PROGRAMME

Baseline study to appraise coastal adaptation interventions in Mediterranean coastal hotspots – Stage I

Tangier-Tetouan-Al Hoceima region, Morocco and Kotor Bay, Montenegro

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SCCF
Enhancing regional climate change adaptation in the Mediterranean Marine and Coastal Areas

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1. Introduction

The manifold impacts of climate change are increasingly apparent at all scales. Adapting to them requires rapid action, innovation and colossal investments to support and protect human communities and ecosystems. However, the United Nations Environment Programme's 2022 Adaptation Gap Report states that although global efforts in adaptation planning, financing and implementation continue to make incremental progress, they fail to keep pace with increasing climate risks (UNEP, 2022).

Nonetheless, 84% of UNFCCC signatories have already established national adaptation plans containing mitigation and adaptation objectives. These plans are based on current and future projections of climate change risks and impacts, and aim to strengthen scientific and multilateral cooperation. Moreover, these efforts are accompanied by an increase in international adaptation finance to developing countries. Unfortunately, these funds are insufficient, and are actually undergoing a reduction in volume.

Estimated global adaptation needs are currently 5 to 10 times higher than international adaptation finance flows, and this adaptation finance gap continues to widen. Indeed, UNEP estimates that annual adaptation needs will range from US$160–340 billion by 2030, and US$315–565 billion by 2050. However, international adaptation finance to developing countries was only US$28.6 billion in 2020. Without a massive leap in financial support, adaptation actions could be outstripped by accelerating climate impacts, which would further widen the adaptation implementation gap and stymie collaboration between developed and developing countries in the planetary fight against climate change (UNEP, 2022).

Furthermore, adaptation actions remain largely incremental in nature and do not usually address future climate change impacts. They may also reinforce pre-existing socio-economic or gender-based vulnerabilities and introduce new risks, particularly in the most vulnerable areas, such as coastal zones. To be effective, inclusive and adequate in the longer term, solutions should be context-specific and address the root causes of climate vulnerability, such as underlying structural socioeconomic and gender-based inequities, while reducing climate-related exposures and vulnerabilities to climate hazards. Without holistic and inclusive efforts to address climate change's impacts, the world's most vulnerable populations will continue to bear the brunt of climate change in all regions of the world.

The Mediterranean region is located at the forefront of the global unfolding of climate change: it is the second most rapidly warming region of the world, after the Arctic. More than ever, its natural and cultural diversity are seriously threatened by anthropogenic activities. During this period, the average annual temperatures of the air and the sea have increased, sea levels have risen, seawater acidification is ongoing, and overall climatic conditions are warmer and drier (MedECC, 2020). These changes carry numerous fundamental risks for ecosystems, humans and non-humans alike. It is thus crucial to update and consolidate the latest scientific knowledge about climate and environmental change in the Mediterranean basin, making it accessible to policymakers, scientists and civil society. This will support the process of collectively imagining, designing and implementing site-specific adaptation solutions to reinforce the resilience and coping capacities of humans and ecosystems over the coming decades.

1.1 The Global Environment Facility MedProgramme

The Global Environment Facility's (GEF) "MedProgramme : Enhancing Environmental Security" is a US$43 million assortment of eight projects comprising more than 100 coordinated actions at the regional and national levels. Its ten beneficiary countries are Albania, Algeria, Bosnia and

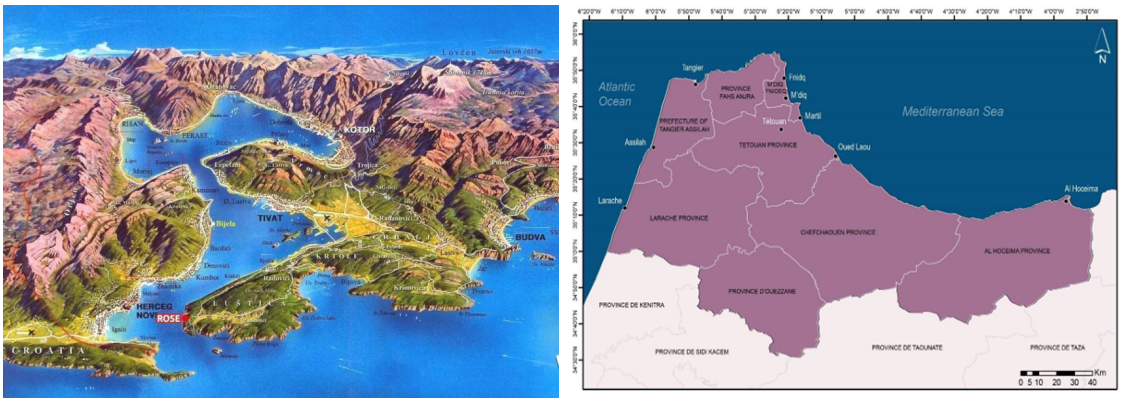
Herzegovina, Egypt, Libya, Lebanon, Morocco, Montenegro, Tunisia and Türkiye. The MedProgramme aims to operationalise priority actions to reduce major transboundary environmental stresses in its coastal areas, strengthen climate resilience and water security, and improve the health and livelihoods of coastal populations.

The MedProgramme comprises the Special Climate Change Fund (SCCF) Project "Enhancing regional climate change adaptation in the Mediterranean Marine and Coastal Areas". Its main objective is to identify climate risks affecting the Mediterranean's coastal areas (both in the terrestrial and marine zones) and to develop adaptation strategies to overcome or cope with these risks. The SCCF Project also seeks to facilitate access to climate finance in an effort to scale up adaptation measures in the region.

This project is closely interlinked with another MedProgramme project: Child Project 2.1 "Mediterranean Coastal Zones: Climate Resilience, Water Security and Habitat Protection" (CP 2.1), which, amongst others, supports Mediterranean countries in implementing the Barcelona Convention's Integrated Coastal Zone Management Protocol (ICZM Protocol). A key feature of CP 2.1 consists in the elaboration of Coastal Plans in two Mediterranean coastal hotspots: the Tangier-Tetouan-Al Hoceima region (TTA) , Morocco and Kotor Bay, Montenegro. These efforts are led by PAP/RAC and supported by Plan Bleu's Climagine participatory foresight methodology, with inputs from the SCCF Project concerning climate-change related aspects. Furthermore, CP 2.1 is also being implemented by UNESCO-IHP, working on coastal aquifers and conjunctive water management, and collaborating closely with Child Project 2.2, executed by GWP-Mediterranean concerning the Water-Food-Energy-Ecosystems Nexus.

Furthermore, gender is one of the key pillars of the GEF MedProgramme, as a key prism of analysis in evaluating climate risks. Indeed, the degree to which people are affected by climate change impacts is defined not only by their age and socio-economic status, but also by their gender. It is widely acknowledged that women in general are disproportionately affected by climate change impacts due to persistent gender inequalities. Women have lower capacity compared to men to build resilience and adapt to climate change impacts as a result of their limited access to and control over resources; limited access to finance and markets; limited access to and use of technology; limited access to information and social capital; as well as reduced mobility. Yet, women and men also present different skills, coping capacities, experiences and knowledge, when it comes to dealing with climate change. These attributes should also be mobilised in order to develop context-specific and inclusive adaptation solutions.

1.2 Report Objectives



Kotor Bay, Montenegro and the Tangier-Tetouan Al Hoceima Region, Morocco

In the context of the SCCF Project, Plan Bleu/RAC (UNEP/MAP) hosted two participatory workshops on coastal adaptation in collaboration with PAP/RAC and technical experts from Metroeconomica (Bilbao, Spain). These workshops targeted the respective TTA and Kotor Bay stakeholders of the ongoing Coastal Plan elaboration processes and respectively took place on 5 July 2022 in Kotor, Montenegro and on 7 December 2022 in Tangier, Morocco. They were both organised back-to-back with dedicated CP 2.1 Coastal Plan/Climagine workshops, led by PAP/RAC.

These workshops reinforced participants' understandings of coastal risks and adaptation, specific economic analysis methods applied to adaptation (Cost-benefit analysis – CBA, and Multi-criteria analysis - MCA), and resulted in stakeholders collectively discussing and proposing concrete adaptation proposals to address the main environmental and climate-related challenges affecting these two coastal zones, informed by the gender-sensitive climate risk assessments carried out by Plan Bleu and its experts in both coastal hotspots[1].

With a view to connecting these participatory coastal management and adaptation processes to adaptation finance, this report carries out an initial overview of the proposed adaptation solutions, which will be submitted to full CBAs throughout 2023, carried out by PAP/RAC and its experts. The outcomes of both workshops thus form one of the main datasets to inform the economic analysis of the proposed adaptation solutions. A first selection of the complete list of proposed solutions was carried out internally by the project team so as to identify redundancies, omit proposals that only remotely or did not fall under the adaptation theme, or were too general to present any context- and site-specific relevance. This shortlist was subsequently analysed by the Metroeconomica experts, and is presented in Section 2 below. In Section 3, the two methodologies used to prioritise sectoral coastal adaptation interventions are described. Finally, these interventions are presented in more detail in Section 4, followed by a selection of those solutions considered eligible for a later full CBA. Each proposal is described briefly, its main objectives stated and a preliminary MCA performed so as to determine whether it is suited to undergo a full CBA, taking data availability into account. When a CBA is considered possible, a list of the key data requirements is provided by the authors.

[1] For the full versions of the gender-sensitive climate risk assessments of Kotor Bay and TTA, visit:

- Gender-sensitive climate risk assessment of TTA, Morocco (Plan Bleu, 2022) – also available in French.
- Gender-sensitive climate risk assessment of Kotor Bay, Montenegro (Plan Bleu, 2022).

2. Outcomes of the participatory workshops on economic analyses of coastal adaptation solutions

To ensure continuous and in-depth stakeholder engagement, and to build synergies between the various MedProgramme activities underway in both coastal hotspots, both coastal adaptation workshops were organised back-to-back with CP 2.1 Coastal Plan/Climagine workshops described above. In total, four Coastal Plan/Climagine workshops took place in Kotor Bay (between December 2021 and July 2023) and the Tangier-Tetouan-Al Hoceima region (between 16 March 2022 and 21 June 2023), and involved numerous stakeholders, including a core group of coastal decision-makers and managers, researchers, technical experts and civil society representatives. The coastal adaptation theme was thus streamlined into the ongoing Coastal Plan elaboration/Climagine processes.

These coastal adaptation workshops aimed to convene the main sectors and actors affected by coastal climate risks in order to describe the current situation and future trends in each area, and to work together to propose potential coastal adaptation measures. The stakeholder discussions were informed by the strategic foresight approach employed in the Coastal Plan/Climagine process. According to the European Commission, "foresight is the discipline of exploring, anticipating and shaping the future to help build and use collective intelligence in a structured, and systemic way to anticipate developments… [It] "anticipates trends, risks, emerging issues, and their potential implications and opportunities in order to draw useful insights for strategic planning, policy-making and preparedness."[2]

In this sense, Climagine aims to initiate and inform such collective intelligence processes in Mediterranean coastal zones by building on the expertise and experience of coastal stakeholders. Indeed, their inputs are crucial to better identifying and understanding the main trends and potential development scenarios of a given coastal zone in the light of climate change and variability. Based on these inputs, as well as sectoral quantitative and qualitative data, future scenarios are developed by the project team and technical experts to inform coastal stakeholders' understandings of their area's future evolution in terms of (un)sustainable development trends, climate variability and climate risks[3].

In this sense, the foresight approach that underlies the Coastal Plan elaboration processes offers concrete tools to track progress towards sustainability and identify unsustainable present and future trends, based on an appraisal of the coastal zone's past and current development patterns. Moreover, the participatory nature of this work reinforces local Science-Policy-Civil Society interfaces and participatory governance, while bolstering stakeholders' capacities to understand, evaluate and select appropriate coastal adaptation solutions and short- to long-term strategies.

[2] European Commission, 2023, https://commission.europa.eu/strategy-and-policy/strategic-planning/strategic-foresight_en

[3] For more information about Climagine process, visit https://planbleu.org/en/projects/climagine/.

Kotor Bay, Montenegro workshops

During the first workshop held in Tivat (3 December 2021), participants identified the main priority challenges and issues to be addressed by the Kotor Bay Coastal Management Plan (CMP), and selected the key priority sectors to target in order to address them, namely:

- Spatial planning and transportation;
- Coastal and marine environment;
- Water and wastewater;
- Waste management;
- Sustainable tourism;
- Cross-cutting dimension - gender;
- Cross-cutting dimension - governance and inclusive society.

After this first workshop, a Montenegrin expert team was set up by the project partners to further work on these priority sectors. The following three workshops then carried out the next phases of the Climagine process:

- **CMP/Climagine Workshop 2 (Kotor, 4 July 2022)**: the priority sectors were presented and discussed with stakeholders in terms of their past and current state in the Bay. A set of Sustainability Indicators was then established in order to represent the current and future state of each priority sector, taking the governance and gender themes into account as cross-cutting dimensions.
- **CMP/Climagine Workshop 3 (Herceg Novi, 18-19 January 2023)**: on Day 1, participants revised the suggested Sustainability Indicators and their respective values in order to collectively define the future targets to achieve sustainability for every indicator and, by extension, every priority sector. On Day 2, the coastal adaptation workshop took place, resulting in an extensive list of possible actions, with around one hundred possible coastal adaptation interventions proposed by participants.
- **CMP/Climagine Workshop 4 (Tivat, 4 July 2023):** based on the data and results from the previous workshops, the project partners proposed the past, present and business as usual scenarios to the stakeholders, using “Amoeba” diagrams. These diagrams seek to represent the evolution of each priority sector. This allowed stakeholders to develop an alternative/sustainable future scenario (by 2030 and/or 2050) and to collectively formulate strategic recommendations for the Coastal Plan, aimed at achieving this future scenario and the implementation of the ICZM Protocol in the target zone.

Tangier-Tetouan-Al Hoceima Region, Morocco workshops

Coastal adaptation was also integrated into the Coastal Plan/Climagine process in the Tangier-Tetouan-Al Hoceima region, and followed a process similar to the Montenegrin case described above. The key workshop on coastal adaptation took place in Tanger on 7 December, 2022, based on the priority sectors previously identified by the TTA stakeholders group, namely:

- Sustainable coastal and spatial development;
- Biodiversity and coastal protection;
- Risks and pollution;
- Water;
- Green Economy;
- Blue Economy;
- Cross-cutting dimension - gender;
- Cross-cutting dimension - governance and inclusive society.

The chart below summarises the coastal adaptation solutions that were selected for further investigation, based on a MCA conducted by Plan Bleu and its experts from Metroeconomica. It is important to highlight the participatory nature of these results, and the fact that they may seem, at first hand, only remotely related to coastal adaptation *per se*. Nonetheless, these proposed solutions were collectively perceived as a coastal adaptation solution or as a process that could support coastal adaptation by the stakeholders, and should therefore be taken into account for further study. Generally speaking, this process illustrates the potentially fruitful mutual interactions between participatory, multi-stakeholder interactions and in-depth, technical expert-led work.

Kotor Bay, Montenegro
1. Better waste management for Kotor Bay
2. Updating Kotor Bay's public green space cadastres
3. Afforestation with autochthonous species and greening urban spaces
4. Beach replenishment in harmony with the coastal and marine environments
5. Regulating and treating ballast waters from shipping in Kotor Bay
6. Rehabilitation of Kotor Bay's communal water infrastructure
7. Update the cadastre of sewage outlet cadastre and systematise data management
Tangier-Tetouan-Al Hoceima region, Morocco
1. Reducing coastal erosion by El Jebha
2. Improving flood risk management around Martil
3. Establishing natural dykes and green corridors with native species in Stehat
4. Reducing the threat of invasive species due to ballast waters around Jbel Moussa
5. Developing aquaculture in the Loukkos River Basin
6. Improving water harvesting and management in the region and managing flood risks

7. Boosting food security and biodiversity in TTA's rural areas
8. Creating zones for wind sports and supporting coastal eco-tourism in the Tangier–Asilah and Fahs-Anjra Provinces

Shortlist of adaptation solutions selected by the expert for further analysis

Economic analysis methods were then applied by the project partners in order to evaluate these coastal adaptation proposals. The following section sheds some light on the economic analysis methods employed to analyse these coastal adaptation solutions and their overall suitability for the sites taken into consideration.

3. Methodologies employed to prioritise sectoral coastal adaptation interventions: Cost-benefit and Multi-criteria Analyses

3.1 Cost-Benefit Analyses for Coastal Adaptation

Cost-benefit analysis (CBA) is a systematic process for calculating and comparing the benefits and costs of a given policy or project, based on assigning a monetary value to all of the activities associated with the project (either as an input or as an output). CBA techniques are commonly used to evaluate the feasibility and profitability of business strategies and private and public projects, as well as public policy interventions, including those related to climate change adaptation.

This approach compares the total investment and other costs required for the implementation of the project (which might include investment in fixed assets, labour and training costs, as well as the time utilised for training or implementation) against its potential returns (e.g. reduced negative health outcomes).

A common indicator for evaluating a project is its net present value (NPV), which is calculated as:

$$NPV = \sum_{t=0}^{t=T} \frac{(B_t - C_t)}{(1+r)^t}$$

Where B_t is the value of benefits from the project in year t, C_t is the cost incurred in year *t* and *r* is the discount rate. An NPV greater than zero would be a necessary but not sufficient condition for a project to be accepted.

Additional indicators include:

- the payback period (the minimum time at which the present value of benefits exceeds the costs, i.e. the time needed for the investment to pay for itself);
- the internal rate of return IRR (the percentage return on investment, which is the discount rate that makes the NPV equal to zero); and
- the benefit to cost ratio (BCR), which is the ratio of the present value of benefits to costs (a ratio greater than one would be necessary but not sufficient for a project to be selected).

The formula for the IRR is:

$$0 = \sum_t (R_t - C_t)/(1+r^*)^t$$

The acceptable IRR for a project will vary according to the risks it involves. In the European Commission (EC) guidelines for example, an IRR > 6% is required for a project funded by the EC to be acceptable (European Commission, 2015).

The formula for the benefit cost ratio (BCR) is:

$$BCR = \frac{\sum_t R_t/(1+r)^t}{\sum_t C_t/(1+r)^t}$$

The discount rate is a key component of the CBA. The EC's guidelines propose a real discount rate of 5% for the appraisal of projects. The term "real" implies that the discount rate is applied to the flow of costs and benefits net of any general increase in the price level (European Commission, 2015). By the same measure, if the IRR is applied a value of over 5% would be expected for a project to be approved. Finally, for the benefit to cost ratio, a value of over 1 is required. We should note, however, that governments normally require a BCR of well over 1 (BCR<1), as funds are limited, and only projects with the highest BCRs are funded.

A key feature of CBA is the aggregation of costs and benefits in different periods to a single value, using the discount rate. This allows interventions with multiple benefits in different sectors, which is frequently the case with climate adaptation, to be treated in one framework. In estimating the costs and benefits, it is important to correct any market prices for distortions that result in a deviation of the true resource or opportunity cost from the market price. Possible reasons for such deviations could be taxes and subsidies, monopoly power or excess supply or demand (e.g., in the case of unemployment). For methods on how to treat such distortions, see Squire and van der Tak (1975) and Treasury HM (2018).

Example of a CBA

A simple example of CBA in the context of climate change adaptation is the following. A flood-prone area has been identified, and a flood barrier is proposed to prevent damage.

- *The initial investment of a barrier in year 0 is 20€ Mn.*
- *There is an annual cost of 1.5€ Mn to maintain the system.*
- *The benefits are avoided damages to assets, infrastructure and human beings, estimated at 400€ Mn if there is a storm.*
- *The probability of a storm is 1% in any year.*
- *The lifetime of the investment is 50 years.*
- *The discount rate is 5%.*

***Result**:*

- *NPV=6.9€ Mn*
- *IRR=7%*
- *BCR=1.15.*

According to these results, this coastal adaptation solution is valid. Of course, in an actual CBA the analysts would have to conduct a sensitivity analysis to take other impacts into account, such as the potential employment benefits of the flood barrier, or its positive or negative effects on coastal or marine ecosystems or tourism, for instance. Nonetheless, the core of the CBA evaluation is formed by the figures presented above.

The limitations of CBA

CBA is a powerful tool, but presents several limitations. Most importantly, it does not address the distributional question of who gains, and what, from the project, and who bears its monetary and non-monetary costs. This factor has to be evaluated in addition to the CBA indicators presented above. Second, it gives no importance to non-valued costs and benefits, which cannot be expressed in monetary terms. However, adaptation projects often include impacts that cannot be evaluated in monetary terms (such as the protection of cultural capital, or a reduction in biodiversity loss). Such impacts must also be considered in addition to the summary CBA indicators described above.

Another important consideration is that the estimates of benefits and costs (especially benefits) contain large uncertainties. In the case of adaptation projects relating to climate change, the figures and data reveal considerable ranges when it comes to its physical impacts. When these impacts are valued in monetary terms, the ranges go further. This means that the decision criteria should include methods to handle uncertain outcomes, hence the importance of engaging in climate risk assessment and strategic foresight analysis. The simplest manner is to undertake a sensitivity analysis and to report the indicators of NPV, BCR etc. for the range of likely benefits and costs. The European Commission's CBA guidelines referred to above provide further guidance on such methods.

For all of these reasons, CBA is usually a major input to any evaluation process. Most governments and funding agencies require it before funding is approved, but it is never sufficient to determine the outcome of the evaluation. Usually, it is approached as a necessary but insufficient condition to give the green light to a coastal adaptation project.

3.2 Multi-criteria Analysis for Coastal Adaptation

The second method employed in this study is Multi-criteria analysis (MCA), which is based on scoring each intervention according to several criteria and then adding up a weighted total of the scores, which can be attributed both for qualitative and quantitative criteria. The successive steps involved in a MCA process involve:

- structuring the decision problem being addressed;
- specifying criteria;
- measuring alternatives' performance;
- scoring alternatives on the criteria and weighting the criteria;
- applying the scores and weights to rank the alternatives;
- presenting the MCA results, including sensitivity analysis, to decision-makers to support their decision-making.

Issues that arise in conducting an MCA include:

- The criteria must avoid overlaps or redundancy. Relevant criteria could include jobs created, equality of provision, patient needs etc.
- The measurement of scoring for each criterion has to be based on as much data as possible to be credible.
- The weighting of criteria has to reflect decision-makers´ preferences as closely as possible. There are different methods for eliciting the weights, each with its strengths and weaknesses (Hansen and Devlin, 2019).

The advantage of a MCA is that it expands the boundaries of the analysis compared to CBA, and allows the assessment of projects against a variety of relevant criteria, including

quantitative and qualitative ones. MCA is thus increasingly used by governments around the world to assist in evaluating projects and policies that have complex socio-economic and environmental impacts and are therefore often difficult to measure purely in monetary terms, or are treated as externalities. The main problems that arise in MCA relate to selecting which criteria to include and what weights to give to the different criteria. The selection of criteria and weights can greatly impact the results of the exercise, and should thus be carried out with the utmost attention.

As far as economic aspects are concerned in MCA, the main factors are to what extent such methods incorporate information on the costs of the intervention, and whether they can include any measure of the benefits in monetary terms. In general, MCA does not address the opportunity cost of resources. It has been debated whether cost effectiveness could be one of the criteria in a MCA but the prevailing view is that it cannot, given that doing so would involve double counting. This means that MCA has to be used in conjunction with considerations of the economic cost of the intervention in order to arrive at a decision. The use of MCA to evaluate climate policies has been developed by the United Nations Environment Programme (UNEP) and applied in a number of case studies. It covers projects both adaptation and mitigation[4].

Here, we present those elements that focus on adaptation, as a preliminary guide to what may be possible in the context of the MedProgramme SCCF project. Indeed, UNEP has proposed a set of criteria that cover most factors of concern for coastal adaptation projects. Each criterion is independent of the others and can be measured in an objective and transparent way. These seven criteria are further subdivided to give a total of 18 subcriteria that can be applied to each action, as listed below.

Main Criteria	Subcriteria	Indicator
Public finance needs	• Investment expenditure	• Overall cost of investment
	• Other expenditure	• All variable costs
Implementation barriers	• Ease of implementation	• Quality of institutions and capacity to implement
	• Ability to meet deadlines	• Expert judgement score
Climate outputs	• Reduce GHGs	• Reduction as % of baseline
	• Enhance resilience	• Expert judgement score
Economic outputs	• Promote private investment	• Estimate of private investment generated
	• Improve economic performance	• Increase in energy efficiency (%)
	• Create employment	• Number of jobs created
	• Contribute to fiscal sustainability	• Revenues generated to the public sector

[4] See A practical framework for planning pro-development climate policy (UNEP, 2011).

Environmental outputs	• Protect environmental resources	• Change in environmental quality indicators in region
	• Support biodiversity	• Changes in number of species
	• Support ecosystem services	• Expert judgement score
Social outputs	• Reduce poverty	• Change in poverty rate
	• Improve health	• Expert judgement score
	• Preserve cultural heritage	• Expert judgement score
Political outputs	• Contribute to political stability	• Reduced dependency on imports
	• Improve governance	• Expert judgement score

Not all of these criteria have to be used in all cases, but a good selection is expected to be deployed. Possible indicators for these sub-criteria are also proposed. In conducting the various analyses, the following seven steps need to be carried out:

1. Establish the context;
2. Identify options to be evaluated;
3. Agree on criteria to be used;
4. Agree on scenarios, timeline and methods of assessment;
5. Score the different options;
6. Weight the different scores for the criteria to obtain a total score;
7. Test and compare the results.

The scores for the various indicators are multiplied by a weight, and then added to obtain a total score for each project. Weights for each indicator will reflect the units in which it is measured, and are based on consultations and expert judgements. Weights add up to 1.

The guidelines note that subjectivity in scoring and weighting can be reduced by:

- the involvement of individuals with expertise in both the concept under evaluation (e.g. health impacts) and the application (for example, in a specific region);
- the specification or construction of an appropriate scale defined in terms of performance against one or more objectively measurable criteria;
- a solid stakeholder engagement process;
- the mobilisation of an experienced facilitator who supports and challenges those responsible for scoring and weighting the options.

All in all, it is possible to consider that these aspects are met by the MedProgramme's CP 2.1 and SCCF Project's coastal management and adaptation activities that are currently underway in both coastal hotspots. This is especially the case in terms of stakeholder engagement, the involvement of sectoral experts with strong expertise in these specific coastal hotspots, and the involvement of national consultants and experts who are able to translate the objectives of the MedProgramme to local contexts.

Regarding the application of MCA to the projects identified by the local stakeholders in both areas, the following points should be considered. First is the question of which alternatives to evaluate. MCA can be applied within a measure as listed above, or between measures. In the former case, it would apply to variations in the design of the action and its implementation. In the latter, it would apply to agreed designs for each action. The second is much more difficult, and in the examples given by UNEP the alternatives are in one location, with different ways of adapting being evaluated. If MCA is to be applied to each location, the information we have is not detailed enough to consider alternative designs. The best that can be done is to compare each measure against the alternative of no action, as presented in the next section.

4. Selecting Coastal Adaptation Solutions For Cost-Benefit Analyses In Both Coastal Hotspots

In this section, we analyse the proposed coastal adaptation measures listed in Section 2 in a qualitative manner, with a subset of the sub-criteria proposed by UNEP. In addition to the sub-criteria proposed, two more criteria have been added:

i) contribution to gender equality, so as to reflect the overall MedProgramme focus on gender;

ii) availability of data to conduct a CBA.

The purpose of this exercise is to screen whether a project is worth investigating further by applying a CBA during the second phase of this activity within the MedProgramme SCCF Project. If this is the case, a list of the information required is provided. At this stage, it is important to note that this preliminary MCA is based on the results of the participatory workshops described in Section 2, and are therefore based on limited data and indicators. It nonetheless provides a useful basis from which to further pursue and deepen the SCCF activities in Kotor Bay and the Tangier-Tetouan-Al Hoceima region. The qualitative scores are graded on a scale of three: low, medium and high and are described by the following legend:

Legend	
Low	
Medium	
High	

4.1 Proposed coastal adaptation solutions in Kotor Bay, Montenegro

<table>
<tr><th colspan="6">Solution 1: Better waste management for Kotor Bay</th></tr>
<tr><td>Description</td><td colspan="5">This solution would consist in developing a waste management plan coupled with a land remediation plan for the Lovanja landfill as well as illegal landfills in Kotor Bay. At present, Kotor Bay's only landfill is located in Lovanja, close to Tivat and the Tivat salines, a Ramsar site. This landfill also services the large town of Budva, located south of the Bay. Moreover, transporting waste from the other side of the Bay is lengthy, costly and inefficient.
These waste dumps directly impact soils, groundwater, seawater quality, leading to environmental pollution that negatively impacts the coastal and marine ecosystems of the Bay. Illegal dumps in particular also impact human wellbeing and health, and can negatively impact crucial economic activities, such as tourism.</td></tr>
<tr><td rowspan="4">MCA evaluation</td><td>Ease of implementation</td><td>Enhance resilience</td><td>Protect the environment</td><td>Support biodiversity and ecosystem services</td><td>Reduce poverty</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Improve health and well-being</td><td>Create employment</td><td>Gender equality and advancement</td><td>Improve governance</td><td>Data availability for CBA</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CBA feasibility</td><td colspan="5">The project is likely to be quite difficult to implement and its contribution to enhancing climate resilience will be low. It can, however, create a moderate amount of employment and, by managing waste and preventing it from leaching into the Bay's soils, groundwater and seawater, should make a good contribution to the protection of the environment as well as human health and wellbeing. In this sense, it can also support and enhance biodiversity and ecosystem services. The impacts on poverty and gender equality are likely to be low, although this is subject to discussion with stakeholders. Governance should be positively impacted, since this solution would require enhanced collaboration between the Bay's three municipalities, as well as Budva municipality. In our view, the CBA is feasible but requires a lot of data. This would include the following:
• Savings in costs of transportation and emissions of the waste that is currently taken to the Lovanja landfill from the entire Bay and Budva.
• Estimates of amounts of waste deposited in non-sanitary landfills throughout Kotor Bay.
• Composition of the waste that goes to such landfills. Since local studies do not seem to be available, estimates can be drawn from EU-level studies (cf. Bio Intelligence Service, 2011).
• Estimates of environmental damages and human health impacts, based on the composition of waste.
• Costs of a new landfill, including capital and maintenance costs. This can be obtained from local engineering companies, working on landfills in the country. If not, data can be obtained from the literature.</td></tr>
</table>

	• Estimates of depreciation of property close to the new landfill site. This is usually a percent of the current land values, and would require information on current land values as well as stock exposed to the landfill at different distances from the site (Schutt, 2021). The main challenges will be to estimate damages from disposal in non-sanitary landfills and property depreciation. Such a study would be very time consuming and require considerable amounts of technical information. If this item is to be subject to a CBA, it will depend heavily on work conducted elsewhere, and will still require local data as previously indicated.

Solution 2: Updating public green space cadastres in Kotor Bay					
Description	Both Kotor and Herceg Novi municipalities possess such a cadastre, and Tivat's is currently underway. This solution is easy to implement, and provides a good basis from which to undertake more ambitious adaptation actions in Kotor Bay's urban and periurban areas. Once the updated cadastres are available, urban afforestation and greening measures could build on them to boost the Bay's overall resilience. This could consist in the development of an integrated, Bay-wide database to inform spatial planning.				
MCA evaluation	Ease of implementation	Enhance resilience	Protect the environment	Support biodiversity and ecosystem services	Reduce poverty
	Improve health and well-being	Create employment	Gender equality and advancement	Improve governance	Data availability for CBA
					not applicable
CBA feasibility	The screening MCA revealed that achieving a better understanding of public urban green spaces' locations, maintenance, resource input needs and composition in terms of fauna and flora can support the overall resilience of the Bay, notably in terms of: • reducing the urban heat island effect and supporting healthier urban microclimates • increasing water infiltration and retention in urban spaces (thereby reducing flood risks) and increasing soil health and drought resistance • diminishing the levels and impacts of air and noise pollution • increasing urban green space carbon sequestration capacity • supporting the Bay's biodiversity and allowing for the establishment of urban/periurban green corridors to preserve ecosystem integrity • positively impacting human health and wellbeing Better public green space management in the Bay could also enhance the area's image and touristic value, indirectly generating jobs and income. It could moderately improve governance, allowing for improved inter-municipal collaboration and citizen involvement in designing, maintaining and contributing to public urban green spaces. Given the great variety of these potential impacts and the different locations and types of spaces concerned in Kotor Bay, the benefits of this action could not easily be captured by a CBA. Nonetheless, and				

	since the MCA screening reveals quite a positive score, this solution is worth further exploring in the future.

Solution 3: Afforestation with autochthonous species and greening urban spaces					
Description	This proposed solution is related to Solution 2 above, but also includes Kotor Bay's periurban and natural areas. It would actually benefit from the updated public green space cadastres targeted by Solution 2, extending the potential benefits mentioned above to a broader scale in the Bay, notably encompassing the area's agricultural and natural areas.				
MCA evaluation	Ease of implementation	Enhance resilience	Protect the environment	Support biodiversity and ecosystem services	Reduce poverty
	Improve health and well-being	Create employment	Gender equality and advancement	Improve governance	Data availability for CBA
CBA feasibility	The screening MCA indicates a positive score with respect to enhanced resilience, protection of the environment, supporting biodiversity and enhancing ecosystem services. This solution would also help to create employment, both in the implementation of the program and through maintaining the greened areas. Data availability for a CBA is moderately good. The measure can thus be evaluated using this approach, but the data requirements are quite demanding. On the cost side, the value of land where afforestation takes place and revenues forgone from current uses is needed. In terms of benefits, see Solution 2 above for a selection of the main benefits of these greening and afforestation measures. This solution could be assessed using different models. For instance, the InVEST[5] model was set up to estimate and value such gains as well as an increase in water availability in the water basin (if any). Indeed, InVEST (Integrated Valuation of Ecosystem Services and Tradeoffs) is a suite of models used to map and value the goods and services from nature that sustain and fulfil human life. It helps to explore how changes in ecosystems can lead to changes in the flows of many different benefits to humans. InVEST can also estimate erosion prevention, biodiversity gains and carbon sequestration. It is also possible to estimate the benefits resulting from the filtering of contaminants present in water as it flows through these afforested and/or greened areas and the resulting savings in terms of water treatment costs, (Ncaves and Maia, 2022). Heat island benefits would be derived from energy savings due to reduced temperatures in the adjoining areas. It may also be possible to estimate the reduced health impacts, but this effort would require much more data on climate projections. For instance, an application of such benefits was conducted in the United Kingdom (ONS, 2019; ONS, 2021). These estimates demand considerable amounts of data at a spatially disaggregated level. In summary, a CBA is possible, but demands considerable modelling and numerous data inputs.				

[5]For more information about InVEST, see https://naturalcapitalproject.stanford.edu/software/invest.

<table>
<tr><th colspan="6">Solution 4: Beach replenishment in harmony with the coastal and marine environments</th></tr>
<tr><td>Description</td><td colspan="5">This proposed solution aims at undertaking beach replenishment in areas of the Bay that are affected by sea level rise, storm surges, wave impacts and coastal erosion. The potential benefits of this solution include:

● the protection of natural beach habitats
● the retention of sediment volumes despite sea level rise
● the protection of buildings, infrastructure and coasts from wave impacts
● improvement of the touristic and recreational potential of beaches

The potential locations of these interventions have yet to be defined.</td></tr>
<tr><td rowspan="4">MCA evaluation</td><td>Ease of implementation</td><td>Enhance resilience</td><td>Protect the environment</td><td>Support biodiversity and ecosystem services</td><td>Reduce poverty</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Improve health and well-being</td><td>Create employment</td><td>Gender equality and advancement</td><td>Improve governance</td><td>Data availability for CBA</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CBA feasibility</td><td colspan="5">Despite the benefits listed above, beach replenishment is a short-term and often costly solution that usually needs to be repeated periodically in order to maintain the current state of the beach. It can also negatively impact the coastal and marine ecosystems in and around the location. This could be important in terms of supporting tourism in Kotor Bay, a crucial sector in this area. As a side note, it is important to note that coastal erosion in the Bay is also caused by cruise ships entering the Bay, which calls for a reappraisal of the manner in which tourism will function in the Bay in the medium- to long-term.

The alternative scenario is no action. Although it is possible to consider alternatives such as sea walls, it is safe to assume that these would be rejected on technical grounds in the selected locations, first and foremost due to the distinctive topography of Kotor Bay[6].

All in all, a CBA is possible for this measure. The data needed would consist of:

● Current and projected losses of the beach front(s), and damages to assets caused by storm surges and sea level rise in the area.

● Estimates of reductions in damages resulting from replenishment over a defined horizon. This would be based on current losses from sea level-rise and storm surges and expected future losses, based on increases in both phenomena.

● The number of visitors to the beaches affected and estimates of benefits derived currently from such visits (usually based on the cost of travel and time spent at the site). Projections of future benefits in the absence of loss of beach if replenishment takes place.</td></tr>
</table>

[6] For a useful CBA of beach nourishment, see Lupino et al, 2005.

	• Costs of the program, in terms of both capital and maintenance[7].

Solution 5: Regulating and treating ballast waters from shipping in Kotor Bay					
Description	In general, ballast waters are an important environmental problem in all of the world's marine areas. The disposal of ballast water in coastal areas takes place when vessels reach shipping ports. In this way, thousands of coastal and marine species are unknowingly transported across the world's oceans in ships' ballast water. Once the latter are released, these species can become invasive, damage ecosystems, displace species, and also cause economic damages. To reduce the risk of invasive species threatening the distinctive coastal and marine ecosystems of Kotor Bay, this solution aims at better regulating and treating the ballast waters that are brought to the Bay onboard vessels. According to a report by WWF, non-treated ballast waters imposed marine pest-associated direct costs of over USD $7 billion per year in 2004-05 (WWF, 2009). At the time, WWF calculated a cost of USD $0.70/tonne of untreated ballast water. This compares to a cost to society of not ensuring ballast water treatment of no more than 16 USD cents, making the damages about 350% higher than fitting adequate treatment on-board vessels, using the higher estimate for cost of treatment. For a more recent assessment of the impacts of invasive species, see the IPBES Invasive Alien Species Assessment: Summary for Policymakers (IPBES, 2023). This report indicates that invasive species play a key role in 60% of global plant and animal extinctions. The annual costs of this threat now exceed USD $423 billion, having quadrupled every decade since 1970.				
MCA evaluation	Ease of implementation	Enhance resilience	Protect the environment	Support biodiversity and ecosystem services	Reduce poverty
	Improve health and well-being	Create employment	Gender equality and advancement	Improve governance	Data availability for CBA
CBA feasibility	An MCA screening shows a relatively low score for this option. It will protect the environment and could improve environmental governance in the Bay by encouraging more collaboration between local authorities and boat operators. A CBA is relatively easy to conduct. In addition to the information on costs provided by the WWF report, the following information would also be needed: (a) the costs of undertaking the regulatory measures, (b) the amount of ballast water that would be collected. If this can be done, a CBA can be conducted relatively easily.				

Solution 6: Rehabilitation of Kotor Bay's communal water infrastructure	
Description	Due to its steep, rugged topography and very narrow coastline, Kotor Bay is highly vulnerable to water insecurity in the context of climate change. Over the coming decades, numerous efforts will be needed to ensure that the Bay has access to

[7] For data on the costs of coastal protection, see UK Environment Agency, 2015.

<table>
<tr><td></td><td>water. Therefore, stakeholders emphasised the need to improve the area's communal water infrastructure. The benefits of this measure would be:
a decrease in water losses
an increased number of network connections
an increase in the capacity of the water supply system
increased wastewater treatment capacity.
This solution could also include the rehabilitation of water reservoirs built during the Austro-Hungarian period, located in the mountains above Kotor Bay and used for natural water harvesting and retention.</td></tr>
<tr><td>MCA evaluation</td><td><table>
<tr><td>Ease of implementation</td><td>Enhance resilience</td><td>Protect the environment</td><td>Support biodiversity and ecosystem services</td><td>Reduce poverty</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Improve health and well-being</td><td>Create employment</td><td>Gender equality and advancement</td><td>Improve governance</td><td>Data availability for CBA</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
</table></td></tr>
<tr><td>CBA feasibility</td><td>This proposed intervention scores relatively well in the screening MCA. It should be relatively easy to implement, would create employment, improve Kotor Bay's water security, and better protect the environment from untreated water discharges. In turn, this would have some health benefits for the Bay's inhabitants and visitors, as well as its biodiversity. Such projects are commonly subject to a CBA and one is possible here. The required data consists of:
The estimated reduction of water losses and its value in terms of revenues recovered, as well as the value of water to final users. Ideally, this is obtained from the demand curve for water but in the absence of that, the cost of supply per metre can be used as a proxy.
The estimated increase in the capacity of the wastewater system and its value. Again, for the value, the ideal case would be to estimate the damage avoided by the present methods of disposal (probably discharge of untreated water into a river or the sea). In the absence of a damage study, the benefits can be proxied by the cost per cubic metre of treated wastewater.
The costs of the program, both in terms of capital and maintenance. These are available from engineering estimates.</td></tr>
</table>

<table>
<tr><th colspan="6">Solution 7: Update the cadastre of sewage outlets and systematise data management</th></tr>
<tr><td>Description</td><td colspan="5">This solution aims at alleviating the pressures on Kotor Bay’s coastal and marine environments due to untreated water discharges, while improving both municipal and inter-municipal collaboration and governance in terms of water and wastewater management. In this sense, it could be combined with Solution 6 above.</td></tr>
<tr><td rowspan="4">MCA evaluation</td><td>Ease of implementation</td><td>Enhance resilience</td><td>Protect the environment</td><td>Support biodiversity and ecosystem services</td><td>Reduce poverty</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Improve health and well-being</td><td>Create employment</td><td>Gender equality and advancement</td><td>Improve governance</td><td>Data availability for CBA</td></tr>
<tr><td></td><td></td><td></td><td></td><td>not applicable</td></tr>
<tr><td>CBA feasibility</td><td colspan="5">The preliminary MCA screening indicates that the action is easy to implement and should help to protect the environment and improve water governance in Kotor Bay. The benefits are the construction of a database that can provide information on the current status of wastewater sewage outlets in the Bay, and inform decision-making regarding future needs in terms of wastewater infrastructure. This is something of value, but is not usually subject to a CBA.</td></tr>
</table>

4.2 Proposed coastal adaptation solutions in the Tangier-Tetouan-Al Hoceima region, Morocco

In this subsection, we go through the coastal adaptation solutions proposed by the workshop stakeholders in the Tangier-Tetouan-Al Hoceima region, Morocco.

<table>
<tr><th colspan="6">Solution 1: Reducing coastal erosion by El Jebha</th></tr>
<tr><td>Description</td><td colspan="5">This solution aims at reducing the risk of coastal erosion in the small port town of El Jebha. This notably involves the installation of both grey and green infrastructure to alleviate this risk:

● Grey infrastructure would consist in the installation of metallic nets covering about 500 metres of vulnerable frontage on cliffs to prevent coastal erosion, and reduce the risk of injury to people or damage to infrastructure due to rockfall.

● Green infrastructure would consist in terracing the slopes above El Jebha, while planting deep-rooted trees and shrubs to stabilise soils and reduce run-off and erosion. This would have the additional benefit of increasing water infiltration and retention, creating microclimates in the area and bolstering biodiversity.</td></tr>
<tr><td rowspan="4">MCA evaluation</td><td>Ease of implementation</td><td>Enhance resilience</td><td>Protect the environment</td><td>Support biodiversity and ecosystem services</td><td>Reduce poverty</td></tr>
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<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CBA feasibility</td><td colspan="5">The MCA screening suggests that this intervention is attractive according to the criteria applied. It should be easy to implement, will increase resilience to climate change, create employment and help protect the environment. In principle, this solution may be submitted to a CBA. The data required to do so includes:

● Costs of the protective measures (capital plus maintenance)
● Current cases of injury to people and damage to infrastructure and property from falling rocks and debris.

The grey infrastructure proposed in this case is an efficient, short-term solution, the benefits of which may be summed up more easily than in the case of the green infrastructure solutions proposed above. Indeed, the mid- to long-term benefits of the latter in terms of carbon sequestration, biodiversity benefits, water availability and ecosystem services provided would require a considerable amount of additional data.</td></tr>
</table>

<table>
<tr><th colspan="6">Solution 2: Improving flood risk management around Martil</th></tr>
<tr><td>Description</td><td colspan="5">Floods can result in damage to the environment and to human health. The coastal town of Martil, located close to Tetouan, is highly exposed to flood risks, since it is located in the Martil River (Oued Martil) watershed, which encompasses both urban areas. This area is flood-prone due to the mountainous topography that gives way to the vast alluvial floodplain of the river further downstream, coupled with an irregular hydrological regime. Sea level rise and long periods of drought interrupted by bouts of intense precipitation are further compounding this risk. Several anthropogenic factors are further aggravating this situation, notably due to the presence of constructions in flood-prone areas, encroachments of infrastructure on the riverbed, a majority of impermeable surfaces in the urban fabric and the dumping of construction materials and debris in or close to the river.

Given the scale of this challenge, more details on the measures are necessary than the ones that stakeholders were able to provide during the workshop. However, participants agreed on the fact that population displacement is not an option in this case. Conversely, green infrastructure and Nature-based solutions were proposed to address this challenge, coupled with awareness-raising efforts amongst the population (especially youth). Moreover, participants indicated that land use planning should be strengthened in the region, since it does not currently take enough account of flooding. More specifically, the construction of natural dykes and green corridors with native species were suggested.</td></tr>
<tr><td rowspan="4">MCA evaluation</td><td>Ease of implementation</td><td>Enhance resilience</td><td>Protect the environment</td><td>Support biodiversity and ecosystem services</td><td>Reduce poverty</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Improve health and well-being</td><td>Create employment</td><td>Gender equality and advancement</td><td>Improve governance</td><td>Data availability for CBA</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CBA feasibility</td><td colspan="5">This measure scores very highly according to the screening MCA, since it significantly enhances resilience to climate change, while lowering the risk posed by floods to people and infrastructure. As Plan Bleu’s gender-sensitive climate risk assessment of the TTA region illustrates, vulnerable populations (especially women) tend to live in the areas that are most exposed to extreme weather events and climate risks, including floods. Given the scale of this potential effort, the outcomes in terms of governance, employment and poverty reduction could also be located in the medium range.

From a CBA viewpoint, however, data availability is a major problem, since this effort would ultimately involve numerous lines of work at different scales and in different sectors. Although it scores very highly in MCA terms, given the nature of these interventions, it does not seem suitable for a CBA. It will be almost impossible to quantify the benefits of the actions and value them in monetary terms. In this specific case, a more in-depth MCA could better capture the potential benefits of this proposed adaptation solution.</td></tr>
</table>

<table>
<tr><th colspan="6">Solution 3: Establishing natural dykes and green corridors with native species in Stehat</th></tr>
<tr><td>Description</td><td colspan="5">This solution targets the same issue as Solution 2 above, namely flood risk. Given the smaller size of this area than the Martil floodplain, it could serve as a useful demonstration site and potential “proof of concept” for the latter zone. Indeed, Stehat is located close to seasonal rivers (oueds), which are difficult to canalise using grey infrastructure. Participants thus proposed a total surface of 5 km² as an initial demonstration site in order to showcase the benefits of using natural dykes and green corridors to counter flood risk. A period of 3 years for the feasibility study and 2 years for construction is envisaged, resulting in a perennial solution that would require periodic maintenance. The proposal also included awareness-raising activities concerning the Loi littoral, the Moroccan Coastal Law.</td></tr>
<tr><td rowspan="4">MCA evaluation</td><td>Ease of implementation</td><td>Enhance resilience</td><td>Protect the environment</td><td>Support biodiversity and ecosystem services</td><td>Reduce poverty</td></tr>
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<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CBA feasibility</td><td colspan="5">The screening MCA indicates that, while the project can potentially present implementation challenges, it presents important benefits in terms of environmental protection, boosting resilience and improving the living conditions of the area’s inhabitants, with health and wellbeing benefits coupled with the possibility of generating employment. In principle, the proposed intervention could be evaluated with a CBA. In order to do so, the following estimates are needed:
The assets in the zone affected by floods and their respective value. These assets include private and public buildings, roads and other infrastructure.
The frequency of floods that the dykes seek to protect against.
The degree of protection that the dykes will provide.
The number of people affected by floods of the kinds that the dykes will protect against.
An estimate of the future growth in assets and numbers of people in the zone.
The capital and operating costs of the system of dykes.
Other benefits associated with the program (these may not be converted into monetary terms).
With this information, a CBA could be undertaken to evaluate this coastal adaptation solution.</td></tr>
</table>

Solution 4: Reducing the threat of invasive species due to ballast waters around Jbel Moussa	
Description	This solution aims at addressing the issue of invasive species in the marine areas located around Jbel Moussa, on the African shore of the Strait of Gibraltar. This is a pressing issue in one of the world’s busiest maritime areas. Given the transboundary nature of this challenge, the workshop participants suggested initiating a transboundary adaptation collaboration with the Port Authority of Valencia, Spain (VALENCIAPORT), potentially through the European Union’s Horizon

	2020 Odyssea Platform[8] project. As noted above in Solution 5 for Kotor Bay, invasive species represent a major global threat for biodiversity, and are also the cause of huge economic losses.

MCA evaluation					
	Ease of implementation	Enhance resilience	Protect the environment	Support biodiversity and ecosystem services	Reduce poverty
	Improve health and well-being	Create employment	Gender equality and advancement	Improve governance	Data availability for CBA

CBA feasibility	
	The MCA here is similar to that undertaken for Kotor Bay (cf. Solution 5 above). However, it is important to highlight the stark difference between both locations in terms of the volume of marine traffic that they experience. To sum up, the information listed in Solution above 5 could be combined with: • the costs of setting up control facilities on vessels and setting up the local control system; • estimates of the amount of ballast water that would have been released, that is now disposed of properly. Based on this information, a CBA could be carried out.

Solution 5: Developing aquaculture in the Loukkos river basin	
Description	This coastal adaptation solution varied slightly from the other ones proposed by zooming in on food security and food production in TTA, in the context of the Blue Economy. The intervention aims to develop resilient and durable aquaculture in the area. This would be done through the diversification of aquaculture sites at sea and on land. Measures would consist of: • Choice of species resistant to diseases and climatic hazards; • Seaweed farming; • Adoption of innovative techniques at sea resistant to hydraulic variations; • Adoption of innovative and efficient low impact techniques on land. This solution could also comprise capacity-building and technology/best practice transfer to best adapt both marine and freshwater aquaculture to climate change.

MCA evaluation					
	Ease of implementation	Enhance resilience	Protect the environment	Support biodiversity and ecosystem services	Reduce poverty
	Improve health and well-being	Create employment	Gender equality and advancement	Improve governance	Data availability for CBA
					not applicable

[8] For more information, visit https://odysseaplatform.eu/.

CBA feasibility	The MCA screening indicates that the proposed intervention has a number of positive outcomes in terms of the selected criteria. However, from a CBA viewpoint, the activity is focussed on aquaculture with few links to coastal adaptation. Most importantly, it would involve commercial information held by private actors that will be difficult to obtain. Therefore, this solution does not seem suitable for a detailed CBA focusing on adaptation to climate change, although sustainable aquaculture has significant contributions to make to food security.

Solution 6: Improving water harvesting and management in the region and managing flood risks					
Description	This solution aims to improve water security and awareness on a large scale in several areas of TTA. Workshop participants proposed a set of different practices to support this effort, including: ● Protecting local communities from flooding through measures such as terracing, dykes, improved drainage systems and reforestation/afforestation; ● Rainwater harvesting; ● Participatory water governance and management of local water systems; ● Seawater desalination. The potential locations listed by workshop participants were: Tizgane, M'tioua and Amthar (Chefchaouen Province) as well as TTA's Ramsar Sites (wetlands), coastal areas (the *Tangérois*), and TTA's rural areas. Although some of these areas are not necessarily coastal locations, it is important to note that integrated adaptation efforts between coastal areas and the hinterland are especially valuable when it comes to water and adopting a "source-to-sea" approach.				
MCA evaluation	Ease of implementation	Enhance resilience	Protect the environment	Support biodiversity and ecosystem services	Reduce poverty
	Improve health and well-being	Create employment	Gender equality and advancement	Improve governance	Data availability for CBA
CBA feasibility	The screening MCA rates this intervention very highly. It will boost climate resilience, ecosystem health and service provision. It will also contribute to human health and wellbeing, while creating opportunities for employment creation and poverty alleviation, depending on the locations and scale of the interventions. Governance can also be improved through the suggested participatory approaches. Although a list of possible sites was proposed, a prioritisation of the latter should be performed to determine how the proposed solutions can best fit the specific contexts of the different locations mentioned by the stakeholders. This ranking could be derived by using the MCA tool as it has been used here, or in a modified form. Detailed information for each site on the criteria would, however, have to be collected. In principle, projects involving water management can be submitted to a CBA. In order to undertake the analysis, the specific actions should be explored in more detail. While some information was given on costs at a general level, the following data is also necessary:				

	• Specific capital and operating costs for each project at each location. • Benefits, in terms of water losses prevented and water collected. • Estimates of the value of water, based on a combination of costs of supply (piped and irrigation water) and costs of getting water from other sources (e.g., where individuals currently have to walk to a water source). • Other benefits in terms of less flooding, less erosion, loss of biodiversity. From this data, a CBA could be made for selected projects. This proposed solution could also be combined with the following one, which focuses on food security. The authors do not, however, recommend including desalination plants, as they are a very technical option for which the biodiversity costs are still unclear (e.g., the impacts of brine on marine ecosystems). There are also potentially high energy costs for desalination.

Solution 7: Boosting food security and biodiversity in TTA's rural areas					
Description	This solution aims at bolstering food security and food sovereignty, notably through the creation of local seed banks for indigenous seed varieties, for free distribution and dissemination in TTA and Morocco. Often, these varieties tend to be particularly adapted to the local conditions in which they have evolved over time. In the case of TTA, local seeds are potentially more heat- and/or drought-resistant than non-indigenous seeds, and are therefore a cornerstone of resilient food systems, especially in rural, agricultural areas. Given the importance of agriculture for numerous Moroccans and for the country's economy, this solution can form an important part of Morocco's food security. Moreover, it can be combined with landscape restoration interventions and urban agriculture and awareness-raising efforts. During the workshop, the stakeholders proposed several different measures in addition to creating local seed banks, such as: • Promoting and encouraging the marketing of local seeds through state and private sector subsidies; • Promoting and raising awareness of the benefits of agroecological and permaculture practices, as well as water-efficient irrigation practices; • Support and promote local producer associations and farmers cooperatives; • Building natural water retention basins.				
MCA evaluation (to do)	Ease of implementation	Enhance resilience	Protect the environment	Support biodiversity and ecosystem services	Reduce poverty
	Improve health and well-being	Create employment	Gender equality and advancement	Improve governance	Data availability for CBA

CBA feasibility	These measures do not constitute a detailed program, but rather a list of actions that need to be further elaborated upon before they can be evaluated. To be sure, they can all generate benefits in terms of rural development, ecosystem health and biodiversity protection. They can also support employment generation and poverty alleviation, while improving nutrition and thereby health, especially in Morocco's rural areas. In order to undertake a CBA, more detailed information is required. It is possible to collect this for some of the interventions, namely: ● the creation of local native seed banks; ● Promoting and supporting the cultivation and dissemination of native seeds through state subsidies and support from the private sector; ● Promoting water-efficient irrigation; ● Building natural water retention basins. As a background to a quantitative analysis and a potential CBA, it would be useful to establish a baseline of current yields and changes in yields between now, 2030 and 2050 while bearing the impacts of climate change in mind. This can be obtained from a major IFPRI study, which looks at data at individual countries for livestock and key crops (IFRPI, 2022). Taking this as a baseline, gains in yields resulting from each of the above actions should be estimated by local experts. In addition, estimates should be provided for: ● The direct capital and operating costs involved for each action. ● Farm gate prices of crops grown and livestock. ● Increase in water availability to farmers and communities from natural water retention basins. ● Value of water supplied based on the water harvesting and management approaches described above. ● Reductions in water use and cost savings to the farmers. ● From this data, a CBA evaluation can be conducted for the selected components of this overarching adaptation solution.

Solution 8: Creating zones for wind sports and supporting coastal eco-tourism in the Provinces of Tangier–Asilah and Fahs-Anjra					
Description	This measure consists in the creation of devoted areas for windsports along the coasts of TTA. In this sense, it can contribute to sustainable ecotourism, leisure, health and wellbeing, awareness-raising and potential conservation actions, as well as income generation in the coastal areas concerned. It is important to highlight the importance of working closely with touristic operators and wind sports companies to ensure that any developments are closely aligned with sustainable tourism approaches.				
MCA evaluation	Ease of implementation	Enhance resilience	Protect the environment	Support biodiversity and ecosystem services	Reduce poverty
	Improve health and well-being	Create employment	Gender equality and advancement	Improve governance	Data availability for CBA

CBA feasibility	For the CBA to be performed, the following information should be collected: ● The increase in the number of visitors to the sites. ● The net cost of providing the services to the visitors. ● The increase in numbers of people employed in providing these services. ● The amounts of revenue generated from the visitors. ● Any impacts on the environment that result from the activities (these could be positive or negative and may not be quantified). It thus seems that this proposed solution can be submitted to a CBA.				

5. Conclusion and Next Steps

This report has summarised a participatory process that was developed in parallel with the development of Coastal Plans in Kotor Bay, Montenegro and the Tangier-Tetouan-Al Hoceima region, Morocco, in the context of the GEF MedProgramme SCCF Project. This participatory process highlighted some of the key issues that local and national stakeholders consider crucial in the coastal hotspots in terms of coastal adaptation and sustainability. Workshop participants also had the opportunity to learn more about these economic analysis methods, and how they can be applied to coastal adaptation solutions and coastal resilience.

From the review of the proposed measures above, a CBA can in principle be conducted in the following cases, which are ordered by priority, given the screening MCA performed. In the case of Kotor Bay, the MCA and CBA rankings concur, whereas CBA feasibility ranks the proposed solutions differently than the MCA scoring. The next step is to present the list of data requirements to local experts so that they can determine if the information can be collected within the project time frame for the elaboration of CBAs.

This second stage of analysis, applying CBAs to selected coastal adaptation solutions, is currently underway in the context of the MedProgramme SCCF Project, and results are forthcoming. Together, these activities will inform future efforts to build local and national stakeholders' capacities on coastal ecosystem-based adaptation and Nature-based solutions in the MedProgramme SCCF project countries, based on the experiences of both coastal hotspots analysed in this report.

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