Proposals for interventions to protect and support the sustainable development of coastal zones

Tangier-Tétouan-Al Hoceima region (Morocco) and Boka Kotorska Bay (Montenegro)

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1. INTRODUCTION

Climate impacts are increasing across the globe despite all the agreements (international, national and at lower level) adopted so far to limit greenhouse gas emissions. However, mitigation action must not be neglected, but must be accompanied by ambitious and efficient action to adapt to climate change.

The UNEP's Adaptation Gap Report 2022 stated that global efforts in adaptation planning, financing and implementation continue to make incremental progress but fail to keep pace with increasing climate risks.

An important number of countries have already established adaptation plans (84% of Parties to the UNFCC), with objectives, time frames, considering future climate change and strengthening the science base and cooperation aspect. Moreover, this is accompanied by an increase in international adaptation finance to developing countries although it is insufficient and slowing: the estimated adaptation cost/needs are currently between five and 10 times higher than international adaptation finance flows, and the adaptation finance gap continues to widen. The UNEP's report has estimated the annual adaptation costs/needs in the range of US$160–340 billion by 2030 and US$315–565 billion by 2050. However, the international adaptation finance to developing countries was only US$28.6 billion in 2020. Therefore, without a step change in financial support, adaptation actions could be outstripped by accelerating climate impacts, which would further widen the adaptation implementation gap.

Furthermore, adaptation actions remain largely incremental in nature, typically do not address future climate change, and may reinforce existing vulnerabilities or introduce new risks, particularly for the most vulnerable areas, such as coastal zones. To be effective and adequate in the longer term, solutions must also be context-specific and address the root causes of vulnerability, such as underlying structural inequities and gendered disadvantages, in addition to reducing climate-related exposures and vulnerabilities to climate hazards.

1.1 Overview of the GEF MedProgramme and context of the SCCF (Special Climate Change Fund) Project

The Mediterranean is a region of cultural and landscape richness, as well as exceptional diversity. Climate and environmental changes resulting from human activity in this region have accelerated for the last few decades. During this period the average annual temperatures of the air and the sea have increased, sea-level has risen and the water acidification is ongoing. Conditions tend to be warmer and drier (Marini, 2018). These changes imply numerous risks for ecosystems and for human well-being. Therefore, it is crucial to update and consolidate the best scientific knowledge about climate and environmental change in the Mediterranean basin and to render it accessible to policymakers, key stakeholders and citizens.

In this context, the Mediterranean Sea Programme (MedProgramme) has been launched: Enhancing Environmental Security (2019-2024). This is a 43 million USD assortment of eight child projects funded by the Global Environment Facility (GEF), with more than 100 coordinated actions at the regional and national levels over the 2021-2025 period. Its ten beneficiary countries are Albania, Algeria, Bosnia and Herzegovina, Egypt, Libya, Lebanon, Morocco, Montenegro, Tunisia and Turkey. It represents the first GEF multi-focal area initiative in the Mediterranean Sea aiming to operationalize priority actions to

reduce major transboundary environmental stresses in its coastal areas while strengthening climate resilience and water security and improving the health and livelihoods of coastal populations. The Special Climate Change Fund (SCCF) Project "Enhancing regional climate change adaptation in the Mediterranean Marine and Coastal Areas" contributes to MedProgramme Component II. Its main objective is to identify climate risk affecting the coast and the development of adaptation strategies to overcome or cope with these risks. It will also facilitate access to climate financing, to scale up these measures in the region. Coastal planning processes represent a natural entry point for the implementation of climate change adaptation strategies in the Mediterranean.

It is important to note that the activities of the SCCF Project are fully integrated with those of MedProgramme Child Project (CP) 2.1 "Mediterranean Coastal Zones Climate Resilience Water Security and Habitat Protection". CP 2.1's main goal is to support Mediterranean countries in the implementation of the Protocol on Integrated Coastal Zone Management (ICZM Protocol) in order to reduce major transboundary environmental stresses affecting the Mediterranean Sea and its coastal areas, taking into account climate change by building climate resilience and water security, and ultimately improving the health and livelihoods of coastal populations. This will be carried out using the *Climagine* methodology, currently being implemented by Plan Bleu PAP/RAC. Climagine will contribute to the elaboration of the Regional Coastal Plans.

1.2 Objectives

This consultancy concerns the MedProgramme SCCF Project: Enhancing regional climate change adaptation in the Mediterranean Marine and Coastal Areas. It specifically focuses on two coastal hotspots: the Tanger-Tetouan-Al Hoceima region, Morocco and Boka Kotorska Bay, Montenegro.

Following several consultations with stakeholders and experts, from the last workshop in Kotor (July 2022) and in Tangier (December 2022) a number of proposals resulted in order to address the environmental and climate-related challenges faced in the coastal zones of these two regions.

The report carries out an initial overview of these adaptation solutions for TTA and Boka Kortorska Bay regions that could undergo a cost-benefit analysis in a later stage. As background material it draws on priority themes identified in hotspot areas and concerning major climate threats identified through the Climate Risk Assessments. Each proposal is described briefly, its main objectives are stated and a preliminary analysis is made to determine which ones are eligible for a full cost benefit analysis. This decision-making uses the framework of a multi-criteria analysis but also takes account of the availability of data. If such an evaluation is considered possible, a list of the key data requirements is provided.

After this introductory section, a contextualisation for the two regions under study: TTA and Boka Kotorska Bay is undertaken, based on their respective climate risk assessment. A third section summarises the workshops developed in the two regions. The results of these workshops are the inputs for the following sections of the report. In section four, the two methodologies to prioritise sectoral coastal adaptation interventions are described. Finally, these interventions are presented in section five and a selection made of those eligible for a later full cost-benefit analysis.

2. BACKGROUND: GENDER-SENSITIVE CLIMATE RISK ASSESSMENTS

In order to assess fully the different interventions proposed to be implemented in both coastal regions, it is necessary to know what is their current situation, what are the most relevant climate risks, which are the most vulnerable areas and, in general, where to put the focus.

For this, two Climate Risk Assessment reports have been elaborated, one for each region. These assessments provide a starting point for considering, prioritising, and coordinating risk management activities. They demonstrate the wide range of risks that climate change poses to regions and targeted municipalities, as well as their complexity across different social groups, municipalities, sectors, and domains of both state and municipal responsibilities. Furthermore, a climate-gender nexus is integrated.

Highlights of each of these assessments are presented in the following sub-sections.

2.1 Boka Kotorska Bay

The key takeaways and conclusion from "*Gender-Sensitive Climate Risk Assessment of Kotor Bay, Montenegro (2022)*" are:

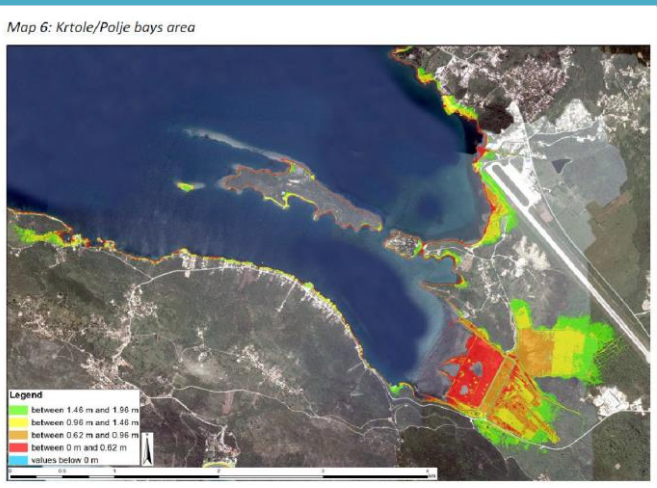
Temperature	The expected range of increases in temperature is from +2 °C in the summer months to +2.5°C in the winter months within the next 30 years for the whole country.
Precipitation	The total amount of average annual precipitation is expected to decrease by -5% in the southern region. Consecutive days with rain are also expected to decrease, while occurrence of the flash floods is expected to increase in the future.
Drought	The occurrence and magnitude of droughts is expected to increase in the future.
Forest management	Heatwaves and drought will affect the forest management related to: increased danger of forest fires; the movement of forest species towards higher latitudes; the increase of pests; the increase of negative impact on distribution of spruce, fir and white pine. ***Needs**: further changes in forest management practises to reduce drought effects and to enhance growth and quality of the forest stands (better forest fire early warning systems, modification of tending and thinning practises, use of more drought resistant trees in reforestation and plantation actions etc.)*
Marine environment	There are a number of risks related to the marine environment. Invasive species, pest outbreaks and diseases form an important risk for the natural environment (but also for other productive sectors such as agriculture and fisheries) that have to be addressed in time thought adaptation strategies. ***Needs:** Regional plans on protection of marine life in the Boka Kotorska Bay and ending practice of cruise ships entering Boka Kotorska Bay should be seriously considered. Furthermore, grater investments in waste water infrastructure are needed in order to protect marine environment in the upcoming years.*

Tourism	Favourable climate conditions are projected for the tourism industry. However, unsustainable tourism can lead to increased energy and water consumption, waste production and further losses of natural habitats especially in the coastal zone. Loss of beach assets can be further increased by coastal erosion, and it could adversely affect the tourism industry of the Boka Kotorska Bay. ***Needs:*** *increase the resilience of the energy supply system in order to meet the increasing demands for cooling and drinking water supply, due the higher touristic traffic.*
Agriculture and Food Production	Agriculture will suffer from production losses due to irrigation water deficits, while livestock production and welfare will also be impacted. Yields will be reduced due to an increase of land degradation and soil erosion. Mitigation measures by using indoor farming will increase energy consumption. **Needs**: *water conservation measures are needed, along with awareness raising campaigns in three municipalities of Boka Kotorska Bay.*
Water resources	This sector will be specially concerned by heatwaves and droughts. Impacts will be: 1) increased water demand; 2) decrease in water supply; 3) water quality problems (e.g. mixture of salty and fresh water); 4) decreased annual river. Other impacts are linked to the risk of flash floods that will affect the surface and ground water quality and could contaminate the water supply by sewerage systems. ***Needs:*** *better sewage infrastructure, especially in city centers of Herceg Novi and Tivat, along with better water supply infrastructure, resilient to the occurrence of these events.*
Energy	Energy sector will have to deal with changes in energy demands (higher overall) due to heat waves. On the other side, the risk of more frequent drought will reduce hydropower potential. ***Needs:*** *increase the resilience of the energy supply system in order to meet the increasing demands for cooling and drinking water supply.*
Transport and road infrastructure	Floods (mainly linked to sea level rise) could interrupt the transport and roads. This will result in: 1) increase of financial external cost; 2) lower reliability of the transport system. ***Needs:*** *higher seaside pavement could be implemented in order to protect cities and infrastructure from sea level rise.*
Human health	Mortality and injuries may increase due to heat waves and flood. Human health could also be affected by the increased risk of water and food shortages, and the development of food borne disease. Impact will be more significant on the older population, especially older women, who make up around 58% of the older generation. **Needs**: *improving health care structures (infrastructure and organisation) and existing building stock. Furthermore, the green and blue infrastructure should be increased, especially in city centres where, due to rapid urbanisation, it is not available.*

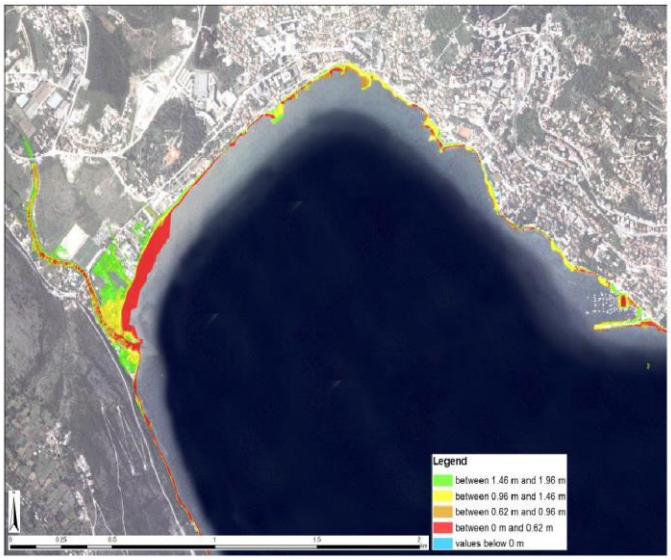
Gender	Gender continues to be identified as an 'add on' aspect, rather than an integral component. This stems from the lack of knowledge and understanding of government and municipal of how gender and social inclusion is relevant to climate change vulnerabilities and impacts and climate action. ***Needs:*** *collection of gender disaggregated data. Government should establish gender specific data and statistics on impact of disasters, carry out gender-sensitive vulnerability, risk and capacity assessments and develop gender-sensitive indicators to monitor and measure progress. Municipalities in Boka Kotorska Bay should carry out vulnerability studies with inclusion of climate-gender nexus.*

All these aspects must be considered, especially for the six bays recognised as vulnerable to the sea level rise risk. They should therefore be prioritised in the coastal adaptation plan. The maps below show the key areas at greatest risk.

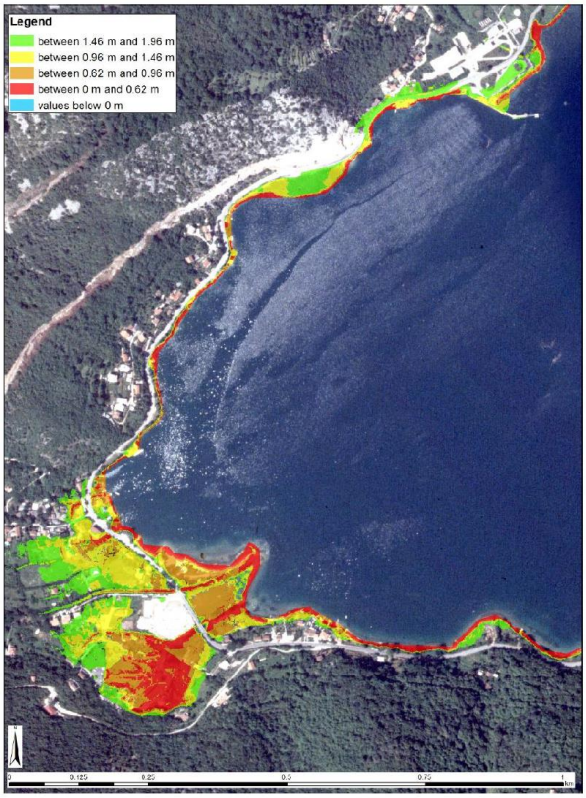
Figure 1. Bays vulnerable to sea level rise in Boka Kotorska

Krtole	Bigova
	
Igalo	**Morinj**

Map 2: Igalo area

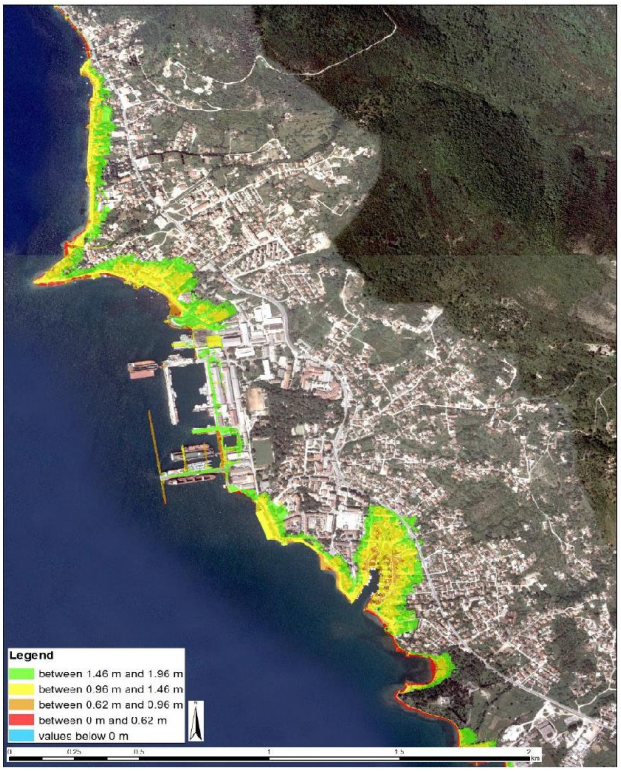


Map 3: Morinj area



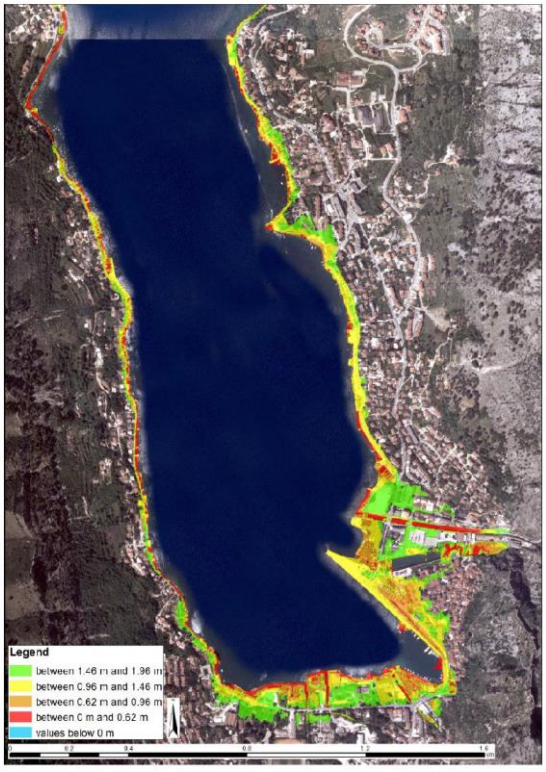
Tivat

Map 4: Tivat area



Kotor

Map 5: Kotor area



Source: Gender-Sensitive Climate Risk Assessment of Kotor Bay, Montenegro (2022)

2.2 Tanger- Tétouan-Al Hoceima region

In this case, the Climate Risk Assessment was harder to carry out given that the TTA region is a new administrative unit created in 2015, so there were some difficulties in finding homogeneous data. Despite this, it has been possible to draw up the "*Gender-Sensitive Climate Risk Assessment of the Tanger-Tétouan-Al Hoceima region, Morocco (2022)*", in which the main climate risks have been identified:

Sea level rise	Concentrated in cities and settlements by the sea, this risk is already being faced and will accelerate beyond 2050 and 2100. It involves floods, to which are added secondary risks such as coastal erosion, the salt intrusion phenomenon, the loss or alteration of important low-lying coastal ecosystems such as the wetlands and of marine and coastal biodiversity. All these impacts will have important consequences on settlements, infrastructure, and productive activities in coastal areas. If urbanisation trends in exposed areas continue, this will exacerbate the impacts, with more challenges where energy, water and other services are constrained. The number of people at risk from climate change and associated loss of biodiversity will progressively increase. The TTA region recorded sea level rise values between 2.4 and 5.2 mm per year between January 1993 and October 2019, which are among the highest values recorded along the entire Mediterranean coast.
Significant wave height	Storm surges associated with violent winds, strong waves, intense currents, flash floods triggered by heavy rains are able to damage marine and coastal ecosystems. The scientific community believes that, in all likelihood, the current coastal protection structures will not be sufficient to contain the increase in the frequency and intensity of major marine floods. In the TTA region the wave height values ranging from 6.1 m to a maximum of 11 m. The coasts of the Prefecture of Tanger and Assilah and the Province of Larache, facing the Atlantic Ocean, record the highest values ranging from 10 to 11 meters. Comparing these values with the rest of the Mediterranean coast the TTA region appears to be exposed to extreme waves.
Soil Aridity	One of the major consequences of a warming climate is the potential for increased global aridity. More than 60% of the TTA region, more than 9,760 km^2, is classified as dryland, in particular, all the coastal areas as well as the northern area of the Prefecture of Tangier-Assilah, the whole Province of Fahs Anjra and the internal areas.
Extreme precipitations	Heavy rains represent a natural hazard causing huge human and economic damages in the Mediterranean countries. Climatic scenarios indicate a significant temperature rise associated with an annual rainfall decrease and a multiplication of extreme rainfall events in many parts of the Mediterranean basin. The quick flood generation potential is important throughout the Mediterranean basin due to its steep topography, small-sized basins, and a scarce vegetation cover. Northern Morocco is particularly sensitive to extreme hydroclimatic events, especially floods related to intense rainfall events and droughts related to the high interannual variability of rainfall. The cities of

	Tetouan, Tangier and Al Hoceima are located downstream of their respective watersheds thus they are exposed to serious damage during repetitive violent floods
Population Growth and tourism trend	Increase of tourism arrivals have a huge impact putting local infrastructure and habitats under enormous pressure. Tourism overdevelopment has the same problems as other coastal developments, but often has a greater impact as the tourist developments are located at or near fragile coastal and marine ecosystems.

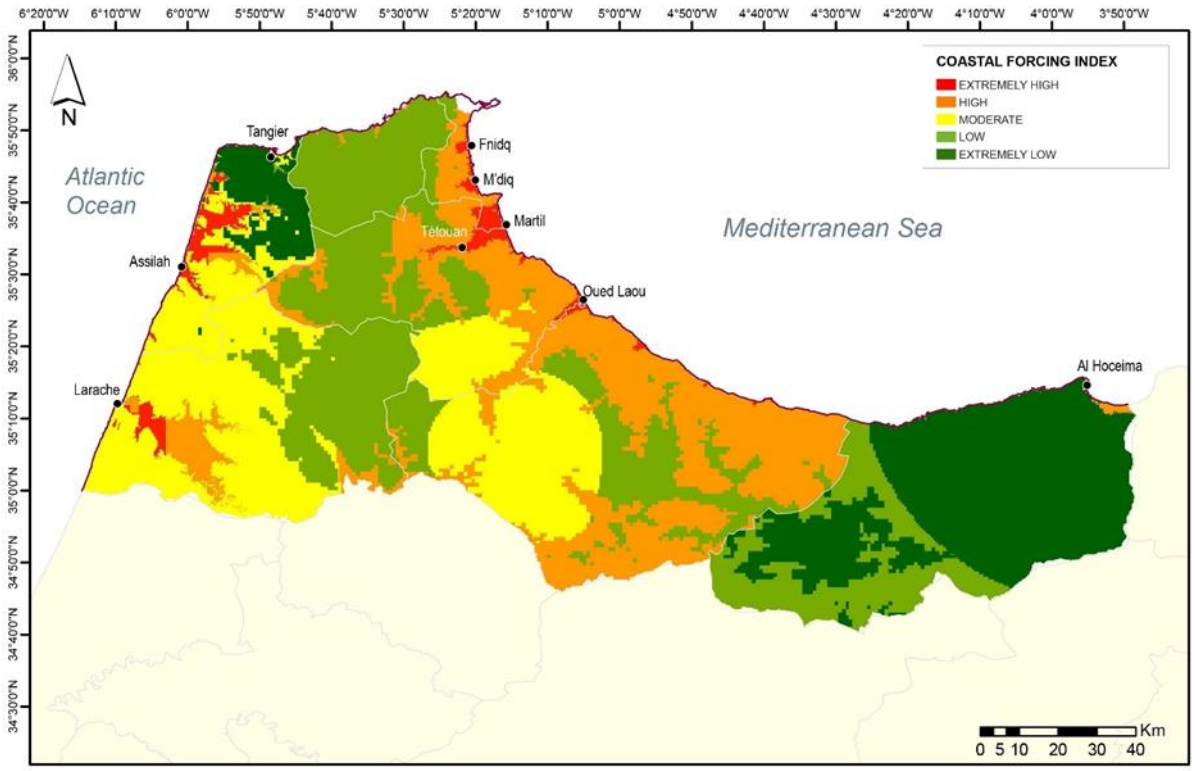
Gender is one of the key pillars of the GEF funded MedProgramme. To this end, it seeks to integrate gender as a key prism of analysis in evaluating climate risks in the TTA region. The degree to which people are affected by climate change impacts is defined by their social and economic status, age, gender. It is widely acknowledged that women in general are disproportionately affected by climate change impacts due to persistent gender inequalities. Women have lower capacity as compared to men to build resilience and adapt to climate change impacts as a result of 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 it is also acknowledged that women and men bring different skills, experiences and knowledge in environmental sustainability efforts, and can become agents of change pioneering solutions for adapting to climate change.

Gender related variable	• **Education:** - *Illiteracy rate*: the gap between men and women with respect to basic training and educational opportunities, consisting in the minimum ability to be able to read and write, is equal to over 20 percentage points (21.3) at the regional level. Thus, women of this territory are in a condition of high illiteracy, more than double the cases compared to their male counterparts. Distinguishing between urban and rural territories highlights how illiteracy rates are much lower in the former case than in the latter. - *Share of population with tertiary education:* the gender gap is quite small, equal to 1 percentage point in favour of men. The difference between urban and rural areas appears even more marked. It denotes two truly distant socio-cultural worlds marked by the urbanisation of the younger and more educated cohorts of the last decades, further accentuating the erosion of the human capital left in rural areas. Just 1.1% of the population residing in rural areas holds a tertiary qualification at the TTA scale (0.7% for females and 1.5% for males). This value increases to 7.7% for the urban population (7.0% for women and 8.3% for men).
	• **Labour market**: at the TTA level, the overall activity rate reaches a value of 51.55%, with an enormous difference of 53.5 percentage points between females (24%) and males (77.5%). This is also due to the prevalent female presence in unpaid domestic and care work, and the lack of formal regularisation of their contribution in the different phases of the production chain of the agricultural and agro-

	food sectors, especially in the context of small family-run businesses. A difference emerges between rural and urban areas, with a much more pronounced gender gap in the former case than in the latter. At the regional scale, the activity rate of the population residing in rural areas is 49.6% (79% for men and 18.8% for women, with a gap of 60.2 percentage points to the disadvantage of women), while the indicator reaches a total value of 52% in urban areas, with a gap of "only" 49.5 percentage points between men (76.6%) and women (27.1%).
	● **Health status and quality of life**: in general, the average life expectancy at birth is 73.7 years for the Tanger-Tétouan sub-region, with a value of 75.27 years for women and 71.96 years for men, and a difference of 3.31 years in favour of women.
	● **Socio-economic status**: The only indicator that reports information disaggregated by gender is *poverty distribution*. However, it is only expressed at national level. For 2014 the Moroccan rate was 4.8%, between 3.9% of female-run households and 4.9% of male-run households. A significant difference for this indicator was evident between the data recorded in rural areas (9.5%, with a difference of just 0.1 percentage points between the female and male values) and that found in urban areas (1.6%, with a 0.3 percentage point gap between the female and male component). In 2019, the general rate drops to 1.7%, with female and male values equal to 1% and 1.9%, respectively. Furthermore, the gaps between rural and urban areas also decreased, with respective values of 3.9% (3.2% for women and 4% for men) and just 0.48% (with female and male rates of 0.26% and 0.54%).

The Coastal Forcing Index Map shows the coastal areas that are facing significant pressures from multiple forces driven by climate change. This map needs to be taken into account when assessing possible intervention measures, in order to prioritise those targeted at the riskiest areas.

Figure 2. Map of the Coastal Forcing Index



Source: Gender-Sensitive Climate Risk Assessment of the Tanger-Tétouan-Al Hoceima region, Morocco (2022)

As conclusions of the assessments, some considerations about the kind of measures to be implemented are:

- Focusing on reducing vulnerability and increasing resilience
- Resilience-building measures of biodiversity and supporting ecosystem integrity can maintain benefits for people, including livelihoods, human health and well-being and the provision of food and water, as well as contributing to disaster risk reduction and climate change adaptation and mitigation.
- Integrated, inclusive planning and investment in everyday decision-making about urban infrastructure, including social, ecological, and grey/physical infrastructures, can significantly increase the adaptive capacity of urban and rural settlements, since a focus on climate risk alone does not enable effective climate resilience.
- Women are effective agents of change in the processes of adaptation and elaboration of ecological metamorphosis, .beginning with management strategies in family and community organization. Women possess unique knowledge and experience, particularly at the local level, their inclusion in decision-making processes is critical to effective climate action This forms a basis from which to trace plausible and sustainable paths and processes of investment in human, social, economic, financial, and political capital, through gender-sensitive and non-gender-neutral actions, which are much more than a powerful cosmetic coverage of the recurrence of gender gaps in every area.

3. COLLABORATIVE PROCESS: WORKSHOPS

A number of workshops were carried out in both the TTA region and Boka Kotorska Bay. The aim was to bring together the main experts and actors affected by coastal climate risks, in order to describe the current situation in each area, and to work together to propose possible adaptation measures.

3.1 Boka Kotorska Bay

A total of three workshops were held in this region. During the first stakeholder meeting (Scoping meeting) held in Tivat in December 2021, the priority challenges and issues to be addressed by the Coastal Management Plan were identified by the participants and grouped into priority themes:

(i) Coastal construction and infrastructure;
(ii) Transportation;
(iii) Water supply and wastewater;
(iv) Tourism;
(v) Waste management;
(vi) Nature and environmental protection;
(vii) Governance and Knowledge-building.

After the Scoping meeting, a national expert team was established to elaborate on the mentioned themes. Each theme was presented and discussed with stakeholders at a second Diagnostic meeting**,** held in Kotor in July 2022, in terms of state/situation in Boka Kotorska Bay; pressures (anthropogenic and climatic) that lead to such state; vision, i.e**.** to what extent is it possible that the situation could worsen with regard to pressures, especially climatic ones.

The aim of the third stakeholder meeting was to elaborate on proposed sustainability indicators and to open the initial discussion on the first version of a set of measures provided by the expert team.

Outputs

A set of Sustainability Indicators were set up in order to adequately represent the current and future state of the Coastal Management Plan's key priority sectors, taking into account the Governance and Gender themes as cross cutting dimensions:

Sustainability dimension	Proposed Indicators
Sustainable tourism and agriculture	• **Use of local agricultural products in the tourism sector** (as % of total uptake) • **Number of clusters in the agricultural/tourism sector**s (at least 10) • **Number of women in the tourism/entrepreneurship sectors** (at least 50% of woman)
Coastal infrastructure and transportation	• **Adoption of Local Risk Plans with Action Plan and revitalization of existing springs** • **Reduction of losses in the water supply network** (at least 20%) • **Use of public transportation** (increase in the number of electric vehicles and establishment of maritime local transport)

Water supply and waste water	● **Number of pumping stations and number of connections** ● **Wastewater quality at the point of discharge** ● **% utilization of the capacity of existing springs**
Waste management	● **Number of recycling yards in 3 municipalities** (target 1 per 5000 inhabitants) ● **Number of illegal landfills** (engage in remediation and reduction of illegal landfills by 70%) ● **Reduction of the amount of deposited waste by 30%**
Environment and the marine environment	● **Erosion control, water retention and biodiversity:** - % of forested/reforested area ● **Biodiversity protection indicators:** - Status of marine biodiversity - Status of coastal biodiversity - Data on cruise and vessels entry/speed in Boka Kotorska ● **Environmental monitoring indicators:** - status of sea water quality - % of illegal fishing compared to previous year

The initial proposal of measures coming from these workshops were subsequently further discussed with stakeholders. As a result of this process, the following were selected as most relevant to consider for a detailed analysis[1]:

Measure 1
Better waste management for Kotor Bay: - Develop a remediation plan in Lovanja and wild landfills, which directly impacts soil, groundwater, seawater quality and the Tivat salines.
Measure 2
Need for updated cadastres of green public spaces (Kotor/Herceg Novihave one, and Tivat's is underway) - If they are now available, urban afforestation and greening measures to build on these updated cadastres could be considered.
Measure 3
Afforestation with autochthonous species and planting urban greenery: - Drought resistance; - Enhancing water infiltration and retention capacity; - Minimal disruption of ecosystem integrity.

[1] A workshop in January 2023 came up with a very long list of possible actions, which include the ones listed here but go further to cover around one hundred possible interventions. We have not been able to evaluate all these as the amount of information available on each was no more than one or two lines.

Measure 4
Beach replenishment in harmony with the coastal and marine environment.
Measure 5
Regulation and treatment of ballast waters in Boka Kotorska
Measure 6
Rehabilitation of communal water infrastructure and supply systems: - Decrease losses and increase number of network connections; - Increase the capacity of the water supply system; - Increase wastewater treatment capacity - Austro-Hungarian water reservoirs above Kotor Bay for water collection
Measure 7
Update the cadastre of sewage outlets and systematise data

3.2 Tanger-Tétouan-Al Hoceima region

As in the case of Montenegro, a series of workshops have been held in the TTA region.

The first Moroccan workshop in March 2022 aimed to set the scene, establish the local context in order to understand the context and agree on the key and priority challenges that characterise the TTA region.

A few months later, in September 2022, a second workshop took place. Its goal was to present and discuss the diagnosis (status, pressures and threats) about the TTA region; improving stakeholder's understanding of a "Nexus approach" that aims to reconcile the potentially conflicting interests of different sectors that share the same, often scarce, natural resources; and achieving the sectoral collaboration to concrete lines of actions to capture synergies and find trade-offs towards sustainable natural resource management and socio-economic development. The second component of this workshop focused on identifying Sustainability Indicators (SIs) to represent the current status and future evolution of each priority sector identified in the Coastal Plan of the TTA region.

Finally, a third workshop in December 2022, aimed to present the gender-sensitive Climate Risk Assessment and set up, in a collaborative way with stakeholders, a proposal of adaptation interventions for the TTA region, according to the different sectors or groups they belong to:

Group 1- Littoral

Group 2 - Biodiversity

Group 3 - Blue and Green economy

Group 4 - Water

Group 5 - Agriculture and rural development

Group 6 - Tourism

Outputs

As a result of these workshops, a list of Sustainability Indicators is proposed for each priority sector.

Priority sector	Proposed Indicators
Risks and pollution	• **Water pollution** (marine and freshwater): presence of solid waste, chemical, organic pollution… • **Quality of sediments** (heavy metals in sediments) • **Benthic quality** (benthos) • **Risk of erosion** (coastal assessment, modification)
Coastal- use of space, sustainability of spatial development and protection	• **Urbanisation rate** • **Risk of flooding** • **Water use** • **Liquid and solid waste**
Coastal land use	• **Land use rate** (forest/green area; concrete and impervious area) • **Population density** (population, growth rate) • **Land use in the Littoral** (coastal use rate)
Sustainable fisheries and aquaculture	• **Aquaculture production** • **Production tonnage by type of aquaculture** • **Value of aquaculture production** (as % of regional GDP) • **Sustainable agricultural production**
Blue and green economy	• **Rate of natural resource use at ATT level** • **Number of actors operating in the green or blue economy** (nº of jobs created) • **Budget allocated/Budget used** (Percentage committed / Percentage implemented)

For these indicators, an Equilibrium Band should then be established, with a lower and upper value, which ultimately determines the status and durable/non-durable evolution of the priority sector they represent.

On the other hand, several coastal adaptation interventions in the region have been highlighted:

Measure 1
Facing coastal erosion (cliffs) – Zone around El Jebha - Grey (nets) to prevent cliff erosion and danger to people passing below. - Green infrastructure (terracing, planting of deep-rooted trees and shrubs).
Measure 2
Facing floods threatening to displace vulnerable populations – Martil - Soft solutions needed (displacing populations not feasible) - planning documents do not take flooding into account enough. - Nature Based Solutions (NbS) for flood risk reduction and better water infiltration and retention.
Measure 3
Oueds, grey infrastructure is not suitable – Stehat

- Use of natural dykes and green corridors (native species): 5 km² suggested, good size for a demonstration and addresses NbS/ biodiversity/water/flood risk/restoration.
Measure 4
Facing the threat of invasive species from ship ballast – Jbel Moussa - Suggested collaboration with Odyseea project and Valencia Port, transboundary adaptation.
Measure 5
Aquaculture TTA – Loukkos Basin - Potential capacity-building and technology/best practice transfer to best adapt to climate change (marine/freshwater systems)
Measure 6
Flood management and risk reduction and better water harvesting and management - Tizgane, M'tioua and Amthar (Chefchaouen Province) as well as Ramsar Sites (wetlands), coastal areas (Tangérois), rural areas and non-constructible zones. - Participatory water governance - Terraces/dykes for better groundwater availability - Desalination
Measure 7
Checks the rural/biodiversity/community engagement and food security box - Rural areas of TTA, especially those with a lot of smallholder agriculture - Creation of local, indigenous and climate impact resistant (drought, heat…) seed banks, for free distribution and dissemination in TTA and Morocco. - Can be combined with restoration interventions and better groundwater management. - Can also be introduced to cities for urban agriculture and awareness-raising
Measure 8
Creation of zones for wind sports and supporting rural tourism - Tangier–Assilah and Fahs-Anjra Provinces - Combines (eco-) tourism, leisure, health and wellbeing, awareness-raising and potential conservation actions, as well as income generation

4. METHODOLOGY TO PRIORITISE SECTORAL COASTAL ADAPTION INTERVENTIONS

4.1 Cost-Benefit Analysis (CBA)

CBA is a systematic process for calculating and comparing benefits and costs of a given policy or project, based on assigning a monetary value to all the activities associated with the project (either as input or 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 adaptation to climate change.

The 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 utilized 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
- 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.

The formula for the benefit cost ratio 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 cost-benefit analysis. The EC in its guidelines proposes 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, 2014). 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 one is required. We should note, however, that governments normally require a BCR of well over one, 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. 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

A simple example of CBA in the context of adaptation to climate change is the following. An area that faces flooding and a 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 and infrastructure as well as human beings is 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: the NPV is 6.9€ Mn. The IRR is 7% and the BCR is 1.15.

Of course, in an actual CBA the analysts would have to conduct a sensitivity analysis to take account of other impacts, such as employment, effects of marine ecosystems etc. But the core of the evaluation would be the figures presented.

CBA is a powerful tool but has several limitations. Most importantly, it does not address the distributional question of who gains and who bears the costs. This factor has to be evaluated **in addition** to the CBA indicators given above. Second, it gives no importance to non-valued costs and benefits. Adaptation projects often include impacts that cannot be evaluated in monetary terms (such as protection of cultural capital or reduced loss of biodiversity). Such impacts also have to be considered in addition to the summary CBA indicators.

Another important consideration is that estimates of benefits and costs (especially benefits) have large uncertainties. In the case of adaptation projects relating to climate figures show considerable ranges for the physical impacts. When these impacts are valued

in money terms the ranges go further. This means that the decision criteria have to include some methods for handling uncertain outcomes. The simplest is to undertake a sensitivity analysis and report the indicators of NPV, BCR etc. for the range of likely benefits and costs. The CBA guidelines referred to above provide further guidance on the 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 is never sufficient to determine the outcome of the evaluation.**

4.2 Multi-criteria Analysis (MCA)

MCA is based on scoring each intervention according to several criteria and then adding up a weighted total of the scores. The scores can be given for qualitative and quantitative criteria. The 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, and 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 need etc.
- Measurement of scoring for each criteria has to be based on as much data as possible and to be credible.
- Weighting of criteria has to reflect policy 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 an MCA is it expands the boundaries of the analysis 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 that are often hard to measure in monetary terms[2]. The main problems 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 be carried out with utmost attention.

The main factors as far as the economic aspects are concerned are how far 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 an 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 to arrive at a decision.

[2] MCA is now supported by specialized software that is often commercially available as a web application. The software is designed to assist decision makers "at various stages of the decision-making process, including problem exploration and formulation, identification of decision alternatives and solution constraints, structuring of preferences, and trade-off judgments" (Weistroffer & Li, 2016, p. 1302)

The use of MCA to evaluate climate policies has been developed by UNEP and applied in a number of case studies. It covers projects both for adaptation and mitigation[3]. Here we present the part that focuses on adaptation as a guide to what may be possible in this project.

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. The seven criteria for each action are:

1. Public finance needs
2. Implementation barriers
3. Climate- related outputs of the action
4. Economy- related outputs
5. Environment-related outputs
6. Socially-related outputs
7. Politically-related outputs.

These criteria are further sub-divided to give a total of 18 sub-criteria that can be applied to each action. The list of 18 sub-criteria is the following.

Main Criteria	Sub-criteria
Public finance needs	▪ Investment expenditure ▪ Other expenditure
Implementation barriers	▪ Ease of Implementation ▪ Ability to meet deadline
Climate related outputs	▪ Reduce GHGs ▪ Enhance resilience
Economic related outputs	▪ Promote private investment ▪ Improve economic performance ▪ Create employment ▪ Contribute to fiscal sustainability
Environment-related outputs	▪ Protect environmental resources ▪ Support biodiversity ▪ Support ecosystem services
Socially related outputs	▪ Reduce poverty ▪ Improve health ▪ Preserve cultural heritage
Politically related outputs	▪ Contribute to political stability ▪ Improve governance

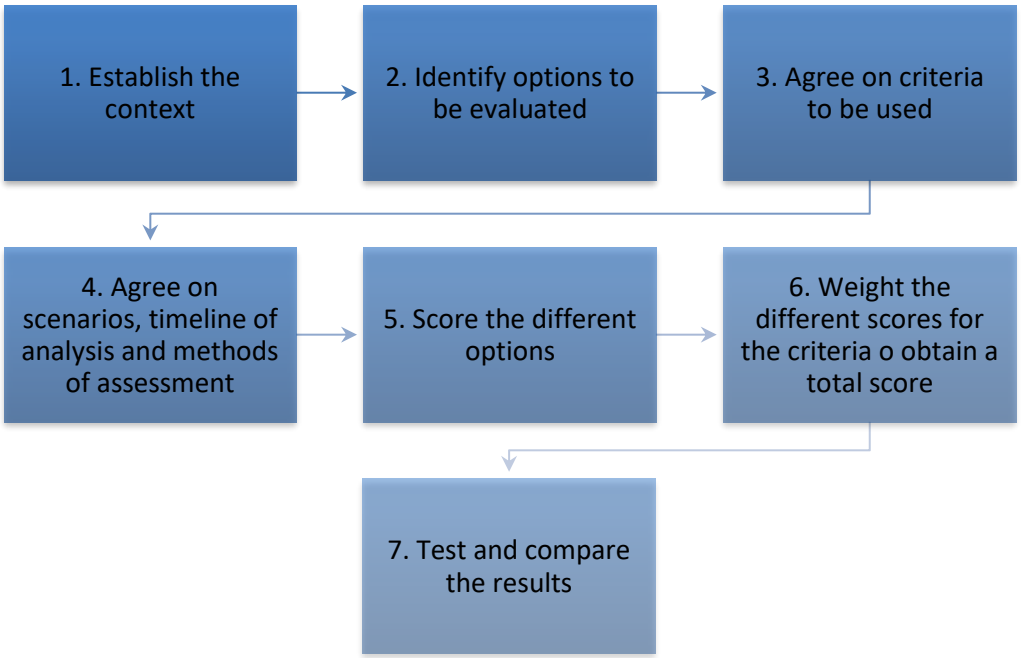
Not all these have to be used in all cases but a good selection is expected to be deployed.

Possible indicators for the sub-criteria are also proposed. They are the following.

[3] A practical framework for planning pro-development climate policy | UNEP - UN Environment Programme.

Criteria	Indicator	Criteria	Indicator
Investment Expenditure	Overall cost of investment	Protect Environmental Resources	Change in environmental quality indicators in region
Other Expenditure	All variable costs	Support Biodiversity	Changes in nº of species
Ease of Implementation	Quality of institutions and capacity to implement	Support Ecosystem Services	Expert judgement score
Able to Meet Deadline	Expert judgement score	Reduce Poverty	Change in poverty rate
Reduce GHGs	Reduction as % of baseline	Improve Health	Expert judgement score
Enhance Resilience	Expert judgement score	Preserve Cultural Heritage	Expert judgement score
Promote Private Investment	Estimate of private investment generated	Contribute to Political Stability	Reduce dependence on imports.
Improve Economic Performance	Increase in energy efficiency (%)	Improve Governance	Expert judgement score
Create Employment	Nº of jobs created		
Contribute to Fiscal Sus.	Revenues generated to the public sector		

In conducting the analysis, the following seven steps have to be carried out:



Scores for different indicators are multiplied by a weight and added to obtain a total score for each project. Weights for each indicator will reflect the units in which it is measured and will be based on consultation and expert judgement. Weights add up to 1[4].

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

- The use of individuals with expertise in both the concept under evaluation (e.g. health impact) 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.
- Use of an experienced facilitator who supports and challenges those responsible for scoring and weighting the options.

Regarding the application of MCA for the projects identified in the two locations 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 second, 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**.

[4] Weighting can be assisted using software such as V.I.S.A (Visual Interactive Sensitivity Analysis) software – a web-based multi-criteria decision-making tool

In the review conducted in the next section this has been undertaken in a qualitative way, with a sub-set of the sub-criteria proposed by UNEP. In addition to the sub-criteria proposed, two more are added: contribution to gender equality (to reflect the concern with this issue in the preparatory work done in the two regions) and availability of data to conduct a CBA. The qualitative scores are on a scale of three: low, medium and high.

The purpose is to screen whether a project is worth investigating further in a CBA. If it is then the list of information required is provided. We should note that the MCA conducted to make this assessment is very rudimentary as the information for the indicators listed above is mostly not available.

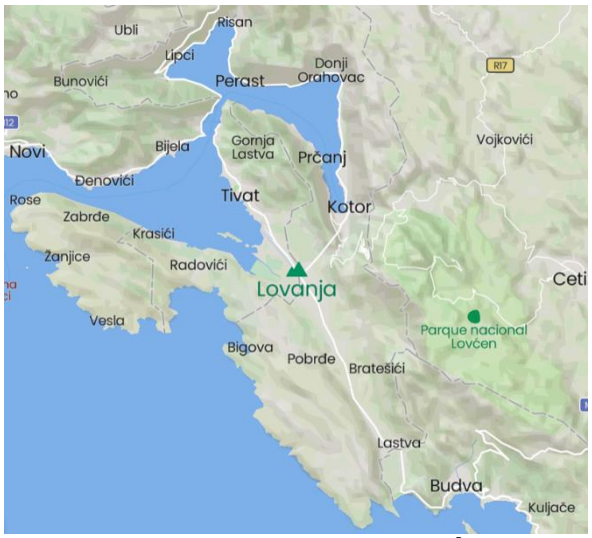
5. SELECTING INTERVENTIONS FOR A COST-BENEFIT ANALYSIS

5.1 Boka Kotorska Bay

We go through the measures listed in Section 3.1

- **Measure 1:** Better waste management for Kotor Bay.
  - Develop a remediation plan in Lovanja and wild landfills, which directly impacts soil, groundwater, seawater quality and the Tivat salines.

Figure 3. Map of Lovanja and surrounding areas



Source: geographic repository[5]

The task would consist of a remediation plan in Lovanja and wild landfills, which directly impact soil, groundwater, seawater quality and the Tivat salines. At present the only garbage dump is located in Lovanja, at one end of the bay (also serves Budva). This means long and inefficient transport from the other side of the Bay.

A screening MCA reveals the following scores.

Better waste management for Kotor Bay				
Ease of Implementation	Enhance Resilience	Create Employment	Protect Environment	Reduce Poverty
Improve Health	Contribute to Political Stability	Improve Governance	Gender Equality and Advancement	Data Availability for CBA
Legend				
	Not Known		Low	
	Medium		High	

[5] https://mapcarta.com/es/19017490

The project is likely to be quite difficult to implement and its contribution to enhancing climate resilience will be low. It will, however, create a moderate amount of employment and, by managing waste and preventing it leaching into soil and ground water, it should make a good contribution to the protection of the environment. This should have moderate health benefits. Impacts on political stability, improved governance and gender equality are likely to be low (although this is subject to discussion with stakeholders). A CBA will be demanding on data, which will be difficult to collect in a timely manner.

In our view, a cost benefit analysis is feasible but requires a lot of data. This would include the following:

- Savings in costs of transportation for waste that is currently taken to Lovanja.
- Estimates of amounts of waste deposited in non-sanitary landfills
- Composition of the waste that goes to such landfills.
- Estimates of damages based on the composition. This can be derived from a EU study as local estimates will not be available. See BIO Intelligence Service (2011)
- Costs of a new landfill, including capital and maintenance costs. These will be obtained from local Engineering companies, working on landfill in the country. If not, data can be obtained from the literature
- Estimates of deprecation 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 land fill at different distances from the site. See Schutt, 2021.

The main problems will be to estimate damages from disposal in non-sanitary landfills and property depreciation. A study such as this would be very time consuming and involve a lot of technical information. It is unlikely that it can be done within the time frame of the study. If this item is to be subject to a CBA it will depend heavily on work conducted elsewhere. It will still need local data as indicated.

- **Measure 2**: Need for updated cadastres of green public spaces (Kotor/Herceg Novi have one, and Tivat's is underway).
  - If they are now available, we could propose urban afforestation and greening measures to build on these updated cadastres.

Figure 4. Kotor/Herceg Novi/Tivat area

Source: Internet repository

The benefits are the construction of a database that can provide information for future planning of discharges. This is something of value but not normally subject to a cost benefit analysis. The screening MCA reveals the following.

Updated cadastres of green public spaces

Ease of Implementation	Enhance Resilience	Create Employment	Protect Environment	Reduce Poverty
Improve Health	Contribute to Political Stability	Improve Governance	Gender Equality and Advancement	Data Availability for CBA
				Not Applicable
Legend				
	Not Known		Low	
	Medium		High	

The action is easy to implement, and makes a moderate contribution to enhancing resilience, protecting the environment and improving governance. It has little or no contribution to creating employment, reducing poverty and improving health; and is unlikely to influence gender issues.

- **Measure 3:** Afforestation with autochthonous species and planting urban greenery
  - Drought resistance;
  - Enhancing water infiltration and retention capacity;
  - Minimal disruption of ecosystem integrity.

The benefits are: increased drought resistance; enhancing water infiltration and retention capacity; reduced disruption of ecosystem integrity; protection or enhancement of ecosystem services; prevent erosion and encourage soil creation and health, richer biodiversity, creation of urban microclimates (evapotranspiration) to counter urban heat islands. It should also help increase carbon sequestration. The locations are yet to be defined.

The MCA screening reveals quite a positive score. The action increases resilience to climate and improves health by reducing heat island effects. It also protects the environment and acts to improve governance, while making a modest contribution to employment.

Ease of Implementation	Enhance Resilience	Create Employment	Protect Environment	Reduce Poverty
Improve Health	Contribute to Political Stability	Improve Governance	Gender Equality and Advancement	Data Availability for CBA
Legend				
	Not Known		Low	
	Medium		High	

The measure can be evaluated using cost benefit analysis 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.

Water benefits would be derived from the gain in filtering of contaminants and increase in water regulation. The vegetation generated through afforestation acts to filter and absorb contaminants and harmful bacteria from the water received from precipitation. The InVest model is set up to estimate and value such gains as well as an increase in water availability in the water basin (if any).

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[6]. It helps explore how changes in ecosystems can lead to changes in the flows of many different benefits to people[7]. Erosion prevention, biodiversity gains and carbon sequestration can also be estimated based on soil and landscape data using the InVEST model.

An alternative might be to estimate the amount by which water treatment costs for water from the source that is currently used are reduced as a result of such filtering. For an example of such estimation, as well as see applications of other models to value water for a source in terms of the costs of avoided higher cost water supply see: NCAVES and MAIA, 2022. This is a UN report of the program for environmental accounting.

Heat island benefits would be derived from energy savings from reduced temperatures in the adjoining areas. Possible benefits of reduced health impact may also be possible but would need much more data on climate projections. An application of such benefits is a study for the UK: see ONS, 2019 and ONS, 2021.

These estimates are all demanding of a lot of data at a spatially disaggregated level. The InVest model has been applied widely and could be applied in a study such as this but it may not be possible in the time available. The same applies to the modelling of the health benefits of urban tree planting.

In summary, a cost benefit analysis is possible but it demands a lot of modelling and data.

[6] InVEST (Integrated Valuation of Ecosystem Services and Trade-Offs) - Ecosystems Knowledge Network.

[7] See: InVEST | Natural Capital Project (stanford.edu).

- **Measure 4:** Beach replenishment in harmony with the coastal and marine environment.

The screening MCA shows this to have a positive score with respect to enhanced resilience and protection of the environment. It also helps to create employment (both in the implementation of the program and through sustaining an asset that is central to tourism). Data availability for a CBA should be moderately good.

Beach replenishment in harmony with the coastal and marine environment

Ease of Implementation	Enhance Resilience	Create Employment	Protect Environment	Reduce Poverty
Improve Health	Contribute to Political Stability	Improve Governance	Gender Equality and Advancement	Data Availability for CBA
Legend				
	Not Known		Low	
	Medium		High	

The benefits are: protection of natural beach habitats; retention of sediment volumes despite sea level rise, protection of buildings, infrastructure and coasts from wave impacts, improvement of the recreational potential of beaches. Locations have yet to be defined.

A cost benefit analysis is possible for this measure. Data needed would consist of:

- Current and projected losses of beach front 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 loss from sea level rise and storm surges and expected future losses, based on increases in sea level rise and storms.
- Visitors to the beaches affected and estimates of benefits derived currently from such visits (usually based on cost of travel and time spent at the site). Projections of future benefits in the absence of loss of beach if replenishment takes place.
- Costs of the program, both capital and maintenance. For data on costs of coastal protection see: UK Environment Agency, 2015.

Based on available data a cost benefit analysis could be conducted. The alternative one would assume is no action (it is possible to consider alternatives such as sea walls but we would assume these are rejected on technical grounds in the selected locations). A benefit cost analysis of beach nourishment that is a useful guide for the design of a study is Lupio et al (2005).

- **Measure 5:** Regulation and treatment of ballast waters in Boka Kotorska.

Figure 5. The Boka Kotorska Bay

Source: Gender-Sensitive Climate Risk Assessment of Kotor Bay, Montenegro (2022)

An MCA screening shows a relatively low score for this option. It will protect the environment and could improve governance if successful. With regard to climate change it could reduce the impact of invasive species (e.g. blue crab) introduced from ballast waters. A CBA is relatively easy to conduct (see below).

Regulation and treatment of ballast waters				
Ease of Implementation	Enhance Resilience	Create Employment	Protect Environment	Reduce Poverty
Improve Health	Contribute to Political Stability	Improve Governance	Gender Equality and Advancement	Data Availability for CBA
Legend				
	Not Known		Low	
	Medium		High	

In general, ballast water is important as an environmental problem. The disposal of ballast water in coastal areas is undertaken when the tankers reach the shipping ports. According to Silent Invasion, a report by WWF not treating ballast waters imposes marine pest associated direct costs of over USD7 billion per year in 2004/05. Using this figure for direct global economic loss to society for damage caused by invasive species of USD7 billion per year and the figure of 10 billion tonnes of ballast water used every year by international shipping WWF calculates a cost per tonne of untreated ballast water at 70 USD cents. 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[8].

[8] Silent Invasion Briefing - WWF Deutschland · Most of these silent travellers do not survive the journey or in the new area, but

In some respects, this information does most of what a cost benefit analysis would do. In this case we would need to add: (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.

- **Measure 6:** Rehabilitation of communal water infrastructure and supply systems.

This includes Austro-Hungarian water reservoirs above Kotor Bay for water collection.

The intervention scores relatively well in the screening MCA. It should be relatively easy to implement and would create employment and protect the environment for untreated water discharges. This in turn would have some health benefits and the rehabilitation shold improve governance. Increased network connects could have some gender benefits. Data for a CBA is not so difficult to obtain.

Rehabilitation of communal water infrastructure and supply systems				
Ease of Implementation	Enhance Resilience	Create Employment	Protect Environment	Reduce Poverty
Improve Health	Contribute to Political Stability	Improve Governance	Gender Equality and Advancement	Data Availability for CBA
Legend				
	Not Known		Low	
	Medium		High	

The benefits of this measure are: a decrease in water losses and an increase number of network connections; an increase the capacity of the water supply system; increase wastewater treatment capacity.

Such projects are commonly subject to a cost benefit analysis and one is possible here. Required data would consist of:

- Estimated reduction on loss of water and its value in terms of revenues recovered as well as value of water to final user. Ideally this is obtained from the demand curve for water but in the absence of that, the cost of supply per meter can be used as a proxy.

- Estimated increase in the capacity of the wastewater system and its value. Again for the value the ideal 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.

- Costs of the program, both capital and maintenance. These are available from engineering estimates.

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- **Measure 7:** Update the cadastre of sewage outlets and systematise data.

The preliminary screening indicates that the action is easy to implement and should help to protect the environment and improve governance.

Update the cadastre of sewage outlets				
Ease of Implementation	Enhance Resilience	Create Employment	Protect Environment	Reduce Poverty
Improve Health	Contribute to Political Stability	Improve Governance	Gender Equality and Advancement	Data Availability for CBA
				Not Applicable
Legend				
	Not Known		Low	
	Medium		High	

The benefits are the construction of a database that can provide information for future planning of discharges. This is something of value but not normally subject to a cost benefit analysis.

5.2 Tanger-Tétouan-Al Hoceima Region

As with Kotor Bay, we go through the list of measures listed in Section 3.

- **Measure 1**: Control coastal erosion (cliffs) – Zone around El Jebha
  - Grey (nets) to prevent cliff erosion and danger to people passing below.
  - Green infrastructure (terracing, planting of deep-rooted trees and shrubs).

Figure 6. El Jebha

Source: NewsTourisme (2023)

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. Setting up the program will increase governance.

Control coastal erosion (cliffs) – Zone around El Jebha				
Ease of Implementation	Enhance Resilience	Create Employment	Protect Environment	Reduce Poverty
Improve Health	Contribute to Political Stability	Improve Governance	Gender Equality and Advancement	Data Availability for CBA
Legend				
	Not Known		Low	
	Medium		High	

The main problem is coastal erosion from the cliffs in the area. Grey infrastructure (nets) is proposed to prevent erosion and danger to people passing below. Green infrastructure (terracing, planting of deep-rooted trees and shrubs) may also be feasible, if the site allows.

For erosion protection the measures against erosion consist of metallic nets covering about 500m of vulnerable frontage.

This intervention is capable in principle of a cost benefit analysis. We would need data on:

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

- **Measure 2**: Control floods threatening to displace vulnerable populations – Martil.

Figure 7. Martil and surrounding areas

Source: geographic repository[9]

This measure scores very highly according to the screening MCA. It enhances resilience to climate change significantly. As the gender based assessment in the region has shown, vulnerable populations are heavily concentrated among women; consequently, action to

[9] https://mapcarta.com/es/25438352

address the problem will be of disproportionate benefit to them. Floods result in damage to the environment and to human health. The gains in these areas from action are classed as medium, as the overall contributions to political stability, governance. From a CBA viewpoint, however, data availability is a major problem.

Control floods threatening to displace vulnerable populations – Martil				
Ease of Implementation	Enhance Resilience	Create Employment	Protect Environment	Reduce Poverty
Improve Health	Contribute to Political Stability	Improve Governance	Gender Equality and Advancement	Data Availability for CBA
Legend				
	Not Known		Low	
	Medium		High	

Details of the measures to be taken are still under consideration. One thing that has been agreed is that moving populations is not feasible, so that is not an option, except in extreme cases. Soft solutions and Nature Based solutions (NbS) are proposed, including raising awareness of the population, especially the young and strengthening the plan for land use in the regions, which currently does not take enough account of flooding.

Although it scores very highly in MCA terms, given the nature of the interventions we do not consider it suitable for a cost benefit analysis. It will be almost impossible to quantify the benefits of the actions and value them in monetary terms.

- **Measure 3**: Oueds, grey infrastructure is not suitable – Stehat
  - Use of natural dykes and green corridors (native species): 5 km² suggested, good size for a demonstration and addresses NbS/ biodiversity/water/flood risk/restoration.

Figure 8. Stehat and surrounding areas

Source: geographic repository[10]

[10] https://mapcarta.com/es/32573944

The screening MCA indicates that, while the project is difficult to implement, it will be very beneficial to protecting the environment and enhance climate resilience significantly. It will also create employment, improve health and contribute to political stability.

Use of natural dykes and green corridors (native species) Stehat				
Ease of Implementation	Enhance Resilience	Create Employment	Protect Environment	Reduce Poverty
Improve Health	Contribute to Political Stability	Improve Governance	Gender Equality and Advancement	Data Availability for CBA
Legend				
	Not Known		Low	
	Medium		High	

To address the problem of floods it is proposed to construct natural dykes for the protection of an area of 5 km^2. A period of 3 years for the feasibility study and 2 years for construction is envisaged. The proposal also includes some awareness raising about the law on coastal zones.

In principle the proposed intervention could be evaluated in cost benefit terms. In order to do so we would need estimates of:

- The assets in the zone affected by floods and the value of these assets. These including private and public buildings, roads and other infrastructure.
- The frequency of floods that the dykes seek to protect against (e.g. 1:50 years)
- The degree of protection that the dykes will provide (e.g. 90%)
- Number of people affected by floods of the kinds 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 cost benefit analysis could be undertaken.

- **Measure 4**: The threat of invasive species from ship ballast – Jbel Moussa
  - Suggested collaboration with Odyseea project and Valencia Port, transboundary adaptation.

The MCA here is similar to that undertaken for Kotor Bay. It is an important contribution to protect the environment and would contribute to governance (especially international commitments).

Tthreat of invasive species from ship ballast – Jbel Moussa				
Ease of Implementation	Enhance Resilience	Create Employment	Protect Environment	Reduce Poverty
Improve Health	Contribute to Political Stability	Improve Governance	Gender Equality and Advancement	Data Availability for CBA

Legend			
	Not Known		Low
	Medium		High

The problem is invasive species entering the port, especially from the Strait of Gibraltar. There is a suggested collaboration with Odyssea project and Valencia Port on measures of transboundary adaptation. Control systems to check on ships' hulls will need to be fitted on board the vessels. Benefits will be from reduced damage to ecosystems and possibly to aquaculture in the region.

As noted earlier, the Silent Invasion report by WWF estimates that not treating ballast waters imposes marine pest associated direct costs of over USD7 billion per year in 2004/05. Using this figure for direct global economic loss to society for damage caused by invasive species of USD7 billion per year and the figure of 10 billion tonnes of ballast water used every year by international shipping WWF calculates a cost per tonne of untreated ballast water at 70 USD cents. 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

This information can be combined with: (a) costs of setting up the control facility on vessels and setting up the local control system (b) estimates of the amount of ballast water that would have been released, that is now disposed of properly.

Based on this a CBA could be carried out.

- **Measure 5**: Aquaculture TTA – Loukkos Basin
  - Potential capacity-building and technology/best practice transfer to best adapt to climate change (marine/freshwater systems)

Figure 9. The mouth of the Oued Loukkos

Source: ResearchGate repository[11]

The MCA screening indicates that the proposed intervention has a number of positive outcomes in terms of the selected criteria. It will increase resilience to climate change, help create employment and reduce poverty. Successful implementation would contribute to political stability and overall governance. From a CBA viewpoint, however, it is difficult to implement for the reasons discussed below.

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

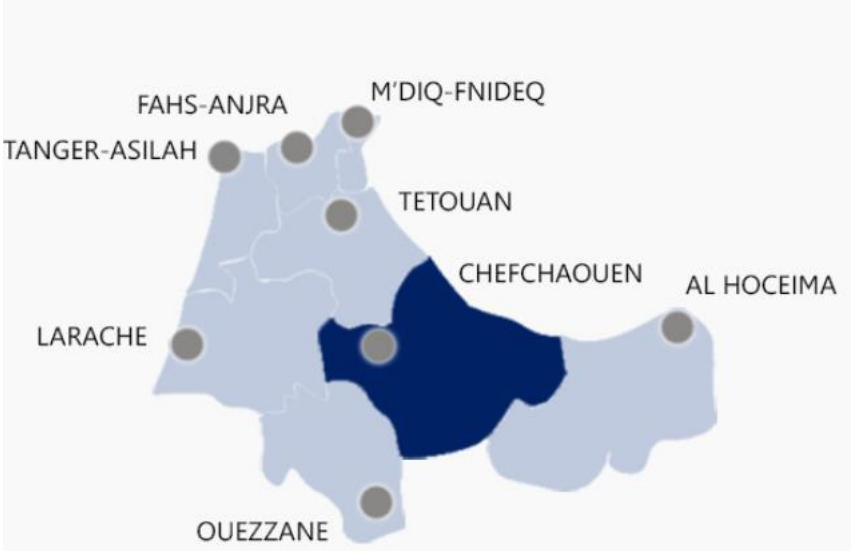
Aquaculture TTA – Loukkos Basin				
Ease of Implementation	Enhance Resilience	Create Employment	Protect Environment	Reduce Poverty
Improve Health	Contribute to Political Stability	Improve Governance	Gender Equality and Advancement	Data Availability for CBA
Legend				
	Not Known		Low	
	Medium		High	

The activity is focussed on aquaculture with little links to coastal zone protection and involves a lot of commercial information that will be difficult to obtain. **Hence we do not recommend it for detailed cost benefit analysis.**

[11] https://www.researchgate.net/figure/Les-salines-de-Larache-et-lembouchure-de-loued-Loukkos-CV-Brouquier-Redde-UMR-8546_fig1_280044712

- **Measure 6**: Flood management, risk reduction and better water harvesting and management - Tizgane, M'tioua and Amthar (Chefchaouen Province) as well as Ramsar Sites (wetlands), coastal areas (Tangérois), rural areas and non-constructible zones.

Figure 10. Tanger-Tétouan-Al Hoceima region



Source: Investangier[12]

The screening MCA rates this intervention very highly. It will contribute highly to climate resilience and protection of the environment. It will also make a medium-level contribution to health, gender equality, improved governance and political stability. It should be noted that the scores will depend a lot on where the projects are located. There is a list of possible sites but a ranking of these has not been made. This ranking can be derived by using the MCA tool in the form it has been used here, or in a modified form. Detailed information for each site on the criteria will, however, have to be collected.

Flood management, risk reduction and better water harvesting and management

Ease of Implementation	Enhance Resilience	Create Employment	Protect Environment	Reduce Poverty
Improve Health	Contribute to Political Stability	Improve Governance	Gender Equality and Advancement	Data Availability for CBA
Legend				
	Not Known		Low	
	Medium		High	

The proposed activities include:

[12] https://investangier.com/province-de-chefchaouen/#

- Participatory water governance
- Terraces/dykes for better groundwater availability
- Desalination

The discussions on water focussed on issues such as:

- Participative management of local water systems;
- Support for rainwater water collection;
- Protection of local communities from flooding through measures such as terracing, building of dykes, improved drainage and reforestation.
- Construction of desalination plants

Potential locations mentioned were: Tizgane, M'tioua and Amthar (Chefchaouen Province) as well as Ramsar Sites (wetlands), coastal areas (Tangérois), rural areas.

In principle projects involving water management and conservation are amenable to cost benefit analysis. In order to undertake the analysis, we would need to specify the actions in more detail. While some information was given on costs at a general level, we would need:

- Specific capital and operating costs for each project at each location
- Benefits, in terms of water losses prevented, water collected.
- Estimates of value of water, based on a combination of costs of supply (piped and irrigation water) and costs of getting water from other sources (where individuals currently have to walk to a water source).
- Other benefits in terms of less flooding, less erosion, loss of biodiversity (all this may not be quantified).

From this data an evaluation in cost benefit terms can be made for selected projects. We would, however, not recommend including desalination plants as they are a very technical option for which the biodiversity costs are still unclear. There are also potentially high energy costs for desalinisation.

- **Measure 7**: Rural/biodiversity/community engagement and food security box - Rural areas of TTA, especially those with a lot of smallholder agriculture
  - Creation of local, indigenous and climate impact resistant (drought, heat…) seed banks, for free distribution and dissemination in TTA and Morocco.
  - Can be combined with restoration interventions and better groundwater management.
  - Can also be introduced to cities for urban agriculture and awareness-raising.

The stakeholders proposed a number of measures. These included:

a) Creation of a local seed bank
b) Promote and encourage the marketing of local seeds with state and private sector subsidies
c) Sensitization of farmers regarding the advantages and disadvantages respectively of the most resistant types to diseases and climatic aliases
d) Agro-ecology/Permaculture/arboriculture
e) Promote more economical irrigation
f) Water retention basins

g) Promote producer associations, cooperatives

These measures are not a detailed program but a list of actions that need **a lot more elaboration** before they can be evaluated. To be sure, they can all generate benefits in terms of rural development and possibly in terms of biodiversity protection. As many involve community engagement that is also a benefit.

In order to undertake a cost benefit analysis a lot of detailed information will be required. It is possible to collect this for some of the interventions. We would include the following:

- Creation of a local seed bank
- Promote and encourage the marketing of local seeds with state and private sector subsidies
- Promote more economical irrigation
- Water retention basins

As background to a quantitative analysis it would be useful to establish a baseline of current yields and changes in yields between now and 2030/2050 with climate change. This can be obtained from a major IFPRI study, which looks at data at individual countries for livestock and key crops[13]. Taking this as a base, gains in yields resulting from each of the above actions will have to be estimated by local experts. In addition, they will have to provide estimates for:

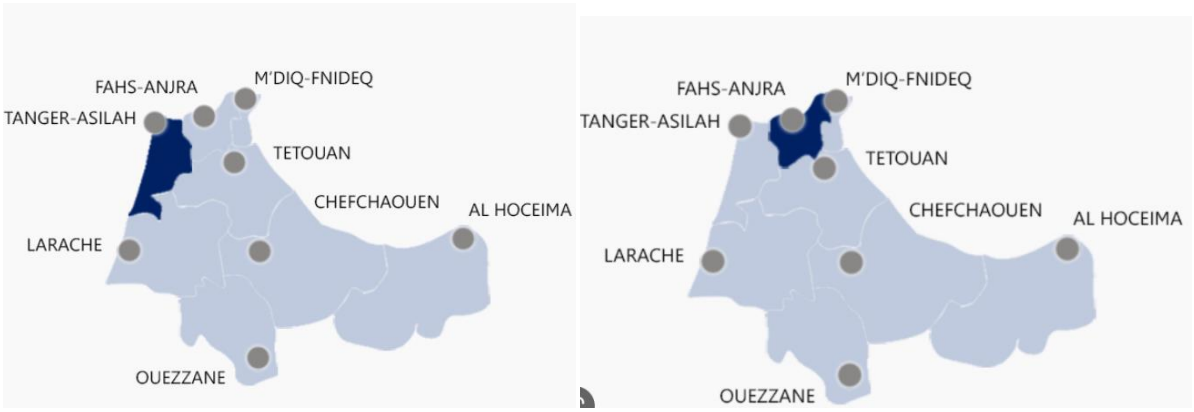
- The direct capital and operating costs involved for each action.
- Farm gate prices of crops grown and livestock
- Increase in water availability to farmers and communities from retention basins
- Value of water supplied based on methods described in the water intervention (Measure Nº.6)
- Reductions in water use and cost savings to the farmers.

From this data an evaluation in cost benefit terms can be made for selected projects.

- **Measure 8**: Creation of zones for wind sports and supporting rural tourism - Tangier–Assilah and Fahs-Anjra Provinces
  - Combines (eco-) tourism, leisure, health and wellbeing, awareness-raising and potential conservation actions, as well as income generation.

[13] We have access to the database underlying the publication.

Figure 11. Tangier-Assilah and Fahs-Anjra Provinces



Source: Investangier

The screening MCA identifies the main criteria in favour of this as: ease of implementation, creation of employment, reduction in poverty, and improved governance. A CBA should be quite straightforward to implement.

Two specific proposals have been made. The first is to create a dedicated zone for wind sports and the second for promotion of rural tourism. Cost estimates are given at 50 MDH for the first and 100MDH for the second. Locations are Tangier–Assilah and Fahs-Anjra Provinces.

For the CBA details will have to be collected on:

- Increase in number of visitors to the sites
- Net cost of providing the services to the visitors.
- Increases in numbers of people employed in providing the 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).

Creation of zones for wind sports and supporting rural tourism - Tangier–Assilah and Fahs-Anjra

Ease of Implementation	Enhance Resilience	Create Employment	Protect Environment	Reduce Poverty
Improve Health	Contribute to Political Stability	Improve Governance	Gender Equality and Advancement	Data Availability for CBA
Legend				
	Not Known		Low	
	Medium		High	

We consider these proposals capable of being evaluated using costs benefit methods.

If this information can be collected a cost benefit analysis can be carried out.

6. NEXT STEPS

From the review of the proposed measures, a CBA can in principle be conducted in the following cases (they are ordered by priority, given the screening MCA).

Kotor Bay

1) Beach replenishment in harmony with the coastal and marine environment
2) Afforestation with autochthonous species and planting urban greenery
3) Better waste management for Kotor Bay
4) Regulation and treatment of ballast waters in Boka Kotorska
5) Rehabilitation of communal water infrastructure and supply systems

Tanger-Tétouan-Al Hoceima Region

1) Control coastal erosion (cliffs) – Zone around El Jebha
2) Control floods threatening to displace vulnerable populations – Martil
3) Use of natural dykes and green corridors (native species) in Stehat
4) Flood management, risk reduction and better water harvesting and management - Tizgane, M'tioua and Amthar (Chefchaouen Province) as well as Ramsar Sites (wetlands), coastal areas (Tangérois), rural areas and non-constructible zones.
5) Creation of zones for wind sports and supporting rural tourism - Tangier–Assilah and Fahs-Anjra Provinces
6) The threat of invasive species from ship ballast – Jbel Moussa
7) Rural/biodiversity/community engagement and food security box - Rural areas of TTA, especially those with a lot of smallholder agriculture

As stated, this is the order of priority based on the MCA. If we also take account of what is feasible for a CBA, we get the following changes in the ranking for the Tanger-Tétouan-Al Hoceima Region.

1) Control coastal erosion (cliffs) – Zone around El Jebha
2) Use of natural dykes and green corridors (native species) in Stehat
3) Creation of zones for wind sports and supporting rural tourism - Tangier–Assilah and Fahs-Anjra Provinces
4) Flood management, risk reduction and better water harvesting and management - Tizgane, M'tioua and Amthar (Chefchaouen Province) as well as Ramsar Sites (wetlands), coastal areas (Tangérois), rural areas and non-constructible zones.
5) The threat of invasive species from ship ballast – Jbel Moussa
6) Rural/biodiversity/community engagement and food security box - Rural areas of TTA, especially those with a lot of smallholder agriculture

The next step is to present the list of data requirements to local experts so they can determine if the information can be collected within the time frame for the conduct of a CBA. Once we have at least key data components we can start the analysis. Where software tools are required such as InVest we will need 12 weeks to process the information.

Given the long list of possible measures we propose that local stakeholders select a small number (perhaps 2-3 from each region) for a full assessment.

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