are considered to be included. It is now for the BBG and resulting mussel community to communicate the projects' results and lobby for such measures to be included, accepted and highlighted. HELCOM and its EU Member States should then in turn lobby on a European level.

Mussel farms need to be officially accepted as an additional measure at given sites to reduce nutrient load and thus being part of the accepted mix of supported abatement measures.

- Support needs to be provided for mussel farms to get 'certified' to be an ecosystem service provider.
- While payments should be based on quantifiable parameters such as P/N uptake or water clarity; a clear, easy, common and cost-efficient monitoring & evaluation scheme should be adopted to showcase these positive impacts to the public.
- The payment would primarily cover the mussel production costs. Investment / set up costs are separate costs that could be covered by grants
- Payments should be at least equal to that given to land-based measures.

Mussel farming can be included in a cost-effective abatement mix.

- Compared to other measures it is in the mid-range in terms of costs –and even has positive externalities
- In some instances, land-based measures are not possible or too costly due to e.g. lack of land. This strengthens the case for mussel farming as a mitigation measure.
- For sea-bed measures there is currently n alternative anyway: Other sea-based measures are all only at experimental stage – with real costs being speculative and negative impacts not yet fully known.

Ensure that incentives to reduce nutrient are not impeded

- Nutrient trading as a scheme is worth considering: But any scheme involving offsetting has to ensure that restrictions on nutrient polluters (e.g. agriculture) remain as strict as before

Examine the financial instruments, which are already available in the region / country.

- The EMFF may already be used for mussel farming or may be easily restructured in such way.
- Mussel farms should receive public support (e.g. by EMFF) as a reflection of the higher costs related to the fact that mussel farms are still first movers and thus far from being standardized.
- The EMFF can be used to lower the overall production costs by providing support to the investments related to the establishment of the farm; but also, other supporting activities.

Provide support to overcome 'first movers' to reach critical mass

- The more mussel farms are established, the lower their cost and the higher the additional positive services provided by the mussels produced; e.g. as an alternative protein source for the feed industry. Any future public or private support schemes should also provide support and forum to mussel farms to set up cooperative solutions for joint use of infrastructure and collective supplier to a given feed industry.
- Public funding programmes may also be used as to support the system design of payment schemes based also on donations from companies or foundations; which are in turn linked to benefits gained by those in view of showing corporate or regional social responsibility.

A payment scheme in which the benefactor pays is a good alternative for success.

- There is a clear willingness to pay for clearer water among the population in Baltic Sea countries, which politically justifies payment scheme for mussel farming
- Benefactors may be individuals, private foundations, enterprises as well as regional authorities.
- Beach house owner / hotels / tourism benefit from clearer water and could pay a small tax or fee for the ecosystem service provided by mussel farmers.
- Alternatively, also other enterprises may integrate the funding of a mussel farm to their Corporate Social Responsibility programme.

Go local (or regional) backed by national support

- In short run, there is a much higher possibility implement an ES payment on a local / regional level, particularly when involving local stakeholders in a coordinated effort to influence national policy

- It is, anyhow, a case by case decision, on whether a mussel farm is the best additional measure in a given place depending on how effective and feasible any other land-based measures would be
- A Baltic-wide approach is theoretically desirable but very difficult to implement
- Reforms at EU level are happening but will take time with the outcome being uncertain. However, also for many EU directives and funds decisions are taken on national level; and in many cases already possible

Let the beneficiary be the owner or buyer of the services of the mussel farm

- Set up a scheme where the municipality / region and/or private foundation/donor enterprise is the owner of the farms or guaranteed buyer of the services - but a private company or organization is the operator, responsible for running the farm and for marketing.
- In such way create a good mix of responsibilities and risk sharing.

Mussel farm operators have to organise themselves as to speak with one voice!

THE PROJECT

This factsheet has been elaborated by the Baltic Blue Growth project. The aim of Baltic Blue Growth is to advance mussel farming in the Baltic Sea from experimental to full scale to improve the water quality and to create blue growth in the feed industry. 18 partners from 7 countries are participating, with representatives from regional and national authorities, research institutions, private companies. The project is coordinated by Region Östergötland (Sweden) and has a total budget of € 4.7 million. It is a flagship project under the Policy Area "Nutri" of the European Union Strategy for the Baltic Sea Region (EUSBSR).

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