

## Mussel Farming Costs in the Baltic Sea

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| Published (date)             | 30 October 2018  |
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| File name                    | Mussel Farming Costs in the Baltic Sea Different Sites |

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## Introduction

The information on mussel farming costs in the Baltic Sea is based on data from mussel farms, established within the project 'Baltic Blue Growth', except Kumlinge, Finland. Data is obtained based on interviews with mussel farmers and information is gathered from 6 different mussel farming sites located in the Baltic Sea:

- Kumlinge, Åland, Finland
- Kalmarsound, Västervik, Sweden
- Kalmarsound, Hagby, Sweden
- St. Anna, Sweden
- Kiel, Germany
- Pavilosta, Latvia.

Mussels in these sites were mostly farmed / grown for scientific purpose, and based on obtained results it was found out that water transparency around mussel farms has increased.

Mussel farms were created to find out the possibilities of applying different technologies in the Baltic Sea, as well as to obtain results that would allow the evaluation of the costs of shellfish farming, as well as to assess changes in the different cost positions, changing location, the purpose of the mussel farming, technology and conditions.

This document is prepared by collecting information from different mussel farming areas in the Baltic Sea. It includes information on specific technology costs at the particular site of cultivation, at the particular time of growth. The weather conditions in 2016, 2017 and 2018 have differed, which slightly affected the cost.

The information obtained within the project allows a potential stakeholder to evaluate which methods have yielded results in a given location.

More successful results were obtained from the places where experienced mussel breeding experts were involved in the development of the farm.

It is important to admit that in the Baltic Sea where salinity is less than 10 PSU the harvested mussel amount was 5-10 times smaller in comparison to mussel farming places in other parts of the world. This directly affects the costs because the yield is significantly lower.

Mussel farming cost positions has been described more detailed in the project "Baltic EcoMussel" by Z.Ozolina, S.Barbale, Z.Fricsons (representing Latvian Environmental Investment Fund) [http://www.kurzemesregions.lv/userfiles/files/Baltic\\_EcoMussel\\_Final\\_Report.pdf](http://www.kurzemesregions.lv/userfiles/files/Baltic_EcoMussel_Final_Report.pdf)

In order to provide a larger amount of harvested mussels, it is crucial to evaluate planned mussel farming site, potential harvesting amount and investment.

## 1 Production cost

Production costs are one of the most important factors for a successful business. Production costs include labor costs, raw materials, manufactural supplies, etc.

Production costs vary based on mussel farming aim, chosen technique, site and other factors.

In this document production cost calculation includes one cycle of mussel farming activity - from the establishing till harvesting / or post – harvesting period. The cycle varies from 5 months to 30 months, it depends on mussel growth rates in specific site and aim of the mussel farming.

Production costs were spilt as follows:

- Maintenance cost
  - Fuel cost
  - Extra materials (e.g. extra ropes, loops, weights, buoys)
  - Salaries and social taxes
  - Taxes, licencing
  - Monitoring costs (in specific sites, e.g. laboratory test, diving service etc.)
- Harvesting cost
  - Fuel cost
  - External service cost
  - Salaries and taxes
- Post - harvesting cost
  - Salaries and taxes
  - Transportation cost
  - Packaging cost
  - Other costs

Based on mussel farming aim, the maintenance cost might be very small one, especially in places where nets are used, because the lines with nets are not suitable for lifting up mussel farm for observation (not taking into account costs spent on technical issue maintenance). However, harvesting cost for nets usually are higher if comparing with the costs in places where ropes where used.

### *Extra production costs for producing human consumption mussels:*

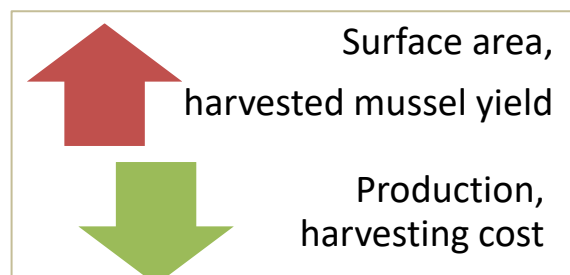
- Maintenance of mussel farm requests **extra time for socking** and preparing mussels for sale.
- **Monitoring and sampling** – in several countries the legislation requests laboratory analysis of water where mussels are farmed which should be covered by mussel farmers. Before harvesting farmer might collect samples to evaluate the quality of mussels according to food safety regulations.

### *Extra sales costs for producing human consumption mussels:*

- Direct sales involve **extra labour time** for preparing and working with customer, also for preparing the production for sales.

- **Preparing for sales** request extra time and expenses. Sales cost position might include not only costs for preparing direct sales materials, but also transportation costs, salaries and taxes for sales person, presenting materials etc. It might include packaging costs, cost for participation in exhibitions, etc.
- **Distribution** of product might be covered from mussel farmer budget as well.

If mussel farming in a certain site aims to increase water transparency and reduce nutrients, the business target is to get the maximum yield from the certain area with the minimum costs as possible.



*Table 1 Production costs per harvested amount using different mussel farming techniques in different places in the Baltic Sea*

| Technique                                      | Maintenance cost, EUR/kg | Harvesting cost, EUR/kg | Post – harvesting cost, EUR/kg | Total production cost EUR/kg |
|--|--------------------------|-------------------------|--------------------------------|------------------------------|
| Fuzzy rope (production cycle 12-18 months)     | 0.10-0.20                | 0.08-0.16               | 0.03-0.04                      | 0.21-0.40                    |
| Collector rope (production cycle ~18 months) * | 0.35                     | 0.09                    | 0.06                           | 0.50                         |
| Nets (production cycle ~6 months)              | 0.19                     | 0.18                    | 0.03                           | 0.40                         |
| Nets (production cycle 24-30 months)           |                          |                         |                                | 1.00-5.00                    |

\* Information is prepared based on interviews with the mussel farming experts and a mussel farmer, and includes prediction.

Fuzzy rope provides the biggest surface for mussel collection, so it allows to reduce production costs, and the costs are 0.21 EUR/kg, applying them on growing period - 18 months.

Collector rope also provides good outcome. Production cost is higher in comparison to fuzzy rope. Mussel farmer need time for visiting mussel farm and due to smaller mussel weight (outcome), the costs are higher in comparison to fuzzy ropes.

In the mussel farms with nets technique the production costs were fluctuated.

Using nets as a technique in different places showed the highest production costs. Several mussel farming sites suffered due to weather conditions, also some mussel farmers rented harvesting equipment, therefore the costs have increased. Also it was observed that surface area of rope in net was smaller and therefore the harvested mussel weight was lower as well.

To reduce production costs, it is critical to evaluate time which is spent on mussel farm doing maintenance and harvesting.

## 2 Investment plan and cost

The concept of investment is wide and difficult to define. In the perspective of macroeconomic theory, the whole flow of funds that is not intended for consumption is considered as an investment. On the other hand, in business, this concept is broader and more comprehensible to people - investments are considered a capital investment method that ensures the maintenance or increase of capital value (read - profit).<sup>1</sup>

Investing in tangible assets, mussel farmer plans to receive a benefit in the future, therefore, investments must be planned, well-thought out, targeted with estimated profit in the foreseeable future.

Equipment which should be included in investment plan, should be intent to hold for more than a year.

The investment amount depends on:

- Site specification – size of farm, site distance till harbour, boat specification, harvesting solutions etc.
- Customer requirements (product delivery options - size, packaging, transportation, etc.)
- Sales strategy - direct or indirect delivery, product packaging options, etc.
- Other factors (available equipment, port equipment and requirements, etc).

The mussel farmer might choose to obtain new or used equipment, or to use already existing equipment.

Investment cost includes – ropes, buoys, anchors, harvesting equipment, boats, lifting equipment, etc.

### *Extra investment costs for producing human consumption mussels:*

- **Socks** – mussel farmer invests in socks which allows to return small mussels back in water and continue growing till they reach marketable size.
- Specific **harvesting equipment**, like grader, declumpers, etc.
- **Investment in packaging** and sales involved equipment, e.g. specific packaging, obtaining trade area etc.

### *Intangible assets include:*

- Licencing cost;
- Trademark cost;
- Branding cost.

None of mussel farm farmers that have located their farms in the Baltic Sea have invested in trademarks or brands, etc.

Licencing process is site specific task, and usually mussel farmer pays for licencing every year, so these costs should not be included in this position.

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<sup>1</sup> <https://www.makroekonomika.lv/investiciju-abece-veidi-ietekme-vide-un-situacija-latvija>

Licence which has to be obtained for several years might be included in this position.

#### *Extra investment in intangible assets for producing human consumption mussels:*

Mussels farming for human consumption includes several extra investments in this position – targeted marketing activities, e.g. branding, trademark cost, specific programs.

#### *Pre – stage mussel farming costs*

Mussel farmer should obtain certain area in the sea or get permission to start mussel farming. The costs for licencing or obtaining an area are very different in each country, starting from 0 EUR and up to several tens of thousands EUR.

Mussel farmers, which are going to sell mussels for human consumption, should go through more specific and complicated licencing process which may be cost- intensive.

Research farms might obtain licencing for free or for lower cost.

For example, in Latvia to obtain mussel farming area in NATURA 2000 site or close to it, the investor (probable mussel farmer) should assess environmental impact of mussel farm on this territory. The Environmental Impact Assessment (EIA) costs are more than 20 000 EUR.

At the same time the assessment of environmental impact in the specific site does not provide mussel farmer with permission to start mussel farming.

#### *Investment costs*

*Table 2 Investment cost in EUR in different mussel farming places in the Baltic Sea*

| <b>Technique</b>             | <b>Total Investment, EUR</b> | <b>Investment per collector rope m, EUR/m</b> | <b>Amortization, depreciation (servicing) period</b> |
|------------------------------|------------------------------|---|--|
| Fuzzy rope                   | 20000-157000                 | 6.5-12.1                                      | 5-20   |
| Sizal or other similar rope* | 100000                       | 1.5-3.0                                       | 5-20   |
| Nets                         | 37000-78000                  | 3.2-12  | ~10  |

\* includes prediction

The amount of investment differs from one technique to another. It can be analysed, also for each collector rope meter.

In this calculation, the following technique was applied, the amount of investment was attributed to the collector rope. Such a calculation allows us to estimate the investment cost ratio to the potentially obtainable volume, which results in high costs for Fuzzy rope costs and sizals.

Net costs are significantly higher for the following reasons:

- The net volumes acquired are relatively small, so the costs remain high;
- Harvesting techniques are relatively expensive;
- Outsourcing is used to create farms, which adds cost to 1 unit.

When comparing ropes and buoys used for mussel farming, it was found that many fishing gears are not suitable for them. It should be noted that it is essential for mussel farming to be able to maintain

a certain amount of harvest that would be able to generate income, which is why it is crucial to maintain wider surface.

An important condition for the use of appropriate equipment is its long-term presence in water, therefore, based on expert recommendations, metal objects are not suitable for mussel breeding, because they are more likely to corrode in water, but the ropes are capable of maintaining durability for more than 20 years.

The lifetime of the equipment was determined for each one separately, based on the recommendations of the growers.

There are ropes that have a lifespan of 5 years, but there are also ropes with a life span of 20 years.

Here it should be noted, however, that serving time is evaluated in the light of its goals and objectives, as well as materials such as polysteel ropes with a diameter of more than 20 mm.

Investment by obtaining fuzzy ropes are enough high but also the mussel weight on these ropes will be higher.

Sisal ropes are common in Canada and Denmark for mussel farming and collector ropes as well. In Canada they have used sisal ropes for more than 20 years.

Polysteel ropes are used in more extreme weather conditions, and they are used as top ropes and securing ropes.

Investment costs should be calculated very carefully, because it was ascertained that costs for thicker rope might exceed the outcome.

*Table 3 Example of rope size, price and mussel weight attribution to cost<sup>2</sup>*

| Type of rope | Size of rope, mm | Prognosed mussel weight, kg/m | Price of rope, EUR/m | Cost, EUR/kg |
|--------------|------------------|-------------------------------|----------------------|--------------|
| Sisal rope   | 8                | 0.6 kg                        | 0.40                 | 0.67         |
| Sisal rope   | 32               | 2.6 kg                        | 5.50                 | 2.12         |

By purchasing more expensive material, the volume of mussels does not grow as fast as the price of a rope, so in this example it can be concluded that the most expensive rope does not provide an adequate yield.

It was observed that transportation cost for delivering of equipment is possible to reduce if the ropes are ordered for several mussel farmers, therefore cooperation between the mussel farmers is advisable.

<sup>2</sup> <https://www.ropesdirect.co.uk/sisal-rope-by-the-metre.html>

### 3 Financing, research cost

Financing cost is cost for attracting financing, like interest rate, etc.

Research costs appear when mussel farmer decides to do some research or study, e.g. before the development of new mussel products. During the project implementation period these costs were not applied.

Financing and research costs are not included in these project calculations, but for real business it might reach 3- 5% from investment costs, depending from the available financing.

### 4 Conclusion

On the basis of the obtained information it appears that the cultivation of mussels in the Baltic Sea represents a rather high cost.

*Table 4 Total cost of mussel farming in the Baltic Sea, EUR/kg*

| Technique          | Production cost<br>EUR/kg | Investment cost<br>EUR/kg | Financial cost,<br>EUR/kg | Total cost,<br>EUR/kg |
|--------------------|---------------------------|---------------------------|---------------------------|-----------------------|
| <b>Fuzzy rope</b>  | 0.21-0.40                 | 0.10-0.33                 | 0.00                      | 0.50-0.54             |
| <b>Sizal rope*</b> | 0.50                      | 0.50                      | 0.00                      | 1.00                  |
| <b>Nets</b>        | 0.40                      | 0.22                      | 0.00                      | 0.62                  |
| <b>Nets</b>        | 1.00-5.00                 | 0.3-2.00                  | 0.00                      | 1.30-5.50             |

\* includes prediction

The obtained results indicate that costs can either increase or decrease due to changes in certain circumstances such as environmental conditions, weather conditions, available equipment, etc.

In order to estimate costs, it would be advisable to monitor them over a longer period of time, thus, obtaining more data and allowing to monitor changes in costs for a longer time period.

It was observed that in salinity 6-10 PSU, in growth period of 14-18 months mussel size and weight has the most increase in Eastern Baltic Sea, where mussels reached size of 2-3 cm in 18-24 months period (Annex 1).

Due to limited project implementation period, it is not possible to continue observation of ratio between mussel growth and costs.

Project is limited in time and resources, and therefore also the costs shown in this document are for the limited amount of mussel farm sizes and harvested amounts, some farms did not plan harvest at all. When planning the mussel farm for a business, it should be taken into account that increase planned production amount of mussels can save up to 40% of costs.

Support (e.g. EU or national funding) can be motivating factor to develop mussel farming.



## 5 Annex

Calculation of Net present value, based on harvesting results in certain growth periods (months), example from mussel farm located in St. Anna

|                        | Period 0 | P1   | ... | P18    | P19  | P20  | P21  | P22  | P23    | P24  | P25  | P26  | P27    | NPV     |
|------------------------|----------|------|-----|--------|------|------|------|------|--------|------|------|------|--------|---------|
| Harvested amount, kg   | 0        |      |     | 15540  |      |      |      |      | 71000  |      |      |      | 15540  |         |
| Cash flow, months - 18 | -13 718  | -901 |     | 14 639 |      |      |      |      |        |      |      |      |        | -15 901 |
| Cash flow, months - 19 | -14 481  | -901 |     | 14 639 | -110 |      |      |      |        |      |      |      |        | -16 668 |
| Cash flow, months - 20 | -15 243  | -901 |     | 14 639 | -110 | -110 |      |      |        |      |      |      |        | -17 434 |
| Cash flow, months - 21 | -16 005  | -901 |     | 14 639 | -110 | -110 | -901 |      |        |      |      |      |        | -18 468 |
| Cash flow, months - 22 | -16 767  | -901 |     | 14 639 | -110 | -110 | -901 | -901 |        |      |      |      |        | -19 487 |
| Cash flow, months - 23 | -17 529  | -901 |     | 14 639 | -110 | -110 | -901 | -901 | 70 099 |      |      |      |        | 1 523   |
| Cash flow, months - 24 | -18 291  | -901 |     | 14 639 | -110 | -110 | -901 | -901 | 70 099 | -901 |      |      |        | 531     |
| Cash flow, months - 25 | -19 053  | -901 |     | 14 639 | -110 | -110 | -901 | -901 | 70 099 | -901 | -901 |      |        | -448    |
| Cash flow, months - 26 | -19 816  | -901 |     | 14 639 | -110 | -110 | -901 | -901 | 70 099 | -901 | -901 | -901 |        | -1 415  |
| Cash flow, months - 27 | -20 578  | -901 |     | 14 639 | -110 | -110 | -901 | -901 | 70 099 | -901 | -901 | -901 | 14 639 | 1 593   |

Calculation of Net present value, based on harvesting results in certain growth periods (months), example from mussel farm located in Pavilosta

|                  | Period 0 | P1 | ... | P12   | P13   | P14   | P15   | P16   | P17   | P18   | P19   | P20   | P21   | NPV |
|------------------|----------|----|-----|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-----|
| Harvested amount |          |    |     | 14945 | 19743 | 26643 | 33195 | 44158 | 57405 | 63146 | 63146 | 63146 | 63146 |     |

|                        |         |        |  |        |        |        |        |        |        |        |        |        |        |          |
|------------------------|---------|--------|--|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----------|
| Cash flow, months - 12 | -8 630  | -1 110 |  | 13 835 |        |        |        |        |        |        |        |        |        | -7 647 € |
| Cash flow, months - 13 | -9 349  | -1 110 |  | -1 110 | 18 633 |        |        |        |        |        |        |        |        | -6 846 € |
| Cash flow, months - 14 | -10 068 | -1 110 |  | -1 110 | -1 110 | 25 533 |        |        |        |        |        |        |        | -5 221 € |
| Cash flow, months - 15 | -10 787 | -1 110 |  | -1 110 | -1 110 | -1 110 | 32 085 |        |        |        |        |        |        | -4 023 € |
| Cash flow, months - 16 | -11 507 | -1 110 |  | -1 110 | -1 110 | -1 110 | -1 110 | 43 048 |        |        |        |        |        | -1 133 € |
| Cash flow, months - 17 | -12 226 | -1 110 |  | -1 110 | -1 110 | -1 110 | -1 110 | -1 110 | 56 295 |        |        |        |        | 2 308 €  |
| Cash flow, months - 18 | -12 945 | -1 110 |  | -1 110 | -1 110 | -1 110 | -1 110 | -1 110 | -1 110 | 62 036 |        |        |        | 2 319 €  |
| Cash flow, months - 19 | -13 664 | -1 110 |  | -1 110 | -1 110 | -1 110 | -1 110 | -1 110 | -1 110 | -1 110 | 63 036 |        |        | 403 €    |
| Cash flow, months - 20 | -14 383 | -1 110 |  | -1 110 | -1 110 | -1 110 | -1 110 | -1 110 | -1 110 | -1 110 | -110   | 63 036 |        | -1 455 € |
| Cash flow, months - 21 | -15 102 | -1 110 |  | -1 110 | -1 110 | -1 110 | -1 110 | -1 110 | -1 110 | -1 110 | -110   | -110   | 62 036 | -3 598 € |