Blue Carbon Capacity Building Programme (BCCap)

Blue Carbon Capacity Building Programme BCCap Education Guide

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This training material has been prepared within the scope of the "Carbon Binding Blue Black Sea (BlueC)" Project.

BCCap Education Guide

This training material consists of five main sections:

1. **Section One** provides general information on the definition, global distribution, and ecosystem services of seagrasses. Particular emphasis is placed on carbon sequestration capacities and the concept of blue carbon.
2. **Section Two** examines threats to seagrass ecosystems; land-based, marine-based, and climate-induced threats are scrutinized.
3. **Section Three** addresses strategies for the protection of seagrass ecosystems, international conventions, and Environmental Impact Assessment (EIA) practices in Mediterranean countries.
4. **Section Four** covers techniques, technologies, and data management regarding the mapping and monitoring of seagrasses.
5. **The Fifth and Final Section** provides detailed information on policy and management options, restoration methods, and stakeholder engagement for the conservation of seagrass ecosystems.

Distinguished Educators,

A training programme has been planned to increase the consciousness and awareness of seagrass ecosystems among public and private sector professionals involved in EIA processes. The design and development process of the training material to be used in this programme is explained below.

Climate change threatens marine ecosystems globally, and the Black Sea region is particularly vulnerable due to multiple anthropogenic pressures. Seagrasses represent one of the planet's most efficient natural carbon sequestration systems, capable of storing carbon up to 35 times faster than tropical rainforests. Despite their ecological and climatic importance, seagrass meadows in the Black Sea region face numerous threats, including coastal development, pollution, destructive fishing practices, and the impacts of climate change.

Raising the awareness level of an individual or society on any subject means, in a sense, shaping the attitudes, behaviors, and beliefs of that individual or society. Raising awareness among professionals in decision-making positions within EIA processes regarding seagrass ecosystems is of critical importance for the protection of these fragile habitats.

This training programme employs the **"Seven Doors of Change"** model. Within the model, a problem-based and inquiry-based learning approach has been adopted.

In the **problem-based learning approach**, participants encounter real-life problems and work collaboratively to find solutions. This approach leads to meaningful and lasting learning as it allows individuals to participate actively in the learning process and self-direct their work.

The **inquiry-based learning approach** adds a dimension of research and investigation to the interaction between the educator and the participant. Educators using this strategy should present the subject in depth and comprehensively to increase the participant's predictive power and test this power to instill the rules related to the subject.

The Seven Doors of Change

1. **Knowledge:** The first step of change. Participants must know the importance of seagrass ecosystems and the threats they face.
2. **Desire:** Imagining oneself in a different future. Participants need to be able to envision a future where seagrasses are effectively protected in EIA processes.
3. **Skills:** Knowing what to do. Participants must possess the necessary skills in mapping, monitoring, and assessing seagrass ecosystems.
4. **Optimism:** Self-confidence. Participants must believe that they can contribute to the protection of seagrasses in EIA processes.
5. **Facilitation:** Receiving outside help. Participants must acquire information about international conventions, EU directives, and national legislation.
6. **Stimulation:** A compelling stimulus that initiates action. Global issues such as climate change, biodiversity loss, and coastal erosion are strong stimuli to initiate seagrass conservation actions.
7. **Reinforcement:** Regular communications that reinforce messages. Monitoring programmes, success stories, and continuous training activities ensure that awareness is permanent.

Learning Outcomes

BCCap Blue Carbon Capacity Building Programme

Participants completing the programme are expected to achieve the following outcomes:

- **Explain** that seagrasses are flowering plants adapted to the marine environment and describe their basic biological characteristics.
- **Define** the concept of blue carbon and the carbon storage capacity of seagrasses.
- **Comprehend** the ecosystem services provided by seagrasses (nursery grounds, water quality, coastal protection) and their economic value.
- **Classify** land-based, marine-based, and climate-induced threats to seagrasses.
- **Explain** the role of international conventions and EIA processes in seagrass conservation.
- **Know** the fundamental principles of seagrass mapping and monitoring techniques.
- **Evaluate** policy and management options for seagrass conservation and **integrate** them into EIA decisions.

1. What is seagrass?

Seagrasses are flowering plants (angiosperms) that have adapted to the marine environment. They are adapted to live fully submerged in saline or brackish water. Like terrestrial plants, they have veins in their leaves (conductive tissue transporting nutrients and water around the plant), stems, roots (buried in the substrate), and reproductive organs such as flowers and fruits.

They should not be confused with algae (seaweeds). Algae do not have veins in their leaves, possess holdfasts instead of roots, and do not produce flowers or seeds. These fundamental differences define seagrasses as true plants, unlike algae.

They are called "seagrass" because many have ribbon-like, grassy leaves. However, in different species, leaf shapes can be oval, fern-like, long spaghetti-like, or ribbon-shaped. Leaf sizes can range from the size of a fingernail to 7 meters.

There are approximately 60 seagrass species worldwide. Four species grow naturally in European waters: *Zostera marina* (eelgrass), *Zostera noltii* (dwarf eelgrass), *Cymodocea nodosa* (little Neptune grass), and *Posidonia oceanica* (Neptune grass). In the Black Sea, *Zostera marina* and *Zostera noltii* are the predominant species.

2. What is blue carbon and how do seagrasses store carbon?

The term "Blue Carbon" refers to the carbon captured and stored in coastal and marine ecosystems (seagrasses, mangroves, salt marshes). This concept is used to define the critical role of seagrasses in climate change mitigation.

Carbon Storage Capacity of Seagrasses: Seagrasses take carbon dioxide from the atmosphere through photosynthesis and store it in their biomass (leaves, roots, rhizomes). Dead plant material is incorporated into sediments, and due to anoxic (oxygen-free) conditions, the carbon can remain without decomposing for thousands of years.

Key Figures:

- Seagrasses can store carbon up to **35 times faster** than tropical rainforests.
- They are estimated to store **19.9 Pg (petagrams)** of organic carbon globally.
- With current loss rates, an estimated **299 Tg (teragrams)** of carbon release per year is predicted.

Importance in EIA Processes: The Intergovernmental Panel on Climate Change (IPCC) has published guidelines supporting the reporting of greenhouse gas emissions resulting from the conversion and restoration of seagrass meadows in countries' national inventories. Therefore, project impacts must be evaluated in terms of the carbon budget in EIA processes.

3. What are the ecosystem services of seagrasses?

Seagrass ecosystems provide a wide variety of services that support human well-being globally. It is estimated that more than 1 billion people living within 100 km of seagrass meadows benefit from these services.

- **Provision of Nursery and Breeding Grounds:** Seagrasses host high faunal diversity by providing shelter, feeding, and breeding grounds. The leaf canopy offers protection from predators for juvenile fish and forms the basis of the food web.
- **Improving Water Quality:** They improve water quality by filtering nutrients and pollutants through their leaves and roots. They act as a natural biofilter for ammonium resulting from intensive oyster farming. They can store pollutants such as trace metals in the sediment for thousands of years.
- **Coastal Protection:** By reducing flow velocity and wave energy, they protect coastal areas from erosion, floods, and storm surges. Their roots and rhizomes stabilize the sediment.
- **Disease Control:** By removing microbiological contamination from the water, they reduce bacterial pathogen exposure for fish, humans, and invertebrates. They produce bioactive secondary metabolites with antibacterial and antifungal activity.
- **Fisheries Support:** They provide valuable nursery habitats for more than one-fifth of the world's 25 largest fisheries.

4. Which organisms do seagrasses provide critical habitat for?

Seagrass ecosystems are indispensable habitats for many marine organisms. These habitats are particularly critical for threatened, endangered, or charismatic species.

- **Sea Turtles:** Green sea turtles (*Chelonia mydas*) use seagrasses as a primary food source. The conservation of this species depends directly on the protection of seagrass habitats.
- **Seahorses (*Hippocampus*):** Seahorses are characteristic residents of seagrass meadows. This is why *Cymodocea nodosa* is sometimes referred to as "seahorse grass."
- **Commercially Important Fish Species:** More than one-fifth of the world's 25 largest fisheries depend on seagrass habitats. These species include sea bass, sea bream, and many coastal fishery species.
- **Dugongs and Manatees:** These large marine mammals (Sirenians) feed almost exclusively on seagrasses.
- **Sharks and Rays:** Many shark and ray species use seagrass meadows as feeding and breeding grounds.
- **Invertebrates:** Shrimp, crabs, mollusks, and many invertebrate species live in seagrass ecosystems.
- **Birds:** Brant geese and numerous waterfowl use seagrass areas as feeding habitats.

5. What is the economic value of seagrass ecosystems?

The economic valuation of seagrass ecosystem services is critical for cost-benefit analyses in EIA processes.

Calculated Economic Value: The initial assessment of the economic value of services provided by seagrass ecosystems has been calculated as a minimum of **15,837 €/hectare/year**. This value is two orders of magnitude (hundreds of times) higher than estimates obtained for agricultural lands.

Sources of Economic Value:

- **Fisheries:** Supports commercial, subsistence, and recreational fisheries; vital for meeting daily protein needs in the Indo-Pacific region.
- **Tourism and Recreation:** Diving and snorkeling tourism; interaction tourism with green turtles and dugongs; bird watching.
- **Coastal Protection:** Wave energy attenuation; erosion prevention; storm surge buffering; low-cost natural protection compared to engineering solutions.
- **Carbon Storage:** Carbon market value per ton of CO_2; contribution to climate change mitigation.

In EIA processes, these values should be used to reveal the true cost of project-induced habitat loss.

6. How much have seagrasses declined globally?

Seagrasses are a critical marine habitat that has been declining globally since the 1930s. This rate of loss underscores the urgency of seagrass conservation.

Global Loss Rates:

- Approximately **7% loss occurs annually**.
- This rate equates to a loss of an area the size of a football field every 30 minutes.
- Serious losses have been documented since the 1930s.
- Losses in many regions are likely greater than recorded because less than one-quarter of global seagrasses have been mapped.

Historical Losses: The "wasting disease" epidemic in the 1930s in the northern hemisphere devastated *Zostera marina* populations. This event is considered a significant historical example demonstrating the fragility of seagrass ecosystems.

Situation in the Black Sea: The Black Sea region is particularly at risk for seagrass losses due to its semi-enclosed sea structure, eutrophication pressure, and coastal development projects.

Importance for EIA: These loss rates emphasize the critical importance of protecting every hectare of remaining seagrass habitats. In EIA processes, the "avoidance" principle has become more important than ever.

7. How does eutrophication threaten seagrasses?

Eutrophication is a condition of excessive plant and algal growth in the water body caused by excessive nutrient loading (especially nitrogen and phosphorus) from agricultural and urban areas. This process constitutes one of the most serious land-based threats to seagrasses.

Mechanism of Eutrophication:

- Excess nutrient input via agricultural fertilizers, domestic wastewater, and industrial discharges.
- Phytoplankton and macroalgal (large algae) blooms.
- Increased turbidity in the water column.
- Reduction in the amount of light reaching seagrasses.
- Inhibition of photosynthesis and seagrass death.

Effects of Eutrophication:

- Algal blooms cover seagrass leaves, reducing light penetration.
- Decomposition of dead algae consumes oxygen, creating hypoxia (oxygen deficiency).
- Sediment quality deteriorates.
- Ecosystem balance shifts.

Assessment in EIA Processes:

- Analysis of the project's potential for nutrient discharge.
- Evaluation of cumulative impacts (existing eutrophication + project impacts).
- Design of water quality monitoring programmes.
- Determination of wastewater treatment requirements.

8. How do marine-based activities threaten seagrasses?

The shallow coastal areas where seagrasses typically live attract a high density of industrial and recreational activity. These activities threaten seagrasses through direct physical damage or indirect degradation.

- **Trawl Fishing:** Bottom trawling scours the seabed, uprooting seagrasses. Complete habitat destruction occurs in traversed areas. Repeated trawling activity prevents recovery.
- **Dredging Activities:**
    - Habitat removal via direct excavation.
    - Smothering of seagrasses at dredge spoil disposal sites.
    - Resuspension of fine sediments and increased turbidity.
    - Impacts can spread tens of kilometers from the dredging site.
- **Boat Anchoring and Propeller Scars:**
    - Anchors and chains uproot seagrasses.
    - Propeller scars create lasting damage in seagrass meadows.
    - Wave energy generated by boat traffic causes sediment resuspension.
- **Invasive Species:**
    - Invasive algal species like *Caulerpa taxifolia* compete with seagrasses.
    - Invasive grazers can reduce seagrass biomass.
    - Introduction of pathogens and invasive species via ship ballast waters.
- **Aquaculture:**
    - Physical displacement and shading.
    - Increase in nutrients and pollutants.
    - Introduction of exotic species and pathogens.

9. How does climate change affect seagrasses?

Climate change poses multiple and interacting threats to seagrass ecosystems. These threats operate on a global scale and complicate local conservation efforts.

- **Rising Sea Temperatures:**
  - Physiological effects on photosynthesis, respiration, and reproductive success.
  - Species at the edge of their distribution range are most at risk.
  - Heatwaves can cause mass mortality events.
  - The wasting disease epidemic of the 1930s has been linked to unusually warm temperatures.
- **Ocean Acidification:**
  - Absorption of increasing atmospheric CO_2 by the ocean.
  - Decrease in seawater pH.
  - Negative effects on calcifying organisms (shellfish, corals).
  - The response of seagrasses to acidification is complex and still under research.
- **Sea Level Rise:**
  - Seagrasses tend to migrate to maintain optimal depth zones.
  - Hardened coastlines (quays, retaining walls) can prevent this migration.
  - The "Coastal Squeeze" phenomenon leads to habitat loss.
  - Improvements in water clarity may be partially compensatory.
- **Extreme Weather Events:**
  - Hurricanes and severe storms uproot seagrasses.
  - Intense rainfall increases freshwater and sediment runoff.
  - The recovery process can take years.

10. How do coastal construction and port projects affect seagrasses?

Coastal development projects create direct and indirect impacts on seagrass habitats. These impacts form the focal point of EIA processes.

Direct Impacts:

- **Habitat Destruction:** Land reclamation (filling) projects permanently destroy seagrass areas. Port basins and marinas cause direct habitat loss. Infrastructure construction (quays, piers, breakwaters) alters the seabed.
- **Physical Disturbance:** Sediment resuspension during construction; pile driving and dredging activities; damage from construction traffic.

Indirect Impacts:

- **Reduced Light Penetration:** Structures may shade seagrass areas. Construction-induced turbidity reduces light penetration. Permanent structures create long-term shading.
- **Hydrodynamic Changes:** Alteration of current patterns; disruption of sediment transport dynamics; changes in wave energy distribution.
- **Coastal Squeeze:** Inability of seagrasses to migrate inland as sea levels rise; artificial coastal structures blocking natural migration routes; long-term habitat loss.

EIA Requirements: These potential impacts of coastal construction and port infrastructure projects on seagrass habitats must be comprehensively evaluated through EIA processes.

11. How do international conventions provide a legal framework for seagrass protection?

Numerous international conventions provide an important legal framework for the protection of seagrass ecosystems. These conventions form the basis for the development of national legislation and the strengthening of EIA processes.

- **Ramsar Convention (Convention on Wetlands):** Promotes the conservation and wise use of wetlands. Seagrass meadows are included in the wetland definition. Resolution XIII.20 (2018) explicitly supports the conservation of intertidal wetlands and seagrass ecosystems.
- **Convention on Biological Diversity (CBD):** Conservation and sustainable use of biodiversity. Kunming-Montreal Global Biodiversity Framework (Targets 1, 2, and 3). Obligation for National Biodiversity Strategy and Action Plans (NBSAPs).
- **Barcelona Convention:** Protection of the Mediterranean Sea against pollution. Protocol concerning Specially Protected Areas and Biological Diversity. Explicit protection of *Posidonia oceanica*.
- **UN Framework Convention on Climate Change (UNFCCC) and Paris Agreement:** Nationally Determined Contributions (NDC) mechanism. Inclusion of blue carbon ecosystems in climate mitigation. IPCC greenhouse gas inventory guidelines.
- **World Seagrass Day:** March 1st was declared World Seagrass Day by UN General Assembly Resolution 76/265. This symbolizes the international recognition of the global importance of seagrass ecosystems.

12. How should seagrasses be evaluated in EIA processes?

The potential impacts of coastal projects on seagrass habitats must be comprehensively evaluated through EIA processes.

Key Components of an EIA Study:

- **Baseline Analysis:** Mapping of seagrass distribution in the project area and its vicinity. Determination of species composition and cover density. Assessment of ecosystem health status.
- **Impact Analysis:** Direct impacts (habitat loss, physical damage); Indirect impacts (turbidity, shading, hydrodynamic changes); Cumulative impacts (existing pressures + project impacts); Temporary and permanent impacts.
- **Mitigation Measures:** Avoidance strategies; Minimization techniques; Restoration plans; Compensation measures.
- **Monitoring Programme:** Pre-project baseline monitoring; Construction phase monitoring; Operational phase long-term monitoring.
- **EU Legislation Requirements:** Habitats Directive (*Posidonia* beds are Annex I habitat type); EIA Directive (Assessment of environmental effects of certain projects); Water Framework Directive (Good ecological status requirements).

13. How are Marine Protected Areas (MPAs) used in seagrass conservation?

The establishment of MPAs is an effective management tool for the conservation of seagrass ecosystems. These areas form the basis of the spatial protection approach for habitat conservation.

Types of MPAs:

- **No-take Zones:** Areas where all extractive activities are prohibited. Full protection of seagrass ecosystems. Function as scientific reference areas.
- **Multiple-Use Protected Areas:** Areas where certain activities are permitted while others are restricted. Zoning approach. Balance between sustainable use and conservation.
- **Locally Managed Marine Areas:** Areas managed with community participation. Integration of traditional knowledge. Protection of local livelihoods.

MPA Design Principles:

- Adequate size (to support ecological processes).
- Habitat representation (covering different seagrass species).
- Connectivity (ecological connection with other MPAs).
- Distance from threats or management of threats.
- Long-term management and monitoring capacity.

Relationship with EIA: Projects planned within or near MPAs may be subject to special EIA requirements. In EU legislation, projects affecting Natura 2000 sites may require authorization at the central level.

14. How are seagrasses mapped and monitored?

Satellite imagery, drones, and field surveys (diving, snorkeling observations) are the main techniques used in mapping and monitoring seagrass areas.

Optical-Based Remote Sensing:

- **Satellite Imaging:** 0.30–30 m spatial resolution. Wide area coverage. Regular revisit capability (1–17 days). Up to maximum 40 m depth depending on water clarity.
- **Drones (Unmanned Aerial Systems):** Very high resolution (sub-decimeter). Low cost and high flexibility. Collection of ground-truthing data. Ability to repeat the same route for routine monitoring.

Acoustic-Based Techniques:

- **Side Scan Sonar:** Acoustic imaging of the seabed. Advantageous in deep or turbid waters.
- **Multi-beam Echosounders:** Three-dimensional seabed mapping. Assessment of canopy structure.

Field Surveys (In Situ):

- **Diving and Snorkeling Observation:** Species-level identification. Shoot density counting. Canopy height measurement. Epiphyte cover assessment.
- **Transect and Quadrat Sampling:** Standardized data collection. Opportunity for long-term comparison.

15. What are the global seagrass monitoring networks?

Global monitoring networks such as SeagrassNet and Seagrass-Watch track the status of seagrasses using standard parameters. These networks enhance the power and value of coordinated monitoring.

Seagrass-Watch (since 1998):

- Global participatory science monitoring programme.
- 408 sites in 21 countries.
- Standardized protocols.
- **Measurements:** Percent cover, species composition, canopy height, epiphyte cover, macroalgal cover, sediment grain size.
- **Assessment frequency:** Dependent on local capacity (quarterly, biannually, or annually).

SeagrassNet (since 2001):

- 126 sites in 33 countries.
- 3 permanent 50 m transects at each site, 12 replicate sampling positions.
- **Biological parameters:** Species, cover, canopy height, biomass, flowers/fruits.
- **Environmental parameters:** Temperature, light, salinity, sediment characteristics.
- Web-based data reporting system (www.seagrassnet.org).

GOOS Essential Ocean Variables (EOV):

- Global Ocean Observing System coordination.
- EOV for seagrass cover and composition.
- www.oceanbestpractices.net

Importance for EIA: The protocols of these networks provide references for the design of EIA monitoring programmes. Standardized methods ensure comparability between different projects and regions.

16. How is the citizen science approach used in seagrass monitoring?

Local communities and volunteers can be included in seagrass monitoring programmes through a citizen science approach.

Advantages of Citizen Science:

- **Data Collection Capacity:** Wider geographical scope; more frequent sampling opportunity; cost-effectiveness; long-term monitoring sustainability.
- **Social Benefits:** Increased awareness; development of a sense of ownership; support for management decisions; environmental citizenship.

Citizen Science Programme Components:

- **Training and Capacity Building:** Species identification training; teaching sampling techniques; data recording procedures.
- **Quality Control:** Standardized protocols; reference cards and guides; pairing with experienced observers; data verification procedures.
- **Data Management:** User-friendly data entry systems; mobile applications; web-based reporting platforms.
- **Stakeholder Groups:** Local fishermen (traditional ecological knowledge); diving clubs and operators; university students; environmental NGOs; coastal residents.

Use in EIA Processes: Citizen science data can support EIA baseline assessments and be integrated into post-project monitoring programmes.

17. Which Sustainable Development Goals does seagrass conservation support?

The protection and restoration of seagrass ecosystems contribute to the achievement of **26 targets and indicators** related to **10 of the United Nations Sustainable Development Goals (SDGs)**.

Directly Related SDGs:

- **SDG 13 - Climate Action:** Climate change mitigation through carbon capture and storage; increasing coastal resilience against extreme weather events.
- **SDG 14 - Life Below Water:** Protection of marine and coastal ecosystems; support for sustainable fisheries; reduction of marine pollution.
- **SDG 2 - Zero Hunger:** Supporting fisheries productivity; contribution to food security.

Indirectly Related SDGs:

- **SDG 1 - No Poverty:** Protection of coastal community livelihoods.
- **SDG 5 - Gender Equality:** Supporting coastal livelihood activities where women are predominant.
- **SDG 6 - Clean Water and Sanitation:** Water quality improvement services.
- **SDG 8 - Decent Work and Economic Growth:** Tourism and fisheries economy.
- **SDG 11 - Sustainable Cities and Communities:** Coastal protection services.
- **SDG 12 - Responsible Consumption and Production:** Ecosystem-based management approaches.
- **SDG 17 - Partnerships for the Goals:** International cooperation and knowledge sharing.

18. How are degraded seagrass areas restored?

Degraded seagrass areas can be restored through various methods such as seed sowing and seedling transplantation. However, restoration should be considered as a last resort in the EIA mitigation hierarchy.

Restoration Methods:

- **Seed-Based Approaches:** Collecting seeds from mature plants; seed scattering or sowing; seed carrier systems; applicability in large areas.
- **Seedling Transplantation:** Extracting seedlings from healthy donor meadows; planting in degraded areas; Plug or Sod methods; advantage of rapid start.
- **Habitat Modification:** Substrate improvement; sediment stabilization; elimination of threat sources.

Success Factors:

- Removal of threats beforehand (critical prerequisite).
- Proximity to donor seagrass beds.
- Large-scale planting (small patches are more prone to failure).
- Appropriate site selection (light, sediment type, hydrodynamic conditions).
- Long-term monitoring and maintenance.

Success Rates: A global assessment examined 1,786 restoration trials and found that success varies significantly depending on the factors above.

Important Notes for EIA:

- Restoration cannot fully replace natural meadows.
- Success is not guaranteed and can take years.
- Avoidance and minimization must always precede restoration.
- Restoration costs must be included in EIA cost-benefit analyses.

19. How is the mitigation hierarchy applied for seagrasses in EIA processes?

The mitigation hierarchy is the fundamental principle of EIA and must be rigorously applied for seagrass habitats. This hierarchy determines the order of priority in managing impacts.

1. Avoidance (Highest Priority):

- Selecting the project location away from seagrass meadows.
- Evaluating alternative technologies.
- Adjusting construction timing to avoid sensitive periods (breeding season).
- Adopting a "Zero Loss" goal.
- Completely avoiding seagrass habitat is always the best option.

2. Minimization:

- Keeping the impact area at the lowest possible level.
- Silt curtains and barriers to prevent sediment spread.
- Turbidity monitoring and threshold value checks.
- Optimization of construction methods.
- Minimizing night lighting and noise.

3. Restoration:

- Remediation of temporary impacts.
- Rehabilitation of degraded areas.
- Commitment to long-term monitoring and maintenance.
- Determination of success criteria.

4. Compensation/Offset (Last Resort):

- Protection or creation of equivalent habitat in another area.
- Net Gain principle (providing more than what is lost).
- Long-term management commitment.
- Critical evaluation of the true conservation value of the compensation is required.

Critical Principle: Each stage must be fully evaluated before moving to the next. Restoration and compensation cannot substitute for avoidance and minimization options.

20. What are the key recommendations for EIA decision-makers?

Key recommendations that decision-makers should consider for the effective protection of seagrass ecosystems in EIA processes are summarized below.

- **Legislation and Procedure:** Ensure seagrass ecosystems are explicitly mentioned in EIA procedures. Implement the requirements of international conventions (Ramsar, CBD, Barcelona). Check compliance with EU directives (Habitats, Water Framework, EIA directives).
- **Expert Assessment:** Ensure EIA studies are conducted or supervised by experts competent in marine biology. Evaluate the quality of mapping and monitoring data. Request the use of standardized protocols.
- **Mitigation Hierarchy:** Rigorously apply the order of **Avoidance** → **Minimization** → **Restoration** → **Compensation**. Adopt the "Zero Loss" target. Remember that restoration cannot replace natural habitat.
- **Cumulative Impacts:** Evaluate the cumulative impacts of multiple projects. Consider existing stress factors (eutrophication, climate change). Conduct assessments on a regional scale.
- **Monitoring and Follow-up:** Demand comprehensive monitoring programmes for pre-, during, and post-project phases. Secure long-term monitoring commitments. Adopt an adaptive management approach.
- **Stakeholder Engagement:** Include local communities, fishermen, and NGOs in the process. Value traditional ecological knowledge. Implement transparent decision-making processes.

Closing

Distinguished Trainer,

- You have completed the training programme.
- We thank you for the effective completion of this process.
- Please ask your participants if they have any questions or contributions regarding the training.
- The protection of seagrass ecosystems is not only an environmental responsibility but also a critical tool in combating climate change and sustainable coastal management.
- The effective evaluation of these ecosystems in EIA processes is one of the fundamental steps to leaving healthy seas for future generations.

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