



cool blue: baltic

Data-Sharing Network



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List of Abbreviations:

ROF regenerative ocean farming
CAPEX capital expenditures
OPEX operational expenditures
BRUV baited remote underwater video
PAM passive acoustic monitoring
eDNA environmental DNA



Executive summary

Regenerative Ocean Farming (ROF) is an emerging approach to sustainable aquaculture that offers multiple environmental and socio-economic benefits, including nutrient absorption, habitat restoration, and job creation for coastal communities. While not yet established in all Baltic Sea countries, its potential is significant. Effective monitoring and data exchange are essential to support its growth, improve regulatory frameworks, and ensure environmental sustainability.

This report focuses on low-cost monitoring solutions and a data-sharing network to consolidate and exchange ROF-related data. To assess the needs and challenges of ROF monitoring, we conducted a survey among project partners, gathering insights on the ecological, economic, and social impacts of ROFs, essential operational data, and relevant data-sharing platforms. The results emphasize the need for standardized environmental and socioeconomic indicators, cost-effective data collection methods, and structured data-sharing approaches to improve farm management, support licensing processes, and enhance stakeholder collaboration.

As part of this report, we present survey findings, practical low-cost monitoring methods, and real-world case studies from Cool Blue partners. These insights provide guidance for farmers, researchers, and policymakers, helping to improve farm performance and potentially support new licensing applications. By expanding access to monitoring tools and data, this initiative strengthens the viability of ROF in the Baltic Sea and beyond.

The report is structured into three main parts:

1. **Survey results** – insights from project partners on ecological, economic, and social data needs, essential farm operations data, and data-sharing opportunities.
2. **Low-cost monitoring and data-sharing options** – practical and affordable tools for tracking farm performance and environmental impacts.
3. **Real-world examples** – case studies from Cool Blue partners implementing ROF monitoring and data-sharing initiatives in the Baltic Sea.

Together, these elements provide a foundation for expanding ROF through accessible and standardized monitoring practices, ensuring that ROF can be developed in a way that is both economically viable and ecologically beneficial.

Disclaimer: Due to limited data, the online dashboard as described above was not implemented at this time. Rather, this deliverable can be seen as a detailed plan of what to include and how to implement such a data-sharing network for small-scale ROF practitioners. Farmers will be encouraged to make use of existing databases to ensure their observations and measurements are recorded and accessible.



Background

As defined in the Grant Agreement, the Data-sharing network: Refers to a framework through which initially project partners, and later self-sustaining ROF communities can share data (e.g. real-time water quality parameters from a specific site) in order to monitor the environmental effects of ROF activities. Data includes ecological indicators such as biodiversity, pH, temperature, light, turbidity, salinity, dissolved oxygen, nutrient levels, dissolved carbon and any other relevant parameters.

The Cool Blue Data-sharing Network (KER4) would result from input from co-assessment workshops and exploitation events, with adjustments for regional and regulatory contexts, and refined through partner feedback. Its creation involves mapping existing data-sharing networks and monitoring methods, establishing standardised measurements, equipment, and protocols for low-cost, smart monitoring of regenerative aquaculture sites, and building an online dashboard for stakeholders to upload environmental data, providing regular or real-time insights. This data will support licence applications under KER1 and may later include socio-economic indicators to assess socioecological performance and resilience, while aligning with databases such as BlueBioClusters and BlueMissionBANOS to consolidate and maximise the impact of monitoring efforts.

Results of the survey

To better understand the key data needs and challenges related to ROF, a survey was conducted among Cool Blue Baltic project partners. The survey focused on identifying the ecological, economic, and social impacts of ROFs, as well as the essential data needed for farm operations and potential data-sharing platforms. The responses highlight the importance of accessible, standardized monitoring methods and the need for a structured data-sharing approach to support farm development, licensing, and long-term sustainability. The survey with full answers can be found in D2.2 Cool Blue Baltic Regenerative Action Plan.

What data is needed to show the ecological impacts of community farms?

Measuring the ecological impact of ROFs requires a combination of low-cost, frequent monitoring by farmers and high-tech, periodic assessments by regional or national authorities. Ecological parameters to measure include:

- Water quality (temperature, salinity, oxygen levels, pH, nutrients, chlorophyll a)
- Biodiversity and benthic impacts (species monitoring, habitat changes)
- Nutrient and carbon absorption vs. harvest volumes
- Waste management and emissions

Monitoring should be conducted before, during, and after farm operation. Local authorities could support assessments using eDNA and seafloor observatories, with potential for citizen science involvement to expand data collection.

What data is needed to show the economic impacts of community farms?

To assess the economic impacts of community farms, key data points include harvest volumes and market value, as well as the local jobs and income generated to evaluate profitability. Tracking capital expenditures (CAPEX) and operational expenditures (OPEX) is essential for understanding financial sustainability, along with identifying market channels that connect products to consumers. Additionally, data on subsidies and grants can provide insight into financial support mechanisms. Establishing baseline economic data prior to farm setup allows for meaningful comparisons over time, particularly in relation to conventional aquaculture and agriculture. Finally,



tracking establishment and decommissioning costs helps measure the full financial lifecycle of community farms, informing future investment and policy decisions.

What data is needed to show the social impacts of community farms?

Measuring the social impact of community farms requires data on public access, participation rates, demographics, and volunteer involvement. Tracking revenues in local businesses, dietary impacts, and educational offerings highlight economic and knowledge-sharing benefits. Community engagement metrics, such as local cooperation, events, and qualitative feedback, provide insights into social cohesion. Additionally, data on mental health benefits, food diversity, and accessibility ensure inclusivity and broader societal impact.

What data do seafarming communities need to help the operation of the farm, and how can they collect it in a simple, affordable, robust way?

Seafarming communities need water quality data (temperature, salinity, pH, dissolved oxygen, and nutrients) collected through affordable test kits, low-cost sensors, and public weather data. Farm health and growth tracking can be done via photographic records and simple logs, while biodiversity and environmental impacts can be monitored with the help of divers, underwater cameras, and sensors. Farm layout maps, maintenance logs, and equipment tracking support operational efficiency. Financial management can be improved using affordable accounting software, and regulatory compliance can be streamlined with checklists, mobile apps, and training workshops. Collaborating with universities, research institutions, and local authorities can provide access to advanced testing, contaminant analysis, and designated regulatory contacts.

To begin, check whether your country is part of the Cool Blue Future network and whether a facilitator is available to help you connect with the right contacts and access the necessary information. Cool Blue Future is a network of country facilitators across Northern Europe, working both individually and collaboratively to advance regenerative ocean cultivation. Their efforts align with the principles outlined in the Manifesto for Regenerative Ocean Farming, ensuring a sustainable and ecosystem-friendly approach.

Find the contact details for country facilitators here: <https://coolbluefuture.org/country-facilitators/>

Please list any relevant national or transnational data platforms here (e.g. EMODNet)

Lithuania: The Open Data Portal is a single point of access to all open datasets in Lithuania: <https://data.gov.lt/>

Sweden: SHARK SharkWeb (smhi.se), SGU Marin miljöövervakning (sgu.se), VISS Välkommen till VISS (lansstyrelsen.se), Dryad Dryad (datadryad.org)

Poland <https://www.findfish.pl/>

Estonia: EELIS (Estonian Nature Information System) offers environmental data <https://infoleht.keskkonnainfo.ee/artikkel/1525036761>, KESE (database of environmental data collected under the National Environmental Monitoring Programme and related environmental research projects) <https://kese.envir.ee/kese/welcome>

Germany: Dataportal for German coastal waters: <https://deutsche-kuestenforschung.de/datenportal.html>

Any other ideas, comments or suggestions?



Danish partner, Havhøst, plans to enhance its educational platform, *Haven i havet*, by introducing a citizen science module. This initiative will involve school classes from 18 locations across Denmark, enabling students to contribute marine environmental data to a centralized database. The platform will offer various data views and comparative tools to enrich the educational experience.



Monitoring – How to monitor your site

This part of the report will also serve as a lesson on monitoring at CoolBlueFuture.org website.

Regenerative ocean farming (ROF) is a sustainable aquaculture approach that cultivates seaweed and shellfish without inputs like feed or fertilizer, enhancing marine biodiversity, improving water quality, and sequestering carbon. Monitoring ROF is important for ensuring sustainability, preventing overharvesting, and assessing ecological benefits like nutrient cycling, carbon sequestration, and biodiversity restoration. It also helps improve farming techniques for better environmental and economic outcomes. In the Baltic Sea, ROF is expected to play a key role in reducing eutrophication by absorbing excess nutrients, restoring habitats, enhancing marine biodiversity, and providing sustainable seafood and alternative income for coastal communities.

Low-Cost Monitoring Methods

Monitoring can be done effectively with a mix of simple and advanced tools. Here are practical and affordable ways to track your farm:

1. Visual Inspections

- **Regular Boat Checks** – Use a small boat or kayak to inspect your farm weekly for damage, entanglements, or missing lines.
- **Underwater Camera** – A GoPro or waterproof phone case with a pole-mounted or tethered camera helps check mussel and seaweed health and farm infrastructure.
- **Snorkeling or SCUBA diving**
- **Underwater drone (such as Chasing M2 S 200m)**

2. Monitoring water quality and growth-supporting variables

Some environmental variables, such as salinity, nutrients, and food availability, help explain and predict seaweed and mussel growth, while others, like Secchi depth and turbidity, are useful for tracking the positive outcomes of ROF activities.

- **Simple Test Kits** – Use low-cost kits to measure salinity, temperature, dissolved oxygen, dissolved nutrients (e.g., nitrogen, phosphorus) and pH.
- **Floating Sensors** – Deploy floating buoys with sensors for salinity, temperature, available light, turbidity and phytoplankton (chlorophyll a) such as [HOBO Pendant Temperature/Light 64K Data Logger](#).
 - Smart Buoys (e.g., OpenCTD, Arduino-based sensors)
 - Thermometers (digital or analog)
- **Secchi Disks** (manual water clarity checks)

3. Growth Tracking

- **Marking Ropes or Ruler**– Attach markers at fixed intervals on growth ropes to track growth over time.
- **Photo Documentation** – Take weekly or biweekly photos to monitor growth, detect diseases, bleaching, or fouling organisms. Including a measurement scale in the images helps accurately assess organism size.
- Grazing pressure and epiphytic cover for algae.
- **Weigh samples to track biomass growth, assess health, and detect changes over time.**



4. Invasive Species Control

- **Check for Biofouling** – Inspect ropes and structures regularly for invasive species, excessive algae, or barnacle overgrowth.
- **Use Remote Cameras** – Place wildlife cameras underwater or near the surface to monitor unwanted species and environmental changes.

5. Digital Tools for Easy Tracking

- **Mobile Apps** – Free apps for monitoring:
 - Secchi App (water clarity tracking)
 - Tide Charts App (plan inspections based on tides)
 - Marine Debris Tracker (log floating trash or entanglements)
 - HOBObconnect Monitoring App (pH measurements)
- **Google Sheets or Notebook** – Maintain simple records of observations, including date, weather, and growth conditions.

6. Low-Cost Drones for Aerial Surveys

- A basic waterproof drone can provide aerial views of your farm, especially after storms.

7. Community & Citizen Science

- **Collaborate Locally** – Work with local fishers, divers, or marine scientists already collecting data.
- **Join Monitoring Projects** – Participate in community efforts to track environmental changes.
- **Share Your Data** – Inform your Cool Blue country facilitator about your data collection.
- **Submit Data to European Marine Observation and Data Network (EMODnet)**
[EMODnet](#) collects and shares marine data to support better decision-making across Europe. Public sector marine data is often underutilized, and contributing your observations helps improve ocean monitoring, sustainable management, and scientific research.
 - **How to Contribute:** Follow [this instructional video](#) for a step-by-step guide on submitting data.
 - **Why It Matters:** Learn more about the importance of adding data to EMODnet in [this background video](#).

Baltic Sea: Health and Safety Testing of the Harvest

After harvesting seaweed and shellfish from the Baltic Sea, it is important to ensure they are safe for consumption. Since reliable home testing kits are not widely available, consider reaching out to experts and initiatives with experience in the region to see if they have conducted relevant tests. Additionally, you can collaborate with a laboratory to analyze your samples for key safety and nutritional parameters.

Areas to Investigate:

- **Water Contamination:** Contact a lab to test for pollutants such as nitrates, phosphates, heavy metals (lead, mercury), or other contaminants absorbed by seaweed and shellfish.
- **Bacterial Risks:** Shellfish can carry harmful bacteria like *E. coli* or *Vibrio*. Testing through an accredited lab ensures food safety.
- **Nutritional Content:** To assess iodine levels, mineral composition (calcium, magnesium, iron), and protein content, consult a lab specializing in marine food analysis.



Real-world examples of ROF monitoring in the Baltic Sea

Estonia

Seaweed cultivation and monitoring in Estonia

Jonne and his son Mihkel are exploring seaweed cultivation near Saaremaa Island, Estonia. In October 2023, they began by collecting wild drifting bladderwrack and placing it in a net cage in the sea, allowing it to grow naturally without intervention. The farm successfully endured its first winter, and the initial production season exceeded expectations, with the seaweed tripling in size within just a few months. Now, Jonne is refining the cage design to enhance efficiency, reduce labor at sea, and introduce additional species like sea lettuce to the farm.

To track the growth and environmental conditions at the farm, biomass yield measurements (see figure below) are taken once a month during the cold season and twice a month in the warm season, providing continuous data on seaweed growth rates throughout the entire cultivation period. In addition, underwater oceanographic instruments monitor key factors influencing seaweed growth, including light availability, temperature, and current velocity. Nutrient concentrations in the area remain relatively stable and do not limit seaweed growth. The same instruments also record water quality parameters such as turbidity and phytoplankton abundance (chlorophyll a). These instruments take measurements every 15 minutes, offering a solid dataset to understand the environmental conditions that promote optimal seaweed growth and indicate periods when biofouling is more likely to occur.

This initiative is carried out in cooperation with the [AlgaeProBanos](#) project, which supports sustainable algae production and innovation in the Baltic and North Sea regions. The project helps improve methodologies for seaweed cultivation, monitoring, and utilization while promoting collaboration between farmers, researchers, and policymakers.



Sweden

Monitoring in the Swedish Algae Industry

The [Development of the Swedish Algae Industry report](#), commissioned by the Swedish Board of Agriculture in 2023, highlights the critical role of monitoring in ensuring sustainable algae farming. As the industry grows, effective monitoring is essential to track environmental impacts, optimize farming methods, and meet regulatory requirements.

Key aspects of monitoring in Swedish algae farming include:

- **Water Quality Monitoring** – Tracking nutrient levels, salinity, and pollutants to assess farm impact on the marine environment.
- **Ecosystem Monitoring** – Observing biodiversity changes, potential habitat impacts, and biofouling risks.
- **Farm Infrastructure Monitoring** – Ensuring farm structures remain intact to prevent marine debris and habitat disruption.
- **Regulatory Compliance** – Using data to demonstrate the environmental benefits of algae farming, such as nutrient absorption and carbon sequestration.



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The report emphasizes the need for **cost-effective and scalable monitoring solutions**, calling for collaboration between farmers, researchers, and authorities. Improved monitoring frameworks will help balance industry growth with environmental protection, making algae farming a sustainable and viable food source in Sweden.

Seaweed Coast project in Sweden

The Seaweed Coast project report focuses on effective environmental monitoring for sustainable seaweed farming in the Baltic Sea. Monitoring plays a crucial role in ensuring minimal ecological impact while supporting farm productivity and regulatory compliance.

Once the farm is operational, regular inspections are necessary to maintain infrastructure stability, check line integrity, and ensure anchors remain properly placed (Visch et al., 2024; Greenwave, 2024). Monitoring helps detect potential issues such as line wear, which can prevent marine debris, and ensures that mooring systems do not disturb the seabed.

Monitoring Practices:

- **Water Quality Monitoring** – Farmers can track temperature, salinity, turbidity, and nutrient levels using **simple test kits, digital meters, and Secchi disks** (Flavin et al., 2013; Greenwave, 2024). Monitoring nutrient uptake can demonstrate the positive environmental impact of seaweed farming in reducing eutrophication (Armoskaite et al., 2021).
- **Biodiversity and Habitat Monitoring** – To track species interactions and detect invasive organisms, farms can use underwater cameras, baited remote underwater video (BRUVs), passive acoustic monitoring (PAM), and environmental DNA (eDNA) analysis (Berger et al., 2024). These methods provide insights into ecosystem responses and help identify marine fauna presence.
- **Seabed and Infrastructure Monitoring** – Regular seabed surveys assess sedimentation, shading effects, and biofouling. Anchoring systems should be checked to minimize disturbance to marine habitats (Barda et al., 2022).
- **Adaptive Monitoring** – Continuous adjustments to monitoring protocols based on seasonal changes and farm expansion improve long-term sustainability. Collaboration with researchers and stakeholders helps refine best practices and contributes to broader environmental data collection (Visch et al., 2024).

The project highlights that cost-effective, scalable monitoring solutions can support the growth of seaweed farming while protecting the marine environment.

Denmark

Monitoring seaweed in the marine gardens in Denmark

Aim of this project ("Marine Virkemidler", DTU Aqua and Aarhus Universitet 2022-2023) was to see how sugarkelp grows in different parts of Danish seawaters, where salinity, and other parameters differ. Hence 16 sites were selected and handed out seed lines of sugar kelp to be monitored from startup October 2022 until harvest in May 2023.

Once a month the sites were visited to record a small series of data:

- Water samples were collected in small test tubes and stored locally in fridges.
- Water temperatures were measured and noted on a spread sheet
- Water clearness was measured using a simple disc painted with a black/white pattern. The disc was lowered down until just barely visible. The length of the rope was then noted.
- Growth was recorded by taking pictures. When harvesting, the weight was recorded, and samples of seaweed were saved for analysis in laboratory.

At the end of the project, data was collected from all the sites.





Denmark

Nye Tangarter project in Denmark

In this project by DTU Aqua, starting 2025, the focus is on growing new seaweed types on seed lines, to broaden the types of seaweed species growing in the sea gardens. Knowledge has been built up on preparing and growing sugar kelp. In this project other species will be tried out – toothed wrack, bladder wrack spaghetti kelp, purple laver seaweed and other.

These examples from Estonia, Sweden, and Denmark showcase effective ROF monitoring strategies, emphasizing water quality, biodiversity, and infrastructure stability. Collaboration between farmers, researchers, and policymakers is key to improving monitoring, optimizing farming, and ensuring regulatory compliance. Cost-effective, scalable solutions will support the sustainable expansion of ROF in the Baltic Sea.



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