Ministry of Environment, Albania

Project Reference No: 5386

ALBANIA: "BUILDING THE RESILIENCE OF KUNE-VAINI LAGOON THROUGH ECOSYSTEM-BASED ADAPTATION (EbA)" (SPECIAL CLIMATE CHANGE FUND)

Ecosystem-Based Adaptation Protocols Report

August 2017

TASK 2 - Ecosystem Based Adaptation Protocols Report

“"BUILDING THE RESILIENCE OF KUNE-V AINI LAGOON THROUGH ECOSYSTEM-BASED ADAPTATION (EbA)"
(SPECIAL CLIMATE CHANGE FUND)

Submitted by: Jonathan McCue

August 2017

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Acronyms

CBA	Cost-benefit Analysis
CCA	Climate Change Adaptation
DMRD	Drini-Mati River Deltas
EbA	Ecosystem-based Adaptation
EU	European Union
GDP	Gross Domestic Product
GEF	Global Environment Facility
GhG	Greenhouse Gas
GoA	Government of Albania
IEbAE	International Ecosystem-based Adaptation Expert
ICZM	Integrated Coastal Zone Management
ISPA	Institutional Support for Protected Areas in Albania
IWRM	Integrated Water Resources Management
IUCN	International Union for the Conservation of Nature
KVLS	Kune-Vaini Lagoon System
MTE	Ministry of Tourism and Environment
MARD	Ministry of Agriculture and Rural Development
MIE	Ministry of Infrastructure and Energy
NEA	National Environmental Agency
NGO	Non-Governmental Organisation
NPV	Net Present Value
PV	Present Value
REC	Regional Environmental Centre
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
UNFCCC	United Nations Framework Convention on Climate Change
WB	World Bank

1. INTRODUCTION

1.1. Project Purpose

Ecosystem-based Adaptation (EbA) in coastal environments is being considered as a valid concept to help address the consequences of climate change. It represents a range of adaptive management approaches that use biodiversity and natural habitats as part of an overall approach towards helping coastal business and communities to better adapt to the negative effects of climate change. In addition, EbA can provide other benefits to communities, for example, through the maintenance and enhancement of ecosystem services crucial for livelihoods and human well-being, such as clean water and food. Appropriately designed EbA initiatives can also contribute to climate change mitigation by reducing emissions from ecosystem loss and degradation, and enhancing carbon sequestration.

The design and implementation of coastal adaptation measures, using the EbA approach, is a key goal of the current UNEP funded project objective (being managed by the Ministry of Environment) which involves (specifically for the Kune-Vaini Lagoon System- KVLS), a range of coastal EbA interventions that include:

- The implementation of coastal forests involving the reforestation of some sites of the Ceka. These areas have deteriorated over a number of years, and support is needed to help stabilize the sandy dunes and restore the damaged natural habitats, selecting native plants resilient to climate change.
- Dune rehabilitation. Stabilizing the upper level of the sand dunes, to control erosion caused by normal tide/wave activities and wind erosion, by planting native water and salt resistant species.
- Opening a new tidal inlet channel between the Ceka Lagoon and the Adriatic Sea;
- Possible opening/reopening of 12 artesian wells, to ameliorate the balance on salt and not salted water, and to offer drinking water for wildlife (subject to initial feasibility assessment works).

These sites are located in Figure 1.1.

Figure 1.1: Identified demonstration EbA interventions for the Kune/Vaini site, Albania

The implementation of these coastal adaptation interventions is intended to result in increased ecological functioning and climate-resilience, which will reduce the vulnerability of the KVLS and the communities surrounding it to the negative effects of climate change. Nationally however, there is no study at a species level that is providing the "protocols" required implement EbA in coastal environments.

Table 1.1 identifies the sample adaptation options that have either been implemented in Albania (Drini region) or are being proposed for Kune-Vaini regions (post 2017).

Theme	Example Adaptation Actions
Coastal Geomorphology	There are 3 main approaches to mitigate coastal erosion in the Shëngjini, Kune and northern Vaini-Patok littoral cells that should be considered: • Eliminate factors that exacerbate erosion such as reintroducing sediment to the coast down the Drini River and removing the Drini River breakwater; • Beach restoration strategies particularly beach nourishment and dune management to slow erosion rates; and • Structural methods of sand retention.
Ecosystems	Undertaken wetland restoration
Agriculture	In addition, as sea levels rise, agriculture area will be at risk of coastal flooding. In order to mitigate the trend of habitat loss and reduce flood risk, two adaptation options could be considered: • Restoration of agricultural areas to restore functioning wetland (saltmarsh) habitat to replace that lost and provide a flood defence function; and • Maintenance and upgrade of flood embankments
Hydrology	The limited exchange of water through tidal channels between the Adriatic Sea and the lagoons is a problem common to the entire DMRD. In order to avoid potential eutrophication in the lagoons the tidal exchange needs to be improved significantly over the current situation. Four adaptation measures are being considered: • Structural methods to restrict sediment accumulation in the channels; • Regular maintenance dredging of the channels to maintain functionality; • Increasing lagoon tidal prism and current flow (and hence scour) through the tidal channels by managed realignment of landward agricultural areas; • Controlled discharge of polluted water from the pumping stations

Table 1.1: Sample adaptation actions recommended for Albania to reduce vulnerability to climate impacts.

1.2. Report Purpose

Building on the knowledge created to date, from key projects initiated by UNDP (2012) and UNEP (this project), the purpose of this report is to set up the framework for delivering coastal EbA at a national level for Albania. This framework includes the design of a series of technical "Protocols" which may be applied at a national level, though are initial defined based on experience attained from local pilot study work (UNDP 2012 and UNEP 2017).

The key aspects of this Protocol report are as follows:

- Introduce international examples of coastal EbA protocol or "guidance" documents that have been produced in temperate countries that are of relevance to the interventions that have been undertaken in Albania;
- Introduce technical "protocols" that may be adhered to on specific coastal EbA interventions (for practitioner assistance);

- Introduce how the protocols (technical details) presented in this document can apply within an EbA mainstreaming "guideline" for the future and how this Protocol document will support the development of a more robust EbA Guidance Manual to be produced separately for Albania.

This Protocol report shall ultimately be presented as a formal stand-alone appendix to a separate EbA Guidelines Manual which is to be produced later into 2017.

1.3. Structure of the Report

The report structure is set out as follows:

1. Section 1: Introduction;
2. Section2: International Best Practice: Coastal Guidelines for Reforestation and Rehabilitation;
3. Section 3: Technical Protocols for Coastal Reforestation;
4. Section 4: Technical Protocols for Dune Rehabilitation;
5. Section 5: Technical Protocols for Tidal Channel Inlets ;
6. Section 6: Next Steps – Guidelines for Mainstreaming EbA in Albania;
7. Appendices.

As stated above, information used within this Protocol report is adapted from two key reports produced as part of the larger UNDP (2012) or supporting UNEP (2017) funded projects. Hence any reference to a 'project' should be linked to either of these specific donor funded initiatives which are clearly referenced accordingly.

2. International Best Practice Guidelines for Reforestation and Dune Rehabilitation

2.1. Coastal EbA options

2.1.1. Introduction

Many options exist for adapting to climate change within the coastal environment. These include options that use infrastructure to help people adapt to the adverse effects of climate change ('hard' adaption), options which use biodiversity and ecosystem services as part of an overall adaptation strategy (ecosystem-based adaptation; EbA), and hybrid options which seek to capitalise on the characteristics of both 'hard' and 'soft' EbA approaches. EbA options, like other adaptation options, range from policy and governance-focused approaches (e.g. ensuring that the impact of climate change, including on ecosystems, is considered within wider marine spatial planning) to on-the-ground actions (e.g. restoring mangroves in tropical environments).

It is accepted that an integrated suite of adaptation interventions, including EbA, should be implemented in the KVLS and other parts of Albania with similar geographic and topographic characteristics, in order to reduce vulnerability of communities living near the system to climate change induced events.

A range of different EbA techniques can be used, although the implementation of coastal forests (reforestation) and dune rehabilitation are the two primary EbA focus "headers" for the KVLS (this report). What requires attention is to determine internationally how EbA "protocol" guides or manuals have been produced for these coastal environments, focusing on the level of details provided and the usability of the documents to help regions/nations take forward the key technical advisories being proposed.

2.1.2. Purpose of this Section

The purpose of this section is to present the adaptation benefits of coastal EbA interventions plus also to examine international coastal EbA "protocol" manuals that have been produced for coastal forest and dune systems within temperate climates only. This way, the examples shown and lessons can be learned to help identify possible strengths, weaknesses, and areas of improvement for the Albanian EbA Guidelines Manual (to be produced by the end of 2017) and to provide clear advice on how future updates of this Protocols Document for Albania should be undertaken (with specific technical research etc) for future measures such as implementing coastal forests and dune restoration/ dune rehabilitation.

2.2. Coastal EbA Adaptation Benefits

Coastal EbA interventions often result in multiple benefits to the local communities, economy and environment including: i) reduced flooding; ii) improved biodiversity and iii) improved fisheries production. As such, this suite of interventions will improve the capacity of the ecosystem to adapt to climate change and provide important goods and services to local communities. In so doing, adaptation interventions and EbA will improve the local communities' capacity to adapt to the negative effects of climate change. Specific reference is now placed on coastal reforestation and coastal dune restoration techniques.

2.2.1. Coastal Forests

Coastal forests have a direct impact on wind conditions during storm events impacting on the coast. Multiple studies have examined wind reduction due to windbreaks or shelterbelts used to protect agricultural fields. The zone of wind reduction extends to both windward and leeward sides of a shelterbelt.

- On the windward side, winds reduce for a distance of 2 to 5 times the height of the forest barrier.
- On the leeward side, winds reduce for a distance of 30 times the height of the forest barrier.
- Provide habitat for native fauna
- Help contribute to the provision of Ecosystem Services (See Figure 2.1).

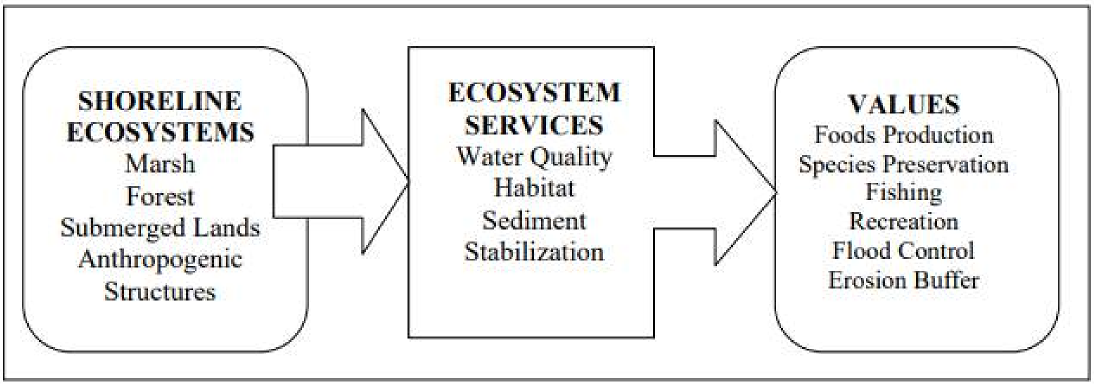

Figure 2.1 Ecosystems Services Flow Diagram. Each element of the ecosystem provides one, or more, functions. These functions provide one, or more, values to society.

2.2.2. Dune restoration/ dune rehabilitation

Sand dunes represent unique and in some ways harsh environments for plant and animal life, and so the species associated with them tend to be specialised in nature and localised in distribution. Conserving dune habitat is therefore important for this specialist flora and fauna. Their presence contributes towards water regulation and purification and they play an important role as coastal dune aquifers.

Vegetated dunes perform more efficiently, ensuring stability, greater energy dissipation, and resistance to erosion and dune presence often reduce the possibility for overwash or breaching, potentially lessening the likelihood of lagoon flood risk as beaches and dunes can act as a barrier to storm surges and flooding and help reduce coastal erosion by stabilizing the shoreline.

Dune vegetation has the ability to prevent wind erosion by decreasing wind speed at ground level and by providing a protective cover over the dune. They also help to build up sand dunes and thereby increase the sand reserve for storm waves, thereby reducing (but not preventing) damage from wave erosion.

A clear protocol for both coastal reforestation and dune rehabilitation is therefore required for Albania. This is because the positive impacts by planting are quite diverse and can have impacts over the long term.

2.3. Implementation of EbA

IUCN (2016) have recently produced a useful Guide Manual that provides a step-by-step guide for setting up and implementing EbA interventions. It promotes an integrated approach to EbA with the ultimate goal of "building resilience of socio-ecological systems". Additionally, the handbook introduces the reader to the building blocks of an EbA strategy and how these can be developed. The steps proposed are set out in Figure 2.2 as they are deemed of relevance to the Albanian situation.

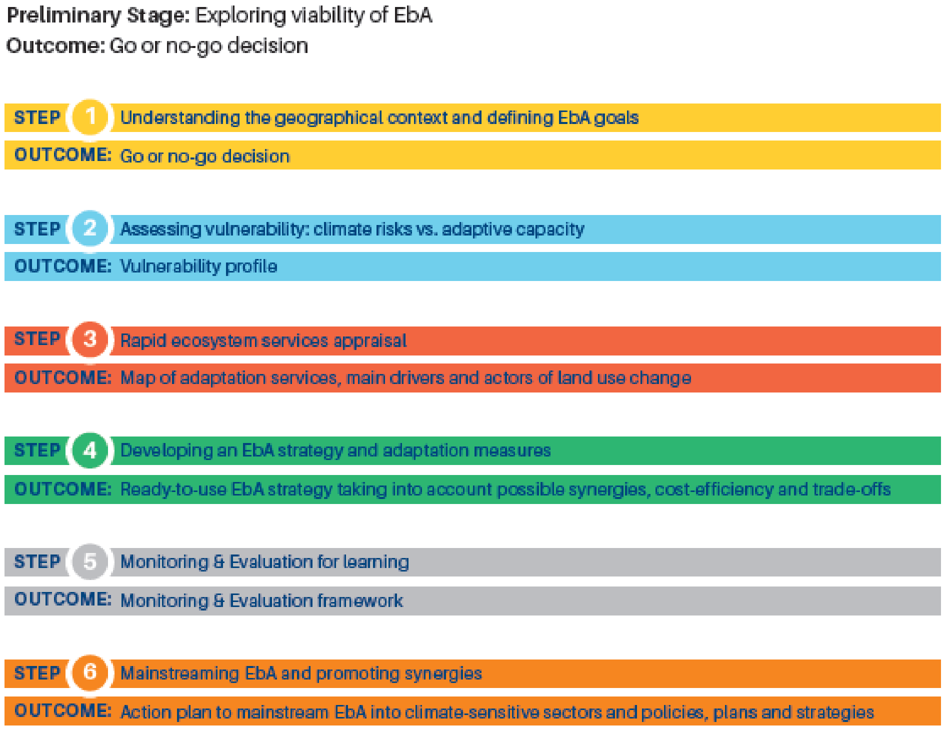

Figure 2.2: Step Approach towards Implementing EbA (Taken from IUCN 2016)

The steps identified above within the IUCN Manual shall be developed further within the forthcoming EbA Guidelines Manual to be produced later this year (2017). Of interest, Step 4 represents the key stage that is reflected within this EbA Protocols Report. The Guide Manual shall address all steps in more detail, though with particular emphasis on Step 6 (Mainsteaming EbA and promoting synergies).

Specific details of the use of Cost Benefit Analysis (CBA) for EbA interventions are presented in Appendix B.

2.4. International EbA Protocol Guidelines

2.4.1. Introduction

In order to conclude whether more research is needed into performing EbA measures for the KVLS, an examination of international EbA guidelines has been undertaken to better understand approaches and presentation styles for similar temperate coastal areas (with specific reference to for reforestation and dune rehabilitation techniques).

The purpose of this sub-section is to demonstrate the level of detail that certain international guides have gone to, to convey technical details regarding coastal reforestation and dune rehabilitation. Using this information, one is then able to better determine whether the level of detail presented within this document for Albania is appropriate for Albania or whether future research areas that may be required (with international donor support) to better update this document with additional technical information to upscale the EbA Technical Guide Manual for all Albanian coastal areas.

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NB: it is not the intention of this section to provide an exhaustive list of all possible guides that exist, but to demonstrate a couple of international examples which can be developed and enhanced within the Albania specific "EbA Guidelines" manual to be produced later into 2017.

2.4.2. Coastal Reforestation Guides

2.4.2.1. Native Forest Restoration Guide – Auckland

http://www.aucklandcouncil.govt.nz/EN/environmentwaste/coastalmarine/Documents/nativeforestrestorationguide.pdf

http://www.aucklandcouncil.govt.nz/EN/environmentwaste/coastalmarine/Documents/coastalplantingguidecoastalforest.pdf

NB: Coastal planting guidelines 1-6 exist which address dunes, cliff tops, coastal forest and wetlands.

This guide presents a technical document that may be followed by technicians to help with the replanting of coastal forests. The advice provided ranges from restoring existing degraded remnants, to re-establishing plant cover on bare sites. Two clear stages are outlined within the guide to help denote what needs to be undertaken at specific stages of planting. These stages are of use within an Albanian context and are presented below:

Stage 1: Initial plantings

Initial plantings need to establish colonizer vegetation. Coloniser species are those plants able to cope with drier, hotter conditions in open areas and make up the bulk of a planting. Coloniser plants will provide shelter for other species to establish naturally. Consider planting a mixture of wind and bird dispersed species to help assist natural regeneration processes.

Stage 2: Enrichment plantings

A successful restoration planting should create conditions where native plants can regenerate themselves, so that eventually the planting can become self-sustaining. Sometimes enrichment planting will be required to assist with providing a natural species composition within the planting, such as when natural dispersers are absent e.g. birds, or the planting is isolated from natural seed sources. Planting should be completed in stages. Once initial colonizers (stage 1) have become established (several years) and have begun to provide shade and shelter, stage 2 planting of enrichment species can be 'inter-planted' between the original plants

Validity towards the approach for Albania and the DMRD/ KVLS

The stages approach advice is relevant to the Albanian situation and mirrors the format adopted by the IEbA specialist. A successful restoration planting approach is needed to help create conditions where native plants can regenerate themselves, so that eventually the planting can become self-sustaining.It is important if possible to provde clarity on the climate resiliency of species being promoted. This aspect is challenging if specific research projects have not been undertaken to test the availability and robustness of new climate adaptation species for coastal forest areas.

2.4.2.2. Coastal Forest Rehabilitation Manual – Aceh, Indonesia (2007)

http://www.fao.org/forestry/14562-0c0f65c565878b45e8dc1455f6861463.pdf

Since the tsunami of December 2004, the Govt of Indonesia has, however, consistently declared an intention to re-establish and maintain a coastal greenbelt in Aceh Province in line with national greenbelt legislation. A number of small scale mangrove and coastal forest reforestation projects have therefore been completed and more projects are anticipated, including some large scale projects of several thousand hectares.

This manual was produced to assist organisations engaged in rehabilitation and reconstruction in Aceh Province that wish to implement mangrove or coastal forest reforestation projects. It provides information on the selection of mangrove and coastal forest species and collection of seeds and propagules, relevant nursery and planting techniques for each species.

The manual concludes that all coastal reforestation projects should be implemented as part of a co-ordinated planning and management process. A key focus of the manual provides a framework for engaging stakeholders and communities in coastal forest rehabilitation. It stresses that although time consuming, such processes are the only way to ensure that project interventions are sustained by individuals and institutions following completion of project activities. The role of legal agreements in protecting planted trees and forests and the long-term benefits they offer is also covered.

This manual is intended as an introduction and field guide to participatory coastal forest rehabilitation. The level of detail provided (protocols) for each tree species is reflected in Figure 2.3.

Xylocarpus granatum
Nyirih (Ina)
Nyirih (Aceh)

General Description: *Xylocarpus granatum* has buttress and ribbon like plank roots, leaves are compound (4 leaflets), tree up to 12 m tall, flowers are small, in groups of 8-20. Fruits very large, hard, cannonball like (up to 25 cm).

Collection of propagules: Ripe fruit yellowish brown, often starting to crack open while on tree, fallen seeds surface yellowish with grey spots, root radicle evident.

Storage of propagules: In shade and moist - 5 days max.

Sowing and potting techniques: float fruits in brackish water, viable seeds will float, select those at least 30g. Sow in mud/sand mixture. Lay seeds on soil with radicle pointed down in medium polythene bags.

Shading: decrease sunlight by 30%, remove shade 1 month before planting.

Watering: natural tidal flows if possible but with watering to keep soil moist at all times if necessary.

Ready for planting out: seedling height greater than 20 cm, and more than two pairs of leaves, usually 3-4 months.**Position on the shoreline:** favours the mid-upper levels of the intertidal zone where there is abundant freshwater influence and low soil salinity. Shade tolerant.

Plantation spacing: 2 m x 3 m or 4 m x 4 m in mixed plantings.

Figure 2.3: Specific Protocol related details for tree species (FAO 2007)

Validity towards the approach for Albania and the DMRD/ KVLS

Although this is a specific tropical focused reforestation manual, the intelligent approach towards supporting local coordination mechanisms, and participatory tools that could be used, remains highly relevant to the Albanian situation (Figure 2.4).

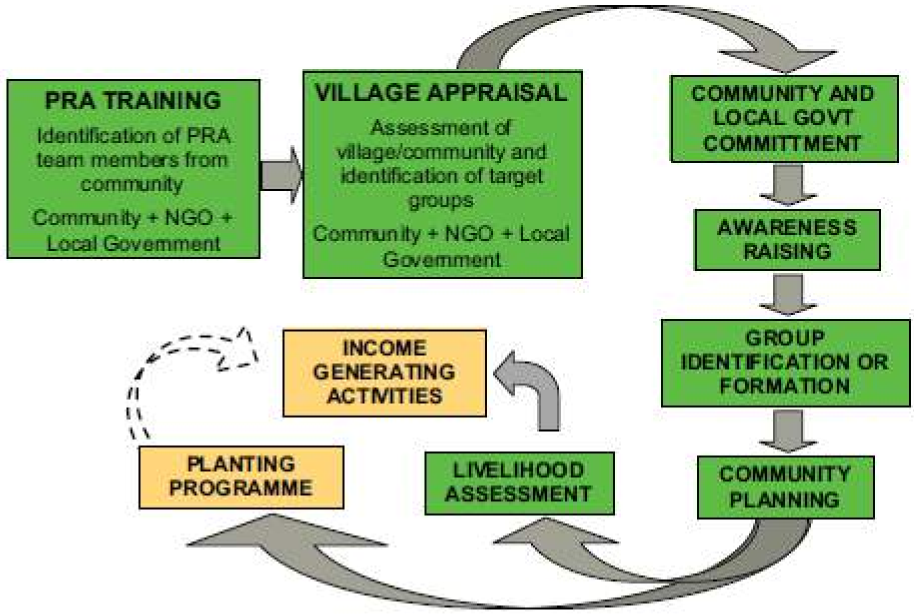


Figure 2.4: Process of Community Involvement in Coastal Forest Rehabilitation (taken from FAO 2007)

2.4.3. Dune Rehabilitation Guides

2.4.3.1. Coastal Dune Management – A Manual of Coastal Dune Management and Rehabilitation techniques

The Department of Land and Water Conservation (New South Wales, Australia) produced a very useful guide on dune rehabilitation in 2001. The web link to this document is presented below.

http://www.environment.nsw.gov.au/resources/coasts/coastal-dune-mngt-manual.pdf

The Manual provides the information required for successful rehabilitation and protection of coastal dunes. It describes the role of coastal dunes within the broad dynamics of the NSW coast and it reviews both the characteristics and some of the regional variability of NSW coastal dune environments. Most importantly, it describes the techniques currently favoured in stabilizing, revegetating and maintaining these sensitive environments.

In a similar way to a number of guides assessment, it discusses revegetation in terms of four clear "themes" or stepped approaches:

1. **Planning and Development**

This involves assessing the site (for example assessing which areas need planting and why), choosing what plants go where (include as many species as are needed to recreate an appropriate vegetation structure) seedling collection and propagation.

2. **Implementation Methods**

Site preparation is the first implementation task, followed by dune reshaping reconstruction and revegetation techniques, including direct seeding, planting tube stock, brush mulching and transplanting. It states that a slow release fertilizer can be used on plants where primary, secondary and tertiary species are being planted for the first time. The addition of fertilizer will also aid in the recovery of partially damaged areas of existing dune vegetation.

3. Maintenance

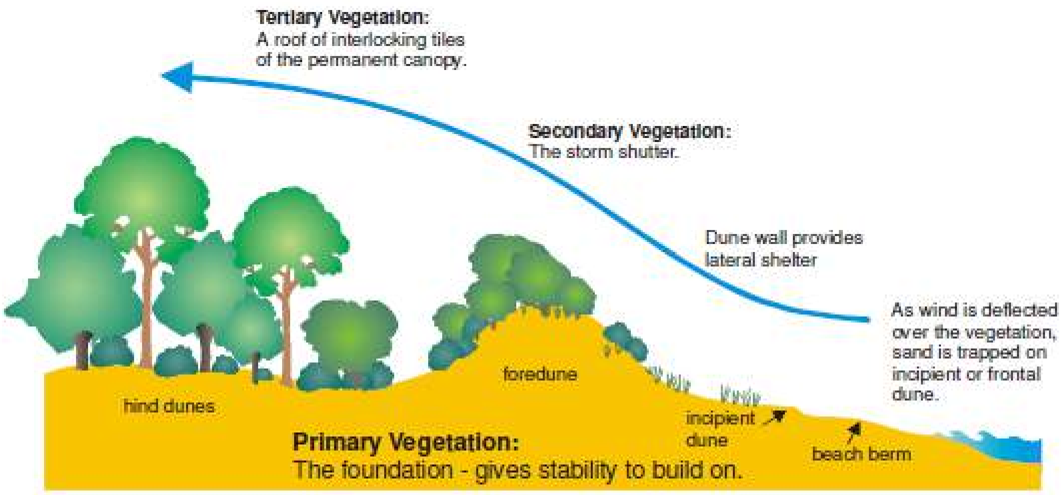
Maintenance is an on-going element that will need to be continued for several years after the vegetation has been established. It is fairly easy to have a very good implementation phase but if it is not nurtured in the early stages to a point where it is self-sustaining then the probability of wasted effort and resources is very high. Some of the maintenance activities include watering, fertilizing, weeding and maintenance of infrastructure.

4. Monitoring

It is strongly recommended that comprehensive records of progress be maintained. This monitoring will then provide the feedback needed to determine maintenance requirements and will help to measure the effectiveness of the revegetation. Record keeping can be done through simple means such as photography and note taking. It should include "before" and "after" photographs and should Coastal Dune Management 90 document plant survival rates, annual plant growth, watering and fertilizer regimes, vandalism etc.

Importantly it states that while the guidelines contained in this Manual represent current best practice and will be applicable to the majority of situations, local circumstances may necessitate departures from them. Community expectations will also increase as time passes, new products and techniques will emerge, new standards will be adopted and occupational health and safety requirements will become stricter. Practitioners must always endeavour to minimise risk to themselves and beach users by adopting appropriate designs and procedures, and ensuring that effective maintenance programs are implemented.

Useful diagrams are presented throughout the guide to help convey some key technical matters (Figure 2.5).



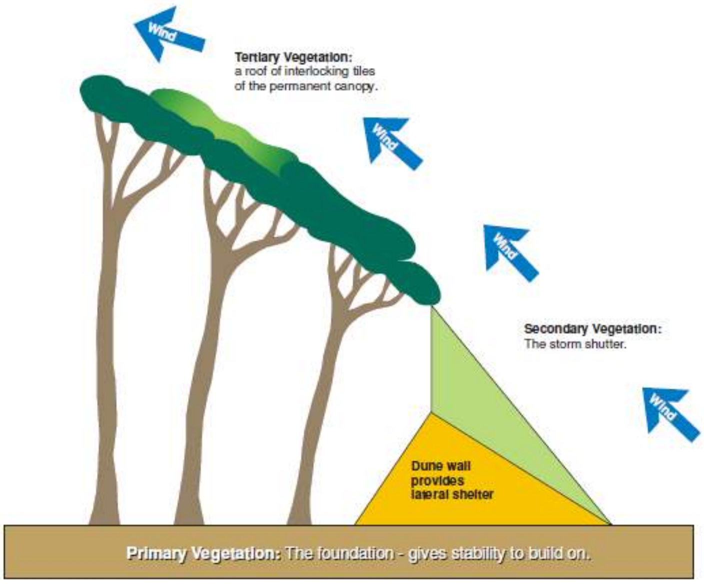


Figure 2.5: Functional model of dune vegetation - streamlining: analagous to a storm proof house.

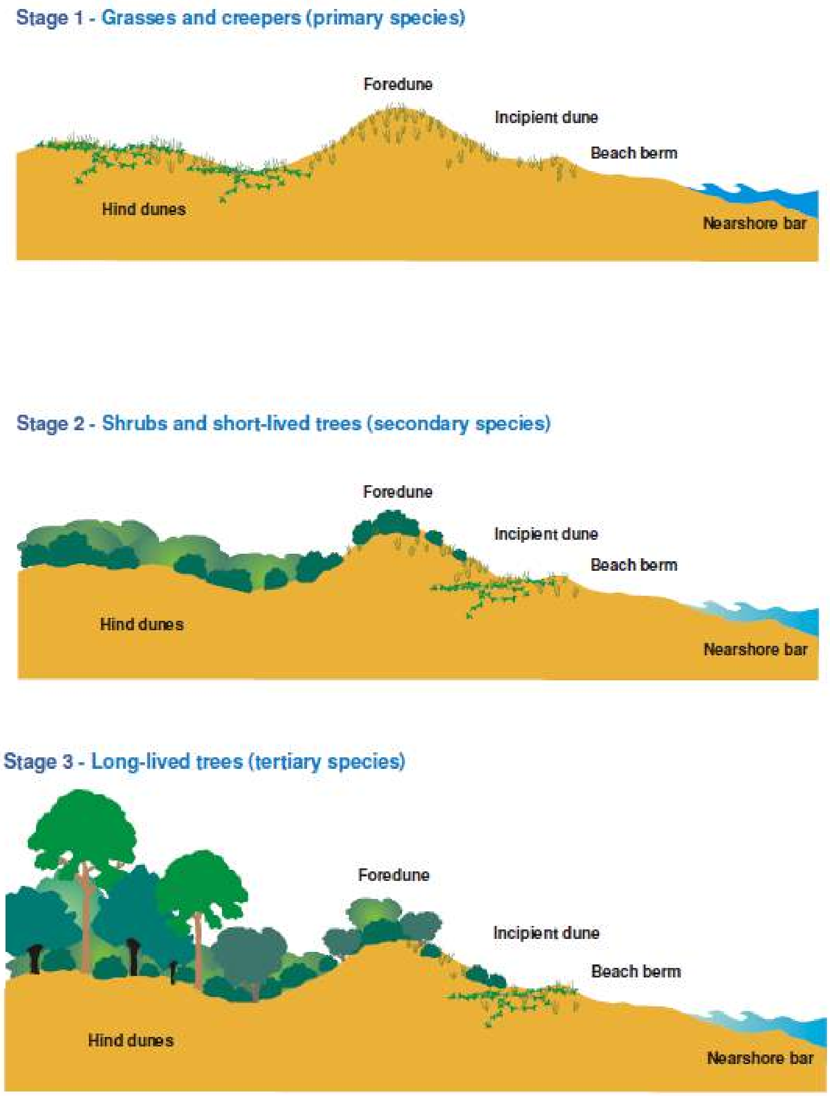


Figure 2.5: Idealised coastal vegetation succession on dunes

2.4.3.2. Coastal Dunes – Dune Protection and Improvement Manual for the Texas Gulf Coast

The web link to this document is presented below.

http://www.glo.texas.gov/coast/coastal-management/forms/files/dune-protection-manual-gpb.pdf

This guide manual provides two useful protocol related sections of relevance to the Albanian situation as follows.

1. Use of Vegetation

The manual states that transplants from the vicinity of the project are more likely to survive than imported ones. It recommends that plants should only be taken from dense stands in areas that are not subject to erosion. Plants should not be taken from coppice mounds or from fore-dunes that are sparsely vegetated. Immediate watering of transplants is not imperative, but success is increased if transplanting is done after a rain or if the dune is watered before transplanting.

Fertilization may be used during the first year after transplanting but is usually unnecessary thereafter. An approved soils testing laboratory can provide fertilizer recommendations for a particular location.

2. Construction with imported sand

The manual states that some beaches may be sand-starved. Natural sand accumulation occurs very slowly, and it may take as long as 20 years for a six-foot-high dune to form. Even with dune-building structures, the process is slow. In areas of limited sand supply, where the sand is saturated, or where it is restrained from blowing, dunes may be constructed of imported sand (Figure 2.6). Imported sand should be similar in color, grain size, and mineral content to the sand at the dune building site. If native sand is topped with imported finer sediment, the finer sediment will quickly erode.

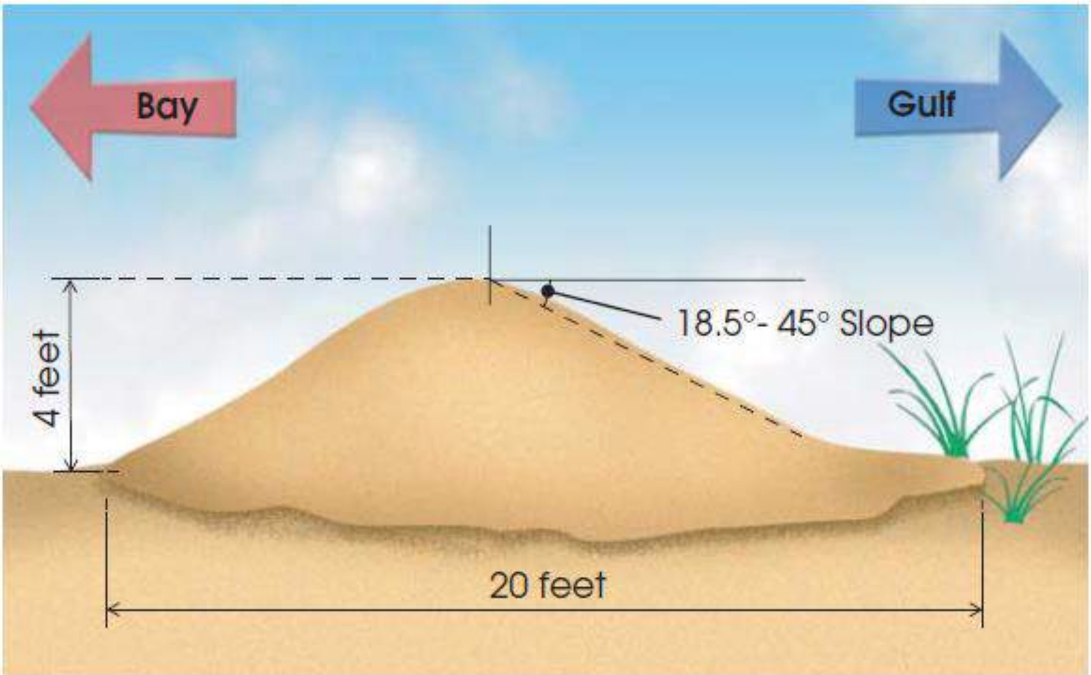


Figure 2.6: Minimum height, width, and slope of a dune constructed of imported sand.

Highlighting the importance of dune protection and construction using vegetation, this manual has relevance to the KVLS. It also examines the use of sand fences as a technique, though states that the planting of native vegetation to trap sand is always preferable to the use of man-made structures. Plants collected from the vicinity of the project are more likely to survive than imported ones (something to be considered for policy makers).

2.4.3.3. Planting Guide for Establishing Coastal Vegetation on the Mississippi Gulf Coast (2007)

The web link to this document is presented below.

https://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/mspmspu7271.pdf

This is a publication written to provide guidance on how to stabilize coastal sand dunes and protect shoreline areas from erosion along the Mississippi Gulf Coast using native plant materials. This document contains individual plant guides on various native coastal plant species found on the Mississippi Gulf Coast. Each plant guide contains a brief plant description; method of establishment; recommended plant varieties or sources; and cultural specifications for establishment and management. Appendices have been included to provide information on how to properly collect and propagate native coastal plant species from their natural habitats, and provide a list of local plant vendors that grow and sell many coastal plant species.

2.5. Lessons Learned for Albania

The main lesson learned for Albania, from reviewing international guide manuals of similar focus is as follows:

- There is value in guide manuals setting out the importance of climate adaptation management for the specific habitat and that the key message is brought out, namely, that the practice of making small but calculated incremental changes, based on site specific observations and analysis, is valuable and can make significant positive impacts at the local level if undertaken professionally and competently;
- The most effective manuals stress that adaptive management is best achieved when a cyclical approach is adopted, that encourages decisions to be made based on knowledge attained at a specific site whilst managing possible limitation as deemed appropriate.
- Most (if not all) the guide manuals assessed propose that adaptive management solutions may need to include minor realignment, movement of materials/species and gradual changes to the geometry or removal of sediment control systems;
- All guidelines promote the incorporation of monitoring systems which may need to be quite detailed and regular following initial EbA technique implementation;

3. Technical Protocols for Coastal Reforestation

3.1. Sites for Intervention

3.1.1. Adaptation Benefits of Reforestation

Adaptation is an adjustment in natural or human systems in response to actual or expected coastal change and climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. In terms of reforestation, the key adaptation benefit is to provide terrestrial ecosystem resilience within coastal hinterland areas, thus providing natural "green belt" buffers from storm inundatin whilst enhancing ecosystem services for a range of stakeholders. More specific EbA mainstreaming approaches, linked to adaptation potential, shall be developed within the EbA Technical Guidelines Manual (end of 2017).

3.1.2. Proposed Locations for Intervention (KVLS)

Within the KVLS, and based on field surveys conducted by NCETSD & Diava Consulting 2017, several plots were identified for reforestation. Figure 3.1 outlines these proposed locations.

Figure 3.1: Proposed intervention locations for coastal reforestation (KVLS) (taken from NCETSD & Diava Consulting 2017)

The proposed plot 8c (Figure 3.1) is situated in the western part of the village Stomi i Madh,. The overall area is 22.62 hectare (ha) and the area proposed to be reforested is 3.1 ha.

Figure 3.2 Detailed View of the area to be afforested in plot 8c

Forest parcel 21a (Figure 3.3) is located in a distance of 1.5 km from Barbulloje village. The forest parcel area proposed, based on the Forest Management Plan, is 1.86 ha. The area proposed for reforestation inside of this forest parcel represents an area covering 0.5 ha.

Figure 3.3: Detailed View of the area to be afforested in plot 21a

Forest parcel 21 b and 21c (Figure 3.4) is situated 198 m away from the Tale Water Pumping Station building to the east. According to the Forest Management Plan, the overall forest parcel area is 34.64 ha whilst the plot area proposed for reforestation is 3 ha.

Figure 3.4 Detailed View of the area to be afforested in plots 21b&21c

Forest parcel 27a (Figure 3.5) is located in the southern end of the Drini estuary (2.47 km away from parcels 21 b and c). This area is used in the past for pheasant breeding and the area proposed for reforestation is 0.4 ha.

Figure 3.5 Detailed View of the area to be afforested in plot 27a

The remaining reforested areas (to make up the allotted 10ha) are located around a range of sites along the edges of roads that occur inside the KVSL (see Figure 3.6).

Figure 3.6 Plantation along roadsides inside the Kune-Vain lagoon

The information of each plot with local name, their position and border are given below (Table 3.1):

Table 3.1: Borders, Geographic Location and Information of each proposed plot site (proposed by NCETSD & Diava Consulting 2017)

<table>
<tr><th colspan="2">Borders, geographic location and information of each proposed plot site</th></tr>
<tr><td>Plot no. 8c

Local name: "Pishat e Stavnikut", Kune Island
Location: 41°45'41.13" N & 19°35'0.26" E
Proposed plot borders:
- North: water body of Kune lagoon
- South: water body of Kune lagoon
- East: forest with Mediterranean pines
- West: Adriatic sea</td><td>Plot no. 21a

Local name: "Stomi i Nikoll Lucës"
Location: 41°43'59.62" N & 19°36'44.59" E
Proposed plot borders:
- North: land plot 19b
- South: land plot 22b
- East: land plot 21c
- West: land plot 20b</td></tr>
<tr><td>Plot no 21b & 21c

Local name: "Shulza"
Location: 41°42'43.12" N; 19°35'23.77" E
Proposed plot borders
- North: plot 19a
- South: plot 22
- East: water body (lagunë)
- West: plot 22a</td><td>Plot no. 27a

Local name: "Ish Fazaneria"
Location: 41°43'43.68" N; 19°34'59.85" E,
Proposed plot borders:
- North: plot 29b
- South: plot 26
- East: plot 28
- West: plot 17d</td></tr>
</table>

3.2. Key Criteria for National Site Selection

General Principles

For a successful reforestation, 3 main principles must be taken into consideration:

- Species selection- this is crucial for the success of the reforestation and adaptation to predicted climate change. It is therefore critical that this task does not continue in a "business-as-usual manner" and instead, careful thought must be given to the selection of appropriate species that can better adapt to changing climate conditions.

- Planting stock density – this along with species mixture is very important for the success of the reforestation. Planting densities must therefore take into account reforestation purpose and winds prevailing in the area (with speed ranges from 2.5 to 3.1 m/s).

- Seedling quality and planting practices - Seedling quality is essential for short and long term success. This can be done by respecting strictly seedling standards which will directly enhance the ability of seedlings to withstand drought, frost, vegetative competition, nutrient deficits, and animal damage (Jacobs et al. 2015). Additionally, planting techniques (pre planting, planting, and post planting operations) must be conform standards in order to provide better chances for seedlings to survive the critical establishment phase.

Key criteria for site selection include a range of factors including the presence of typical grass vegetation for sandy soils as well as reed *(Juncus maritima)* and scrub vegetation. These criteria apply for local site selections that apply at a national (Albania) level and should be adhered to in future site selection assessments.

3.2.1. Physical description of the sites

All proposed plots for reforestation should be situated on flat terrain with elevation ranges from between 0.5 to 3 m above sea level (m a.s.l.) and with no influence of inclination. The area preparation for planting is a prerequisite for the successful implementation of planting works and for rapid adaptation of the planted seedlings. In order to prevent soil erosion, damage of upper soil layers and loss of nutritional elements, the existing ground vegetation must not be totally removed and no heavy machinery should be used to avoid soil compression.

It is recommended that the removal of harmful plants (such as blackthorns or briers) is undertaken by using manual tools during the preparatory works in order to keep safe the soil texture and nutritional elements. Controlled burning of ground vegetation may be applied to small areas but adequate care should be demonstrated. The planting orientation should follow the eastern-western direction, in order to optimize light conditions for the seedlings.

The key information for each forest parcel and proposed plot (as defined for KVLS) is summarized in the Table 3.2:

Table3.2. Summary information on physical description of each proposed forest parcel

Forest parcel	Local name	Terrain pattern	Elevation (m a.s.l)	Site inclination (degree)	European Vegetation classification	Existing vegetation
8 c	"Pishat e Stavnikut"	flat	1	0	Mediterranean salt meadows *(Juncetalia maritimi)* 1410	*tamarix, graminacea* veg.
21a	"Stomi i Nikoll Lucës"	flat	3	0	Mediterranean salt meadows *(Juncetalia maritimi)* 1410	*Juncus maritima*
21 b & 21 c	"Shulza"	flat	1	0	Mediterranean salt meadows *(Juncetalia maritimi)* 1410	*Arthrocnemum fruticosum, Salicornia europaea, Limonium vulgare, Inula crithmoides,Phragmites australis, Scirpus maritimus, Tamarix dalmatica, Vitex agnus-castus, Tamarix hampeana*
27a	"ish Fazaneria"	flat	0.5	0	Mediterranean salt meadows *(Juncetalia maritimi)* 1410	White poplar (*P.alba* L.) and stone pine (*P.pinea* L.).

3.2.2. Climate-resilient Species Selection

It is important to stress that climate-resilient species selection is critical to the success of sustainable reforestation projects. The reforestation of coastal sites with climate resilient forest species aims to achieve the following;

- improve the physical and chemical land proprieties of the site,

- establish a green forest habitat, improving wildlife presence and prevailing winds and waters in storm events ;
- improve the visual potential of the site for tourism and recreation.

With regards to species selection three elements must be taken into consideration:

- Purpose of planting;
- Site conditions and preparation;
- Biological traits of species.

The methods recommended for use to assist in species selection should be the **"method of comparative ecology".** This method is based on the comparison and agreement between species requirements and site conditions and is often applied for species selection when no field experiment has been established (hence, it is of value for other possible locations around Albania).

Table 3.6 shows the requirements and site conditions for each species of plant. ***NB: The species proposed for planting are native and well adopted to site conditions. All species need to possess have a high adaptive capacity to severe site conditions and have ability to improve soil conditions and fertility which may limit vegetation growing rates.***

Table 3.6: Requirements and Site Conditions for specific plant species

Species	Species requirements						
			Temperament				
	Climate	Soil type	temperature	soil moisture	light demand	soil fertility	Advantages
P.halepensis Mill.	lowland mediterranean	sandy-greybrown	termophyle	xerophyte	high	low demand	Improve soil conditions
P.pinea L.	lowland mediterranean	sandy-greybrown	termophyle	xerophyte	high	low demand	Improve soil conditions
Q.pedunculata Ehrh.	lowland mediterranean	sandy-greybrown	termophyle	mesophyte	high	medium demand	plastic species
F.ornus L.	lowland -hilly mediterranean	sandy-greybrown	termophyle	xero-mesophyte	high	low demand	high adaptive capacity

The most successful reforestation projects often relate to situations that create some artificial forest with appropriate and native species, using seedlings of various species in different plot regions. According to NCETSD & Diava Consulting (2017), the proposal of such planting designs will support seedling growth due to the available space and nutrients and the seedling competition would be limited.

Coastal areas are prone to extreme events and strong winds, therefore the establishment of such artificial forest stands, adhering to these planting designs, will serve to protect more climate resilient crops planted in agriculture lands that use seedlings which are (for example) less affected by strong winds. The reforested areas are also expected to be under a greater influence of stronger sunlight. Therefore it is important to select species, where possible, that demonstrate a higher tolerance to increased sunlight and solar radiation levels.

Previous studies have also shown that genetic makeup of reforestation stock is important. Thus according to these studies, *P. halepensis* appears to be a likely substitute for Q. ilex in the short term because it appears to be more resistant to drought conditions (Camara-Obrego´n 1998; Lloret and Siscart 1995).

Table 3.3 identifies the species that have been selected for KVLS (proposed by NCETSD & Diava Consulting 2017). Based on work by NCETSD & Diava Consulting (2017) field surveys denote that existing vegetation is part of the Mediterranean salt meadows *(Juncetalia maritimi*) 1410, subspecies 15.51 of the European System of Vegetation Classification.

Table 3.3 Appropriate climate resilient species to be planted in each plot

Plot	Specie
8c & 21a	Alepo pine (*Pinus halepensis* Mill.) + Stone pine species (*Pinus pinea L.*).
21b & 21c	Stone pine (*Pinus pinea L.*); Ash (*Fraxinus ornus L.*)- native species & English oak (*Quercus pedunculata Ehrh.*) – native species,
27a	Aleppo pine (*Pinus halepensis* Mill.) & English oak (*Quercus pedunculata Ehrh.)* – native species.

Specific additional detail of species to be used is presented in Appendix C.

3.2.3. Planting Densities and Geographic Zonation

According to Nako (1971), reforestation projects using tree species in sandy soils recommends a "zoning" strategy. This strategy proposes the use of conifers within a first "zonal" area (appropriate species used for planting including *Pinus pinea*, *Pinus halepensis* and *Pinus pinaster).* Within a second belt (with 100 m width), it is recommended to plant species such as *Pinus pinea*, *Pinus halepensis*, *Cupressus macrocarpa*, *Pinus brutia.* The third belt of reforestation recommends the mixing of conifers with broadleaves species like: *Populus spp*, *Fraxinus*, *Ulmus spp*, *Quercus pedunculata* , *Eucalyptus*, *Taxodium disticum.*

According to Nako (1971), the appropriate planting density for reforestation of sandy soils along a sandy coast should be as follows:

- ***Pinus pinea*** – Planting can be applied with seeds in small holes (planting density 1 x 1 m or 1 x 2 m) or seedlings with planting density (2 x 1 m and 2 x 2 m);
- ***Pinus halepensis****:* Planting can be applied with seedlings with density 2 x 1 m

The IEbAE concurs with the density related information presented in Table 3.4 below with regards to planting densities proposed. It is imperative that a rigid monitoring programme is closely adhered to assess the validity of these planting densities to assess whether any alteration is required to maximise planting impacts. A "learning by doing" strategic approach is actively encouraged for the Ministry of Environment to formally embrace and use to update future interventions.

Forest parcel	Local name	Planting area	Planting Density	Planting formula
8c	Pisha e Stavnikut	3.1	2 x 2 m	0.5 P.halepensis + 0.5 P.pinea
21a	Stomi Nikoll Lucës	0.5	2 x 2 m	0.5 P.halepensis + 0.5 P.pinea
21 b & 21c	Shulza	3	2 x 2.5 m	0.2 P.pinea + 0.4 F. ornus + 0.4 Q.pendinculata
27a	ish Fazaneria	0.4	2 x 2 m	0.6 Q.pendinculata + 0.4 P.halepensis

Table3.4. Proposed planting densities for the reforested areas

Based on the above planting densities and species participation, NCETSD & Diava Consulting (2017) have assessed the respective number of seedling per each plot and species (see Table 3.5 below)

Forest parcel	Planting area	Total seedling number	Seedlings according to species			
			P.halepensis	*P.pinea*	*Q.pendinculata*	*F.ornus*
8c	3.1	7750	3875	3875	0	0
21a	0.5	1250	625	625	0	0
21 b & 21c	3	6000	0	1200	2400	2400
27a	0.4	1000	400	0	600	0
Total		**16,000**	**4,900**	**5,700**	**3000**	**2400**

Table 3.5: The proposed number of seedlings to be planted in each plot according to species

3.3. Preferred Methods for Implementation

Nr	Species	Age(yr)	root collar diameter (mm)	height(cm)	Planting period
1	*P.helepensis*	> 2 yr	4-5	30-40	Spring or autumn
2	*P.pinea*	> 2 yr	4-6	30-40	Spring or autumn
3	*Q.pendinculata*	1 yr	6-8	30-41	Autumn
4	*F.ornus*	> 2 yr	6-8	80-90	Spring or autumn

3.3.1.2. Hole Dimensions for Seed Planting

Holes for seed planting may be excavated by means of spades or motor drills, which ensure hole excavation is in accordance to the required dimensions and without excess manual labour for workers.

The digging of holes should ideally follow the eastern-western direction, starting from the terminal section of the plot. Planting density is different (see Table 3.7) taking into account site characteristics and species traits. Planting in the second line should commence start in the middle of the first line of seedlings. This irregular planting scheme will help to establish a plantation that is similar to the natural forest stands. A short stake should be used in planting, in order to ensure solid support until the wood stem becomes hard and unbowed. The holes dimensions should be as follows:

- depth-40 cm;
- width 40 cm and
- length of 40 cm.

The excess soil mass obtained from hole excavation process should be placed separately respecting the individual soil layers. Thus soil from the upper layers may need to be used at the bottom of the hole during filling process. Hole filling should then continue with other soil layers which are to be compacted well at the seedling root level.

Given that the soils are often poor in nutrients, an amount of chemical fertilizer (diammonium phosphate) may be required (circa 100 grams per seedling), in order to meet their demands for chemical and organic substances.

Figure 3.7. Hole excavation on flat terrain

After completing the hole filling exercise, seedling watering should take place.

Plant spacing depends on the desired location of maximum sand accumulation and elevation. Closer spaced plants capture sand quicker. Table 3.7 refers to the planting density and area of each forest parcel:

Table 3.7: Planting density and formula for each plot. Ref. technical design (from NCETSD & Diava Consulting 2017)

Forest parcel	Local name	Planting area	Planting Density	Planting formula
8c	Pisha e Stavnikut	3.1	2 x 2 m	0.5 P.halepensis + 0.5 P.pinea
21a	Stomi Nikoll Lucës	0.5	2 x 2 m	0.5 P.halepensis + 0.5 P.pinea
21 b & 21c	Shulza	3	2 x 2.5 m	0.2 P.pinea + 0.4 F. ornus + 0.4 Q.pendinculata
27a	ish Fazaneria	0.4	2 x 2 m	0.6 Q.pendinculata + 0.4 P.halepensis

3.3.1.3. Seedling Planting Areas

Respecting the planting density the designer has estimated the quantity of seedlings for each plot proposed for reforestation (Table 3.8 and 3.9).

Table 3.8 Planting density and scheme proposed for each plot. Ref. technical design from NCETSD & Diava Consulting

Forest parcel	Planting area	Planting Density	Planting formula	Seedling number per 1 ha
8c	3.1	2 x 2 m	0.5 P.halepensis + 0.5 P.pinea	2500
21a	0.5	2 x 2 m	0.5 P.halepensis + 0.5 P.pinea	2500
21 b & 21c	3	2 x 2.5 m	0.2 P.pinea + 0.4 F. ornus + 0.4 Q.pendinculata	2000
27a	0.4	2 x 2 m	0.6 Q.pendinculata + 0.4 P.halepensis	2500

Based on the planting density and species participation according to the planting scheme, the respective number of seedling per each plot and species have been assessed.

Table 3.9 The proposed number of seedlings to be planted in each plot according to species

Forest parcel	Planting area	Total seedling number	Seedlings according to species			
			P.halepensis	*P.pinea*	*Q.pendinculata*	*F.ornus*
8c	3.1	7750	3875	3875	0	0
21a	0.5	1250	625	625	0	0
21 b & 21c	3	6000	0	1200	2400	2400
27a	0.4	1000	400	0	600	0

3.3.1.4. Seedling Protection and Transportation

While transporting and putting the seedlings into the area, proper care should be basically shown for:

- non-exposure of seedlings to high temperatures, wind or when there are contaminants;
- sapling roots should not be exposed and they must be carefully carried during planting process; and;
- planting at the required depth and proper compression, in order to ensure full contact with the earth

While planting seedlings within the area the following requirements should be respected:

- seedlings in pans or bags should be kept far from the sunlight;

- seedlings should be spaced from each other, in order to ensure air circulation;
- seedlings should not be planted during frosty periods; and
- seedlings should be possibly planted within a period of two weeks.

3.4. Monitoring and Maintenance Services

In order to favour the optimal development of seedlings and ensure a high percentage in their sprouting, maintenance services needs to be carried out in the first two years after planting. These maintenance works comprise 2 hoeing works and 2 irrigations in the first and the second year after planting as well as the use of chemical or organic fertilizers. Hoeing will take place around the seedling, with a radius of 0.5 meters and a depth of 10-15 cm. The hoeing period will be from April to June and from August to September. It is recommended that hoeing should take place 2-3 days after rainfall, in order to retain in the hole the largest possible amount of water.

3.4.1. Monitoring Seeding Survival

Monitoring of the seedling rate survive should be conducted in autumn, after the seedlings have completed a full growing season. Monitoring will take place by measuring the number of seedlings in the sample plots within the reforested areas.

3.4.2. Replacement of dead seedlings

Dead seedlings should be replaced during the next planting season. This will be undertaken based on the data derived from the field verification of seedlings survive in the next autumn. The quantity of seedlings to be replaced is the same as the number of those dried due to various reasons. The cost for re-planting should be covered by the contracted entity based on their contractual commitments.

3.4.3. Protection measures

The reforested plot must be protected from grazing for a period of 2-3 years and in case of the appearance of pests or diseases, they should be treated. First it is suggested that plot fencing is constructed in order to prevent the entry of animals inside the area. Also, the area should be encircled by a plastic tape and be supplied with an indicative board showing that it's a reforested area. Also the consultant, propose the assignment of a maintenance worker to safeguard the area and carry out the maintenance works.

3.5. Cost Estimates

3.5.1. Suitability of cost estimates provided for reforestation and rehabilitation activities

Based on existing projects in Albania, in total, it has been calculated that for the scales of intervention being proposed above, that **US$116, 917** is required to achieve the required re-afforestation programme. This figure is similar to that declared within the Project Document (see Figure 3.11 below taken from the Prodoc) which declares that EUR93,000 (equivalent to US$104,000) is needed for such works, which is very similar to the more recent estimate from the NCETSD and Diava Consultants (January 2017).

Table 6. Proposed adaptation interventions

Proposed adaptation intervention	Intervention	Location	Objective of intervention	Indicative cost (EUR)
AI1) Management of freshwater in the Kune-Vaini and Patok protected areas	New wells drilled at various sites in the Kune-Vaini and Patok lagoons	Kune Island Zaje lagoon Patok lagoon	Improve water and habitat quality in the Kune-Vaini and Patok protected areas through opening new artesian wells in the area.	60,000
AI2) Management of forest ecosystems in coastal areas	Reforestation of pilot sites	Ceka lagoon and Alk village	Restore pilot degraded forest areas in DMRD area	93,000

Figure 3.11: Prodoc (UNEP) estimates of reforestation budgets (UNEP 2014)

NCETSD and Diava Consultant have identified and prepared the respective afforestation projects for several forest plots inside the Kune-Vain protected area. Table 3.10 depicts data about plot area which will be reforested as well as the economic costs of afforestation interventions.

Table3.10. Statistical data on the proposed plot area for reforestation and the economic value of reforestation activities per 1 ha unit area and plot are level.

Plot no.	Area (ha)	Cost estimate for the reforestation			
		Reforestation USD ($) /ha	Maintenance USD ($) /ha	Sum USD ($)/ ha	Cost in USD ($)/ plot
27a	0.4	11,835	2,970	14,805	5,922
21b, 21c	3	10,819	2,411	13,230	39,690
21a	0.5	8,456	3,400	11,856	5,928
8c	3.1	8,853	3,400	12,253	37,984
Sum I	7	39,963	12,181		89,524
Along roads	5km	21,604	5,789	27,393	27,393
Sum II		21,604	5,789	27,393	27,393
Sum (I+II)		**61,567**	**17,970**		**116,917**

Appendix A should be reviewed for further detailed costs for the reforestation proposed by DMRD.

4. Technical Protocols for Dune Rehabilitation

The information collated for this Protocol has been compiled from the recently funded UNDP Albania project completed along the Drini frontage (2012)

Key Recommendations

The most suitable planting area for dune rehabilitation projects should be location landward of the surf zone (inland of MHW) to where sand accumulates from the wind. Vegetation shall encourage the growth of dune vegetation by capturing windblown sands. The planting of vegetation will also reduce wind speeds over the dune system thus encouraging the deposition of sand. The beach grass *(Ammophila arenaria L.)* is particularly effective in achieving this because it has high tolerance to enhanced solar radiation and being a native species, it is highly adapted to environmental conditions found along the Albanian coastline. It is therefore recommended to plant *Ammophila arenaria* for dune restoration projects in Albania, as this represents one of the few plants that is able to survive in extreme conditions often encountered.

4.1. Adaptation Benefits of Dune Rehabilitation

The main adaptation benefit of dune rehabilitation is to enhance the resilience of natural dune habitats to the threat of increased sea levels, storms and climate related conditions that may impact upon the natural capacity of the system to respond to climate related threats. Separate co-benefits of the approach include the re-establishment of natural biodiversity of dune plants and animals and to help the restoring, as appropriate, of some natural processes that sustain dunes ecosystems. The key for conservation of the dune ecosystems diversity is to remove invasive non-native plants from the coastal dunes. When the invasive plants are removed, the native ones get back, creating conditions to periodically deposit sand from the natural forces like wind and sea waves. This half-sustainable system creates conditions for variety of plants and animals, including insects (native bees) and many bird species nesting there.

4.2. Sites for Intervention – Kune Vaini Lagoon

Two areas within the KVLS have been selected for sand dune rehabilitation. This includes site 13b on the island of Kune on the part of the Adriatic coast, and zones A and B both north and south of Gryka e Matkeqe respectively (see Figures 4.1, 4.2., and 4.3). These locations are proposed as being valid for future interventions for the following reasons:

- It is a typical damaged area located almost in the middle of the coastal dune system.
- It is more protected by different threats.

- It can be reached by the transport vehicles to realize the activities.
- This area is more protected by the human impact. It is not frequented by tourists for sunbathing.

Figure 4.1 The proposed sites for dune rehabilitation in the KVLS

4.2.1. Dune rehabilitation – site 13b

Rehabilitation will be applied on the island of Kune with the following geographical coordinates:

- N 41 ° 46 '03.87 "
- E 19 ° 34 '58.89 "
- Altitude- 0 m (above sea level)

Figure 4.2. shows the proposed intervention location through the planting of species *Ammophila arenaria* and *Marine*.

Figure4.2. Location of intervention (Site 13b) for dune rehabilitation

This location shall be rehabilitated through the planting of *Ammophila arenaria L.* and *Marine* over a defined are of 18,049 m2 (573 m 31.5 m length x width).

NB: within the UNDP Project Document (2012) the project aimed to restore 2000 m meters of coastline, though only 573 m were finally selected to maximise the successful outcome. Subject to successful monitoring results being reviewed the remaining areas (circa 400m) may be proposed for rehabilitation intervention at this location in the future subject to funds being made available.

The site is proposed as a suitable location for future rehabilitation projects for the following reasons:

- The proposed plot is situated in the NW of the seawall built about 2.12 km away which has exacerbated coastal erosion in the area and there is a subsequent urgent need for future intervention to address this situation.
- This area is not affected by human activity because it is a distance from any settlement.
- The area has a good road access to carry out all the necessary works during the implementation phase of the project.

4.2.2. Dune rehabilitation – Zone A and Zone B

Two additional areas for the dune restoration activity exist within the KVLS, notably at zones A and B (see Figure 4.3 (taken from UNDP2012).

Figure 4.3. Location of intervention (zones A and B) for dune rehabilitation

4.2.2.1. Zone A

Zone A occurs to the north of Gryka e Matkeqe. This area consists of flat dune areas that border the beach and fore-beach areas. The entire area consists of fore-dunes and dune parallel to the coastline spanning a distance up to 524m. From the preliminary calculations it is evident that:

- The planting are is proposed as being rectangular and oriented parallel with coastline in a North-South direction. Dimensions are 500m length and average width up to 5 m (total surface area of 2500 m2).

4.2.2.2. Zone B

This area is located within coastal sandy dunes to the south of Gryka e Matkeqes. This area consists of wide none stabilized fore-dune systems that run parallel with the coastline up to 200m in length. Whilst fragments of *Ammophila arenaria* exist, many invasive plants dominate. The planting surface will be of rectangular form oriented parallel with the coastline in a North-South direction with width dimensions of 200m in length and an average width of up to 10m (total surface area of 2000 m2).

4.3. Site Selection Criteria

4.3.1. Adaptation measures for dune rehabilitation

One of the most appropriate measures for adaptation is the selection of native species for planting due to their ability to adapt with site conditions. In the project adopted by UNDP (2012), two species (*Tamarix spp* & *Ammophyla arenaria*) were proposed which occur in the area. The species is native and has proven to be resilient to climatic events experienced in the area. In order to prevent the negative impacts of human activity in the project area, the following adaptive measures are proposed:

- fencing the project area in order to prevent the livestock entrance.
- the company must use mechanisms and tools which are friendly with environment in the area.
- planting of *tamarix* in the first line aim to mitigate the hitting force of the wind and to protect the grass.
- continuous monitoring of the whole working procedures during the implementation in order to provide a successful planting.

4.4. Appropriate Climate-Resilient Species

4.4.1. Adaptation Response - General Principle

Climate change is proceeding unchecked and average temperatures are rising, forcing many wild animals and plants to move into new habitats. As species come together in new combinations, climate change reshuffles the deck of ecological interactions, with unexplored consequences. Coastal dune themselves plants are subjected to natural multiple stresses and vulnerable to global change. Some changes associated with global change could interact in their effects on vegetation. As vegetation plays a fundamental role in building and stabilizing dune systems, effective coastal habitat management requires a better understanding of the combined effects of such changes on plant populations.

Sand dunes are a component of dynamic coastal systems, and much of the emphasis on adaptation at the coast has been to maintain the natural coastal processes where possible; including through managed realignment. Under this approach, sand dunes will be lost in some places but develop in others. In the long-term this is likely to be the most important response. However, some on-site actions to increase the resilience and diversity of dune systems are also possible. For dune species selection, climate change could mean that in the future that existing dune species will face competition from other species that were previously unknown to them.

The following text presents the key species for use in dune system rehabilitation that is of most significance to Albania.

4.4.2. *Ammophila arenaria* (European marram grass)

The restoration of dunes using *Ammophila arenaria L.* has been applied before in both Albania and other temperate countries. This species that is most often used belongs to the *rendion Poales* family (gender *Poacea Ammophila).*

Ammophila arenaria L. is a drought tolerant plant and often survives in environments with low humidity and drought conditions, where most plants cannot survive. It has a moderate tolerance to salty soils (about 15 g / l, or 1.5%).

It is a perennial that grows up to 1.2 meters in height from a thick rhizome network that gives the plant a very strong and robust root system within the sand enabling it to grow laterally. This rhizome can often grow (stretching) up to 2 meters in a lateral direction (sideways). A batch of plants (bushes) can produce up to 100 seedlings each year. They often have a body height up to 1 meter. Their ability to adapt to harsh low humidity environments' is strengthened by its stoma (stomata) on the surface which is located inside of the curved leaves, thus reducing the water loss. Outside of the leaf, the plant has a strong cell structure that is able to resist wind and scratches (abrasion) caused by wind-blown of sand particles.

Ammophila arenaria, is a species that possesses a good adaptive ability to "capture (trap)" sand transported by the wind, thus influencing the formation and geomorphology of coastal dune systems, which is considered sufficiently important for habitats dynamics and hence biodiversity (wildlife) (Figure 4.4).

Figure 4.4 *Ammophila arenaria* in Vaini site

Any future restoration site must possess the following parameters. The site must consist of a sandy soil, with a low content of clay and organic matter. These soils are often considered as non-productive for both agriculture and forestry. In addition, these are dry lands where rain water drains away quickly), thus providing limited opportunity for plants to grow. Direct contact with sun light also increases the temperature during the summer months up to maximal values, making it unlikely for competing plants in grow in such conditions. Continuous winds coupled with saline flood events (overtopping during storms) also have direct impacts to plant growth.

To maximise adaptation to climate change, this plant *(Ammophila arenaria)* can be combined with other plants such as Tamarix sp. (*T. dalmatica, T. Hampeana*). For example, in Albania, there is a good experience in the application of Tamarix sp. for the restoration of the dunes of the Kune Vain coast.

4.4.3. Marina (*Tamarix parviflora*)

This is a shrub plant which can reach up to 5 m in height. It reproduces quickly and easily and is a species that is common around the Mediterranean and in similar climates to those experienced in Albania. It requires light soils with sand and can be significantly restrained by the phreatic waters near the surface. In Albania these conditions often occur at the riverbeds and marshlands or along the shoreline margins.

Specific additional detail of species to be used is presented in Table 4.1 and also in Appendix C.

Table 4.1; Planting Schema approach for Zones A and B in Albania

4.5. Preferred Methods for Implementation

4.5.1. The preparatory work

- Collection and disposal of waste (litter and other waste must be collected using hand held clearing equipment and all collected material then transferred to landfill via trucks);
- Removal of invasive plants (transferred via truck to landfill sites)

4.5.2. Opening holes

Dune restoration processes are very delicate and any interventions that can take place inappropriately could seriously affect the surrounding habitat. Project implementers will therefore need to be careful in order to avoid any habitat damage within the area. For this purpose, the use of common tools as (spade, shovels, picks) for opening of holes should not be used, since they can often disturb dune habitats. A special device should be used instead within these situations (see Figures 4.5 and 4.6).

Figure 4.5 The tools that can be used for the holes opening

Figure 4.6. Hole excavation in practice

The holes should be circa 30cm depth, the opening of which should be vertical with a round shape in order to ensure a sufficient shape is created to help with the packing of the planted seedlings. The diameter of the hole should be slightly greater than that of the seedling planting hole area in order to allow the introduction in the seedlings easily and to avoid any damage. It is also recommended that the width of the holes should be large enough so as to occupy the saplings to be planted in (together with the relevant land in the pot). The packing materials (pots or plastic sachets) must obviously be removed before planting.

4.5.3. The Planting Process

In the absence of any national criteria for planting protocols, the following advice from the UNDP project (2012) is proposed at this stage. In order for the planting process to resemble as much more natural restoration, there is a need to apply different schemes and planting and holes opening, as follows for the specific identified zones (see Figure 4.7):

Zone 1:

Within this Zone, which represents the first "zone" (see Figure 4.7), a 1 x 1 m scheme for planting should be adopted using *Marina* species. Between the rows of *Marina* (using the same scheme of planting), seedlings of *Ammophila arenaria L.* should be planted. In this way, the first 2 rows should utilize approximately 1713 plants.

Zone 2:

Within this Zone, which represents the second "zones" (see Figure 4.7), this has an area of 4011 m2 (7 m width x 573 m length) under a scheme 70 x 50 cm (70 cm distance between rows and 50 cm distance between the plants). It should be planted with *Ammophila arenaria L*. In this way the number of holes and planted seedlings will be 11460 or 28 571 seedling plants per 1 ha (2.85 plants / m2).

Zone 3:

Within this Zone, which represents the third "zone" (see Figure 4.7), this has an area of 6876 m2 (12 m width x 573 m length) and a planting scheme of 60 * 50 cm should be adopted (60 cm distance between rows and 50 cm distance between holes).

Zone 4:

Within this Zone, which represents the area landward of the zones (see Figure 4.7), this has an area of 6016 m2 (10.5 m 573 m width x length). The planting scheme will be carried out with 50 x 50 cm. The number of seedlings that will be planted in this area is 40.003 plants / ha (4 plants / m2).

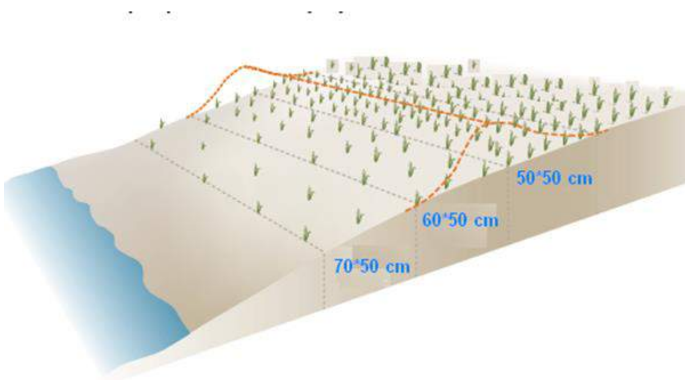


Figure 4.7. Planting schema for the beach grass.

Based on the above schema for the planting of Marina and beach grass, where the rehabilitation of the dunes will take place, the number of seedlings is calculated in Table 4.2.

Table 4.2 The number of seedlings to be planted (in site 13b) for each species

Object	Geographical coordinate	The total area that will be plantet in (m^2)	The area separated in the parcels (m^2)	% of each parcel	The planting schema for each sepcies		Number of seedling by each patrcells		Plant per unit (m^2)
					Marina	*Ammophila arenaria*	*Marina*	*Ammophila arenaria*	
13b	N 41° 46'03.87" E 19° 34'58.89"	18000	1146	6	1x1	1x1 m	3426	3426	3.0
			4011	22		70*50 cm	0	11460	2.85
			6876	38		60*50 cm	0	22920	3.3
			6016	34		50*50 cm	0	24066	4.0
TOTAL of the seedlings							3426	61872	

4.5.4. Seed Germination, Growth and planting

The seedling materials will be produced by taking the vegetative material resident within the area. The packs or plastic bags (see Figure 4.8) will serve to prepare a mixture of lands with sand / and to have a better development and vitality seedlings is proposed to have an mixture in an report of 60% sand / 40% organic fertilizers.

One hole should include 2-3 seedlings plants to guarantee the survival of the first season. These seedlings (before planting) must be accompanied by the certificates of quality issued by the relevant authorities.

Figure 4.8. The beach grass seedlings in plastic bags

Seedlings can be provided in 2 ways:

a) Through the collection of seeds from existing plants

This process can be undertaken during the period August to September. This is considered as the optimal time that seeds are suitable to be used for planting. The collected seeds treated with care and stored in appropriate conditions of moisture and temperature.

Planting of the seeds should be completed between November - March. Seeds can be planted directly into the bag, which are filled with sand first with the mix-and-manure. In optimal conditions, the seed germination rate is up to 80%, so it is recommended that for each sachet to include 4-5 seeds. To increase the probability of occupancy it is recommended that the air sacs in the sealed environment are not influenced by atmospheric conditions (low temperatures, frost etc.).

b) The collection of rhizomes from current plants of the area

The collection of rhizomes should normally be carried out between November-March. Rhizomes should also be collected from coastal areas that possess similar conditions to the area where the restoration will be developed. The rhizomes should be taken from plants which possess a minimum of one bud. These should then be placed in pots or other plots that have already been prepared.. It is recommended that each rhizome is planted into 3-4 / per sachet in order to increase the probability of surviving.

In order to avoid holes filling up with sand transported by the wind, sea water or rain, it is recommended that rhizomes are planted during the same time as the opening of the hole. The seedling should be removed carefully, aiming to protect the root system as well as the soil that holds the seedlings.

During the planting process, the total amount of soil surrounding the roots (to be inserted into the holes) would be preferably 5-10 cm from the surface.

After planting some soft compression (using feet) should take place around the seedling to allow the soil to be in close contact with the seedlings roots plus the surrounding sand. This compression activity enables the roots of the seedling to be in close contact enabing the necessary nutrients and moisture retention to be encouraged. Planting will be considered successful if the number of plants that have survived the end of the first season of growth is over 80%.

4.5.5. Post planting (Monitoring)

Some future monitoring measures that are recommended are as follows:

a) It is generally recommended that the watering of plants is applied 2 to 3 times between June-August but especially when the plants are experiencing drought. For each plant it is recommended to use 0.5 -1 litres of water. The water used should be extracted (irrigated) from local surrounding areas. To encourage the growth of healthy plants it is recommended that the water be mixed with manure. It is recommended that the manure – water ratio is to be 1: 10 (so for every 10 litres of water it is dissolved in 1 kg manure).

b) It is encouraged to clear the planting surface from invasive plants during the first planting season. At the end of the first season (autumn) the replanting of all plants which didn't survive during the first year of planting will need to take place. The replacement process will be the same as for normal sowing identified earlier.

4.6. Cost Estimates

4.5.1. Cost Estimates for site 13b

The following information has been sourced from the project of the rehabilitation of coastal dunes of Kune-Vain by NCETSD and Diava Consulting (2017)

Table 4.3. The budget for planting and dune rehabilitation Ref. technical design from NCETSD & Diava Consulting (2017)

Manual code	Work that will be implemented	Unit	Volume of the work	Day norm	Day of work	Day salary	Value in US$
222-1	Preparing of place marks	cope	65298	1300	50	16	800
222/2	Place marks of the holes	cope	65298	650	100	16	1600
223-8	Opening of the Holes in size: 30x30x30 cm	cope	65298	225	290	16	4640
Analyse	Include the organic fertilisers in holes	cope	65298	1200	54	16	864
224-16	Planting of the seedlings in size: 30x30x30cm	cope	65298	125	52	16	8352
	Amount I						**16256**
	Buying of seedlings of Marine (1-2 years olds)	cope	3426			1,1	3768,6
	Buying of seedlings Ammophyla arenaria (> 1 yers)	cope	61872			1,1	68059,2
	Buying organic	kv	50			80	4000

	fertilisers						
Analyse	Transport of seedlings	ton*km	10			12,5	125,0
	Amount II						**92208,8**
	TVSH	20%					18441,8
	Total budget	**ha**	**1,8**		**1017**		**110 650,6**

Table 4.4The budget and costing for agricultural services related to dunes Ref. technical design from NCETSD & Diava Consulting

Manual code	Work that will be implemented	Unit	Quantity	Norm	Day work	Salary/ day	Amount in US$
229/8	Irrigation of the seedlings	cope	36277	130	279	15	4185
263/6	Sprading the organic fertilasers	dynym	10	25	0,4	15	6
229/10		cope	17450	700	25	15	375
	Amount I						**4566**
	Blerje Pleh organik	Kv	27,3			80	2184
	Amount II						**6750**
	VAT	%	20				1350
	Amount III				**304,4**		**8100**
	Total budged	**ha**	**1,8**		**547,92**		**14580**

Appendix A should be reviewed for further detailed costs for the dune rehabilitation proposed by DMRD.

NB: Although the costs for site 13b are shown, subject to further research and monitoring findings, the costings and approaches set out for 13b will and should also apply not only to Zones A and B, but also other dune systems around Albania.

This information shall be updated within the EbA Guidelines manual as appropriate.

5. Technical Protocols for Tidal Inlet Channels

5.1. Introduction

Tidal inlet areas (that are commonly utilized for navigation, sand mining, waterfront developments, fishing and recreation), often experience high population pressures. The intensive population concentration and excessive natural resources exploitation in these tidal inlet areas could lead to biodiversity loss, destruction of habitats, pollution, as well as conflicts between potential uses, and space congestion problems, which will only be exacerbated by foreshadowed climate change. In the case of tidal inlets, the adjacent coastal zones will be affected not only by climate change driven variations in oceanic processes (e.g. sea level rise, waves), but also by climate change driven variations in terrestrial processes (e.g. rainfall/runoff) (Ranasinghe *et al.*, 2013). Any negative impacts of climate change on inlet environment are therefore very likely to result in large socioeconomic impacts.

Tidal inlets which connect an estuary/lagoon/river to the coast are commonly found throughout the world. While the total number of inlets around the world is to date unquantified, it is likely to be several tens of thousands (Carter and Woodroffe, 1994). Bruun and Gerritsen (1960) distinguish three inlet classes based on their origin, as geological origin (also known as drowned river valleys); littoral origin such as openings through barrier islands, and hydrological origin where a river enters the sea (directly or via an estuary/lagoon) (Figure 5.1).

Figure 5.1: Examples of the three main types of tidal inlets: (a) Golden Gate, California, USA (Geological origin or drowned river valley inlet); (b) Drum Inlet, North Carolina, USA (Littoral origin or barrier island inlet) ; (c) Maha Oya river inlet, Sri Lanka (Hydrological origin or barbuilt/ barrier estuary inlet) (sources: Google and Google earth images).

Tidal inlets exist along the Albanian coast – some are natural and some are man-made. Overall, sediment accumulation in the tidal inlets will continue into the future reducing the exchange of water between the lagoons and the sea. It is possible that the water in the lagoons will become increasingly eutrophic because of this limited exchange. Eutrophication will be exacerbated by the continued discharge of polluted runoff into the lagoons from the pumping stations.

This section outlines the key issues associated with tidal channels and the benefits/impacts of whether interventions could be advantageous or deleterious as an EbA intervention technique.

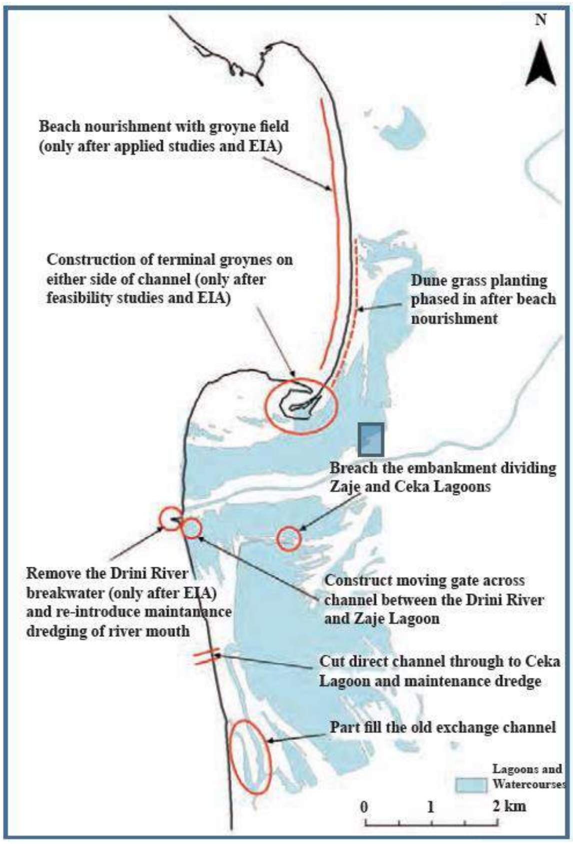
5.2. Tidal Inlet Channels

5.2.1. Types of Tidal Inlets

Four different types of tidal inlet are apparent along the DMRD coast. These are:

- The main inlets to Merxhani Lagoon (north) and outer Patok Lagoon are located between two converging spits which will continue to narrow their inlet widths into the future. It is likely that these inlets will eventually close;
- A new tidal inlet has opened at the southern end of Merxhani Lagoon when Kune Beach breached in September 2009. This inlet is gradually closing between two newly formed relatively small spits and will eventually close (if only temporarily);
- The tidal inlet of Ceka Lagoon crosses a beach with strong longshore transport and its position fluctuates seasonally. The inlet is more likely to close in the summer when freshwater runoff is low;
- Artificial inlets have been cut through the beaches fronting Merxhani and Ceka Lagoons, but these have closed quickly because of the dominance of longshore sediment transport over the lagoons tidal prism (defined as the volume of water in an estuary or inlet between mean high tide and mean low tide, or the volume of water leaving an estuary at ebb tide), which are not strong enough to keep the inlets clear of sediment.
- Sediment accumulation in the tidal inlets will continue into the future reducing the exchange of water between the lagoons and the sea. It is possible that the water in the lagoons will become increasingly eutrophic because of this limited exchange.

5.2.2. Benefits and Impacts of Tidal Inlets



Positive impacts of these types of interventions have some direct and indirect effects in several spatial scale. The importance of fishing and tourism/recreation of KVLS in national level, enlarge intervention effects in larger scale than local/regional.

Tidal inlet construction (barrier breaching) can embrace a range of soft intervention approaches within any project design. For example, dune rehabilitation or bank stabilisation through reforestation approaches can be introduced. To be confident in selecting the most suitable soft engineering support approach requires sound baseline understanding of coastal processes in operation at a specific site. This is because a breach that is artificially engineering may close naturally, or it can increase in size and become a new inlet. A new inlet created by breaching may, for example "compete favourably" for stability with existing inlets within the same bay system, promoting their closure. A trend toward closure of an existing inlet can render the navigation channel unreliable as well as alter the **environment** because of changes in water level, circulation, and salinity.

Construction of a breach closure is costly. In addition, nearshore or beach material that had been protecting the structure and the shore may move into the navigation channel because of the breach, and its removal by dredging adds unanticipated cost to inlet entrance maintenance.

As a result of these uncertainties, site specific examples, of relevance to Albanian coastal situations, shall only be developed further within the EbA Guidelines Manual following more detailed assessment of the validity of this intervention option.

5.2.3. Water exchange and tidal channel maintenance

The KVLS is connected to the Adriatic Sea through tidal channels or varying length and width. Merxhani Lagoon exchanges water through an 800 m long tidal channel located between two diverging spits (Kune Spit and Kune Island). Additional exchange with the sea is currently taking place through the Kune Beach breach south of Kune Island. The limited exchange of water through tidal channels between the Adriatic Sea and the lagoons is a problem that is common to the entire DMRD. In order to avoid potential eutrophication in the lagoons the tidal exchange needs to be improved significantly over the current situation. Four adaptation measures are considered:

- Structural methods to restrict sediment accumulation in the channels;
- Regular maintenance dredging of the channels to maintain functionality;
- Increasing lagoon tidal prism and current flow (and hence scour) through the tidal channels by managed realignment of landward agricultural areas; and
- Controlled discharge of polluted water from the pumping stations.

5.3. Validity of Tidal Inlets as a EbA Approach

A leading influence of wetlands and tidal inlets (within estuaries) and their validity as being an effective EbA measure in areas is their contribution to determining the tidal prism (i.e.: the volume of water entering an inlet during flood tide or exiting an inlet during ebb tide). As wetlands are lost or restored (through tidal inlet channel creation or change), the tidal prism is modified. Changes in tidal prism have several implications on the estuarine hydrodynamics and consequently, sediment transport and morphology.

Many tidal inlets serve as navigation routes for commercial and recreational vessels. An increased tidal prism caused by wetland loss increases current velocity through the tidal inlet, thereby increasing the inlet cross-sectional area and sometimes opening new permanent or ephemeral inlets. Conversely, the development or construction of wetlands within an estuary reduces bay area and the tidal prism, which will change the phase and magnitude of the ebb and flood tides. The non-uniform change in tidal prism within the estuary can significantly alter the circulation pattern and create new channels and fill in existing ones (FitzGerald et al. 2004).

Wetlands can be restored by opening (breaching) diked sections of the shore as a specific EbA intervention approach. Breached restoration sites have been linked to an increase in estuarine cross-sectional area and erosion of the existing salt marsh (Pethick 2002). Tidal wetlands also influence estuarine dynamics by producing tidal asymmetry. For marsh platforms that lie above low tide elevation, the increased flow resistance by wetland vegetation during high tides (as compared to no resistance at low water) produces longer, but weaker flood tides and shorter, but stronger ebb tide—called ebb dominance.

Coastal / wetland vegetation is a key parameter in effective EbA interventions. This is because flow resistance caused by vegetation is proportional to the velocity squared, therefore wetland vegetation is most efficient at dissipating momentum in areas of stronger currents (USACE 2008). This leads to considerations about the location of vegetation and mud flats within estuaries and wetlands. Consequently, it is hypothesized that constructing and restoring vegetated marshes in areas of relatively weak current velocities and mud flats in regions of relatively strong currents (usually occurring near tidal inlets) should promote flood dominance. These placement alternatives must be carefully evaluated to ensure that the hydraulic characteristics are adequate for the sustainability of the mud flats and wetlands, and waves and currents will not erode the project site.

Factors involved in the morphologic evolution of estuaries include sediment inputs and relative sea level rise. For estuaries to be stable in a long-term sense they must keep up with relative sea level rise by accreting both mineral and organic material. In the some tidal lagoon system around the word, eustatic sea level rise, erosion, and local subsidence are drowning the wetlands in place. As bay area increases, fetch increases and wind-generated waves cause marsh fringe erosion. This situation could arise for Kune-Vaini situation over time.

Vegetation density is therefore a critical factor in ensuring EbA interventions are a success. It has to be assumed that this should be constant with respect to tidal elevation, but often in nature this is not the case. Vegetation occurs most commonly at specific elevations (marsh platforms). The predominant marsh elevation will vary for each location, depending on the local physical, chemical, and weather conditions. It is expected that greater vegetation densities in shallow water will enhance ebb dominance.

6. NEXT STEPS - GUIDELINES FOR MAINSTREAMING ECOSYSTEM BASED ADAPTATION IN ALBANIA

NB: This Section shall be the key focus of the EbA Guidelines which is a separate document to be produced before the end of 2017. The following provides some early text to be embellished in the coming months.

6.1. Approach to Mainstreaming EbA and Climate Resilience

6.1.1. Why do it?

Increasingly, countries are coming to realize that, in the long term, climate change adaptation needs to be supported by an integrated, cross-cutting policy approach, in other words, mainstreamed into national development planning. Options for mainstreaming in Albania may appear somewhat chaotic as there are over 40 separate pieces of legislation which address environmental matters. There are numerous government related agencies that are involved in activities which, in varying degrees, may perform functions relevant to the management of the environment. These agencies can be placed into several broad categories:

- There is control at the ministerial level.
- There is control at the level of departments of government, such as the Fisheries Division.
- There is control by certain statutory bodies (boards, tribunals, authorities and commissions).
- There are government-owned or controlled companies which are charged with developing an industrial estate and which introduced environmental requirements in leases.
- Finally, there are the municipal corporations made up of the elected local government officials, which also perform certain environmental functions. The Ministry of Environment (MoE) advised that there are some 50 agencies with environmental functions.

The multiplicity of agencies serving environmental functions has resulted in a somewhat uncoordinated approach to environmental management, which will affect the institutional approach to dealing with climate change. Policy rationalization and harmonization and inter-agency coordination will be critical to ensuring inclusion of climate change considerations into coastal management. It is this absence for institutional and organisational cooperation and coordination that forms the underpinning basis for mainstreaming.

6.2. The Benefits of Mainstreaming

Mainstreaming is not a new concept, but it has become increasingly popular since the late 1990s as a means to (more effectively) tackle development issues such as environmental degradation. The idea is that a cross-cutting issue should be a central feature of the planning and delivery of all public and private sector activities of development, rather than being addressed as separate initiatives by each. Recently, the mainstreaming approach has been adopted in the context of climate change.

In the context of climate change, mainstreaming has been described as a 'holistic' or 'development-first' approach, whereby adaptation (and mitigation) objectives are integrated within all stakeholder agendas. In other words, climate change risks are not addressed through separate initiatives but inform ongoing policy-making, planning and activities across all sectors (Klein et al., 2007; Olhoff and Schaer, 2010).

Climate change is already affecting development in Albania. Rising sea level and changing rainfall patterns are challenging infrastructure, water supply, agriculture, fisheries and natural ecosystems. Extreme weather events such as floods, droughts and cyclones are having significant impacts from the household level up to the level of national economies. Under current climate change scenarios these impacts can be expected to worsen in the coming decades. Mainstreaming climate change within ICZM is a way of reducing these potential impacts on coastal developments, by thinking ahead. Mainstreaming climate change into coastal planning essentially means incorporating climate risks into all development planning decisions. It needs to be addressed by all government agencies, at all levels of government, and across all sectors (e.g. finance, health, agriculture, and environment), as well as by civil society and the private sector.

When climate risk is explicitly considered and incorporated into policies, plans and practice, development efforts are more resilient to climate uncertainty, and more likely to reach their objectives. Climate change mainstreaming therefore contributes to more sustainable development and more resilient communities. Indeed, if climate change is not mainstreamed into decision making, there is a real risk that development goals will not be achieved. The most effective route to mainstreaming is through an integrated 'whole-of-government' approach, preferably coordinated at the highest level of government. Good governance, reflected in vision, commitment, transparency and accountability, provides a vital foundation for climate change mainstreaming.

1. Raising awareness of climate change, and adaptation options that are available, is an important first step towards mainstreaming within the general population.
2. Mainstreaming at the strategic level refers to incorporating climate risks into strategies, policies and plans usually at the national level, but also at other strategic levels.

6.3. The Role of Ecosystem-based Adaptation (EbA)

EbA can provide a structure to ensure mainstreaming leads to an integrated and holistic approach that promotes an effective way to respond to climate change (Figure 6.1). This is because:

1. EbA is based on a comprehensive understanding of the ecosystem and articulation of the full set of societal objectives to be met.
2. EbA integrates the people who make decisions about, can inform or have a stake in how an ecosystem is managed, including relevant policymakers, managers, stakeholders and scientists.
3. EbA uses a process of adaptive management that makes it possible to learn from and continuously improve management actions.
4. EbA encourages a foundation that includes a legal framework that supports multi-sectoral management; management structures that facilitate collaboration; financial resources that sustain implementation; and effective communications that promote integrated approaches.

Such a structure can avoid policy conflicts reduce risks and vulnerability leading to greater efficiency compared with managing adaptation as a series of separate sector activities. In addition, such an approach can leverage much larger climate finance sources and amounts in all developmental sectors that are affected by climate risks than if climate financing sources were pursued separately. This is because EbA helps make the connection between ecosystems and biodiversity and supporting policy decisions that are required to develop adaptive measures that secure longer tem resilience (Figure 6.1).

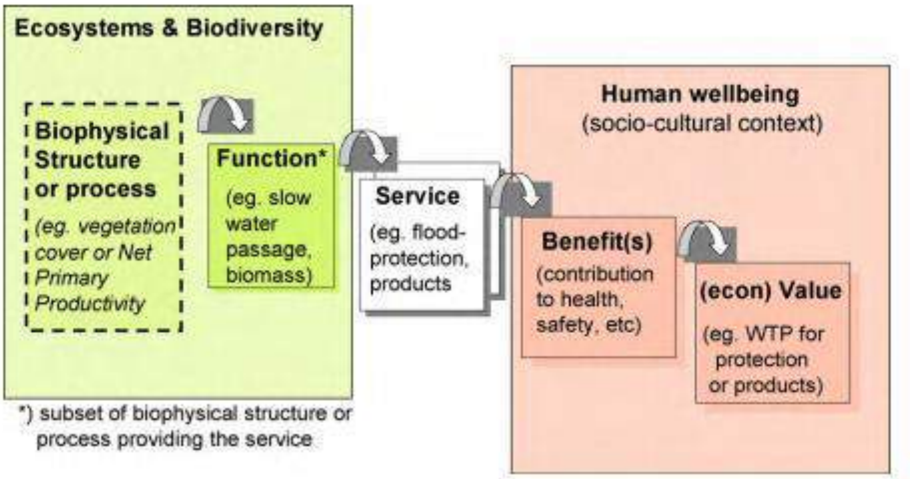


Figure 6.1 Mainstreaming seeks to promote a cross-sectorial response to develop adaptive measures to conserve ecosystem services under climate change. Source Girvan & Teelucksingh (2012)

The outcome from embedding EbA within an ICZM focused mainstreaming framework is that all sectors activities will include:

i. identification of critical coastal and marine concerns, needs and problem areas;
ii. determination of the current state of relevant coastal and marine components and systems;
iii. specification of a timeframe within which improvements in coastal and marine habitat performance and quality are to be achieved (typically by between five and twenty years);
iv. development of goals and targets for coastal and marine ecosystem performance and quality, consistent with national policies, strategic plans and objectives;
v. identification of actions and activities that are required to meet the specified targets;
vi. identification of the implementers and sourcing of financing;
vii. identification and implementation of a system to achieve changes in coastal and marine ecosystem performance and quality;
viii. review of progress at pre-determined intervals (i.e.: monitoring of indicators over time to measure effectiveness of the measure implemented); and
ix. feedback of information from the review process into the implementation process.

EbA can, therefore, help structure mainstreaming at different levels make the trade-off decisions between climate change and development and avoid maladaptation. Mainstreaming can be done in many different ways but whichever approach is adopted raising awareness within different groups of society about climate change and the risks it poses is important. When stakeholders understand climate change and the risks it brings, they can incorporate these risks into their own decision making. Mainstreaming of climate risks is relevant across all levels of development decisions.

6.4. Entry Points for EbA Mainstreaming

6.4.1. Overview

There are multiple entry points for mainstreaming climate risk into the development process. For example, it can be done at a strategic level when developing or revising national sustainable development plans, sectoral policy and plans, or when developing community-based strategic plans. It can also be 'added-on' to an existing strategic instrument, i.e. an existing policy or plan can be retrospectively 'climate-proofed'.

Regardless of entry point, mainstreaming is essentially about integration of climate risks into development. Mainstreaming can also take place at an 'On-the-ground level' mainstreaming that integrates climate risk considerations into local economic, social and environmental development projects, as well as identifying and implementing climate-oriented initiatives to reduce specific risks, manage residual risk, and/or build resilience of targeted communities.

The key differences between mainstreaming at the "strategic" and "on the ground" levels are essentially temporal and spatial. The scope, level of decision-making, and the level of context-specific information required will all vary. For example, strategic level responses to climate change by governments often create the enabling environment (policies, plans and legislations) for government agencies to engage with climate risk reduction and risk management, and for private sector and communities to take their own steps to reduce their risks and manage residual risks. These strategic instruments are also used by government agencies to engage with development partners to secure their financial and other support. The following sub-sections outline each approach in more detail.

6.4.2. Strategic Level Mainstreaming

Mainstreaming at the strategic level refers to incorporating climate risks into strategies, policies and plans usually at the national level, but also at other strategic levels. Mainstreaming adaptation is a multi-level process. Planning at the national level provides the overall framework within which sectoral and other sub-national levels operate. The national level is where the policy goals from long-term visions and national development strategies are translated into actions plans and budgets. Key planning interventions including applying a climate lens to sectoral plans and initiating new programmes to enable adaptation which may, for example, reallocate funds to more vulnerable sectors or regions.

Within a sector there are also several entry points (see Figure 6.2). Entry Points I and II apply to the sub – heading "strategic mainstreaming" as follows. Until recently, national agencies and the development community seldom considered the threats posed by climate change to lives and livelihoods during development planning. That is changing slowly as climate change adaptation rapidly gains importance on national and international agendas. National climate change adaptation strategies (Entry Point I – see Figure 6.2) need to be mainstreamed into other development initiatives such as poverty reduction strategies, country strategies and sector plans. While there are many possible entry points at the national level, it is essential to have a strong agency with the authority and capacity as the champion of your adaptation initiative. This helps ensure effective coordination with and avoids redundancy and/or inefficiencies amongst the various agencies involved. It also helps ensure coastal climate change adaptation finds a place in the national budget. In some cases the most effective approach is to create a national coordination committee, chaired by a government department with authority, such as a country's planning or finance department.

The National Adaptation Programme of Action (NAPA) carried out through the United Nations Framework Convention on Climate Change (UNFCCC) has led some countries to examine several facets of EbA and climate change and the need for adaptation measures. It provides support towards mainstreaming and implementing climate adaptation. However, having a NAPA does not immediately translate to mainstreaming. This "Entry Point" does not apply for Albania.

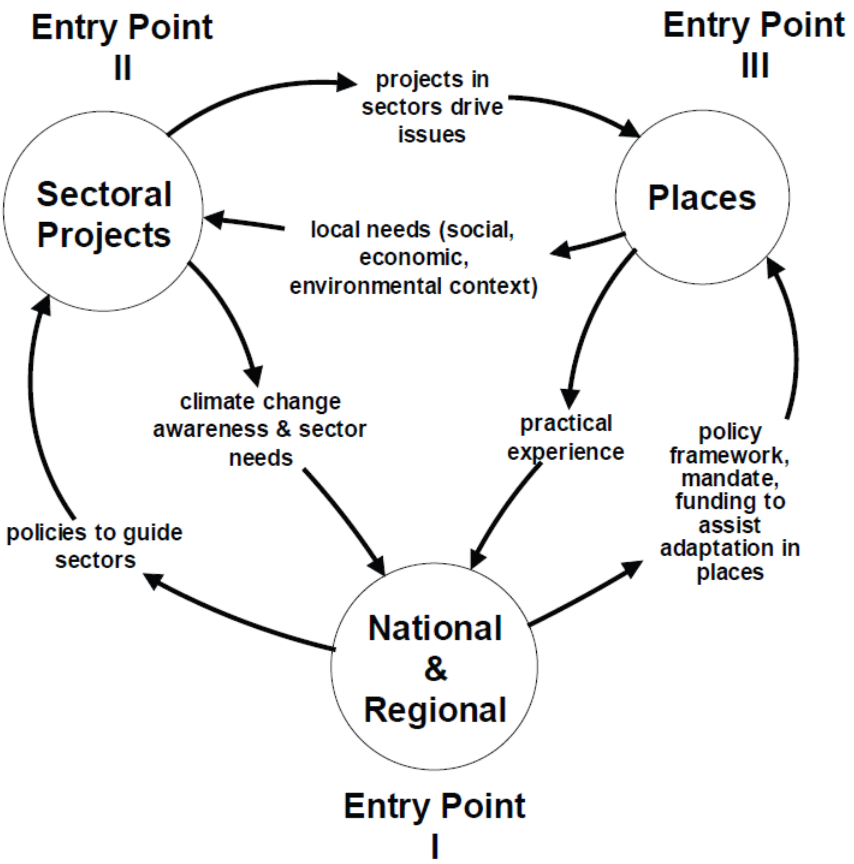


Figure 6.2:Climate Change Mainstreaming Entry Points and how each reinforces each other and contributes to a more integrated strategy (from USAid 2009).

Sectoral investments (Entry Point II) often emanate from national goals and strategies, which define specific strategies for various sectors (livelihoods, food security, water accessibility, energy, infrastructure, health, safety, biodiversity conservation). This can often be an effective starting point for mainstreaming adaptation, and for securing funds for effective implementation through capital investment plans, donors or other financing organizations. This compliments current donor strategies and thinking towards how to mainstream climate change into existing development frameworks and sectoral investments. Development banks, , are increasingly concerned that a substantial share of investments are at risk for direct impacts from climate change and from underperformance. The estimate is that 25% of the World Bank's portfolio may be at such risk (World Bank, 2006). This may, in turn, increase vulnerabilities. For example, infrastructure on the coast that cannot be adapted to withstand the impacts of climate change may expose more coastal communities, livelihoods and assets to coastal flooding and erosion risk. In response, organizations have developed screening tools and guidelines for integrating climate change concerns into development assistance.

Protecting existing and future economic development on the coast is an intrinsically strong and salient motivation for mainstreaming coastal adaptation. IADB (for example in Barbados as part of the current Coastal Risk Management Programme - CRMP) are requesting the donor recipient countries that any plans for sectoral investments (e.g., tourism, fisheries) consider climate change issues in all components of the projects they fund, including in project identification, assessment, ranking and selection, administrative design, financing, and throughout monitoring and evaluation. A similar "model" will be requested for Albania for improved implementation into 2018 and beyond.

Tourism development investments for specific coastal sites (in Albania) must be able to demonstrate and account for dynamic shoreline processes, natural hazards such as potential flooding and storm events, and the effects of climate change that can accelerate, intensify or alter the coastal conditions required for successful tourism. Figure 6.3 illustrates (as an example) the significance of mainstreaming coastal adaptation in tourism. The centre column lists the coastal conditions needed to ensure the success of a tourism investment. On the left side are threats that degrade critical features of coastal tourism. This includes those that are generated by unsustainable tourism development itself, and those that are provoked by the impacts of climate change. On the right side are a list of tourism adaptation measures that reduce or avoid the effects of climate change and inappropriate tourism development.

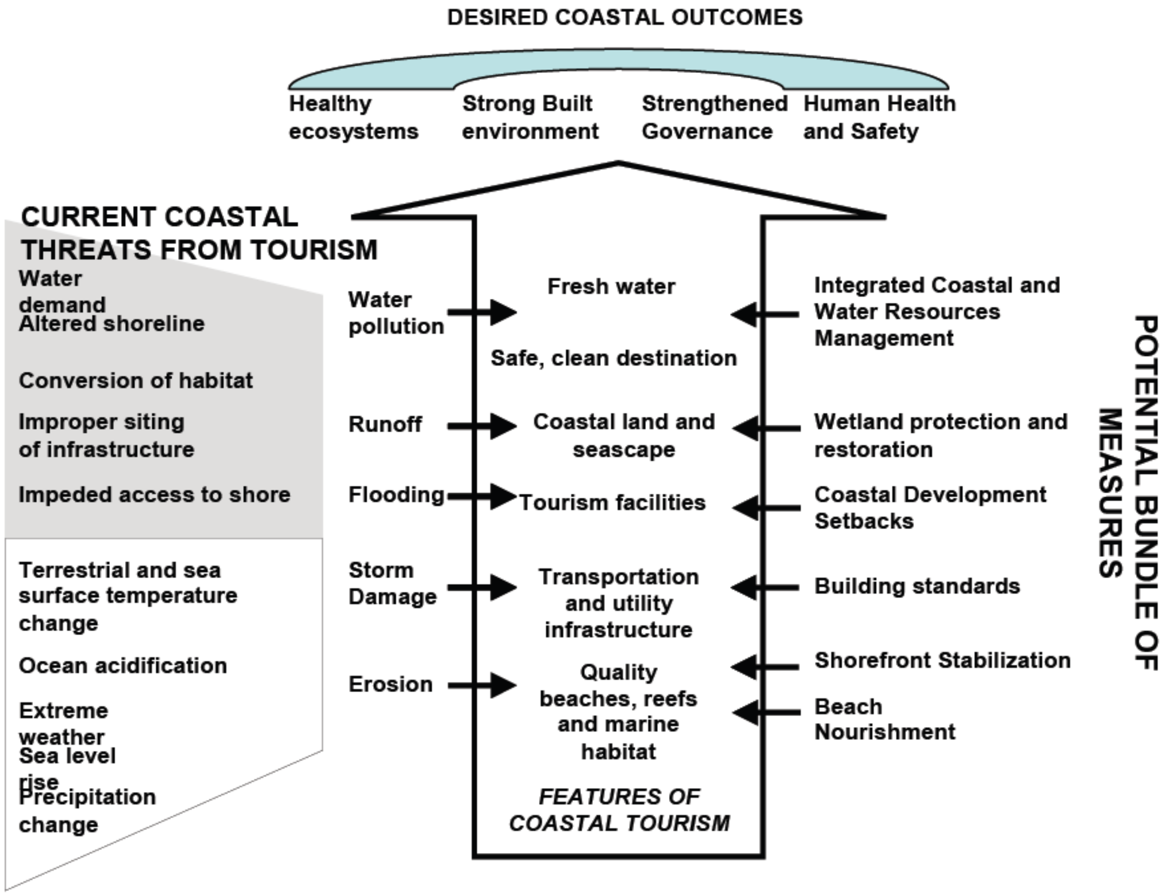


Figure 6.3: Mainstreaming Adaptation into coastal Tourism (from USAid 2009).

In efforts to mainstream at the Sectoral level (Entry Point II), it is important to think about existing processes where planning and capital investments are designed. Within a typical project cycle, there are several opportunities to mainstream climate change including the following:

a) Project programming stage - Vulnerability assessment outcomes can be incorporated into Albanian country strategy documents.

b) Project identification - Identify ICZM planning options and implement actions for adaptation.

c) Preparation, appraisal, approval - include criteria for assessing the project's climate-sensitivity and proposed adaptation.

d) Monitoring and evaluation – does the project appropriately anticipate and address climate change and vulnerability concerns?

6.4.3. On-the-Ground Mainstreaming

On-the-ground mainstreaming climate change means ensuring that current and future climate risks are considered from planning and development stages of any activity to implementation and monitoring and evaluation. On the ground mainstreaming (local delivery) can be considered as the operational actions that emerge from a strategic-level of CCA mainstreaming. This operational level mainstreaming has two objectives, namely 'climate proofing' and 'building adaptive capacity'. Climate proofing is a means to ensure that development interventions are resilient over the long term, reducing climate-related risks to 'acceptable levels' (Olhoff and Schaer, 2010). Building adaptive capacity implies enhancing (and not inadvertently constraining) the ability of individuals, communities or institutions to respond to climate change (Care, 2009).

On-the-ground (local) mainstreaming is therefore about reducing context-specific risks, managing residual risks and/or building resilience of targeted communities, including integrating climate risk considerations into economic, social and environmental development projects. On-the-ground initiatives produce clearly specified outputs, and at times specific outcomes, within a defined time period and budget.

Entry Point III is preferable to starting with overarching national plans and policies, or sectoral development. The reason is that municipalities, districts, provinces, and other sub-national entities already play an important role in disaster response and natural hazard planning. They often implement or co-sponsor local infrastructure, health and development projects as well. Mainstreaming cross-cutting coastal adaptation issues within overall government, and identifying citizen roles and responsibilities may appear difficult and costly. However, it is less so when stakeholders take ownership of the actions and the benefits to be gained are shared.

This Entry Point III is not restricted to existing administrative entities. Ecosystems such as coral reef systems, estuaries, coastal watersheds, and wetland habitats, are compelling focal points for adaptation planning as they also form the logical unit for scientific studies (USAid 2009). Coastal shoreline systems, whether altered or natural, that are already subject to a mix of uses e.g., settlements, tourism, fisheries, recreation, and marine transportation also need to be studied from an ecosystem perspective. Users of such areas must recognize that their continued use and benefits depend on the integrity of a functioning ecosystem.

6.5. Mainstreaming Principles and Policy Protocols

It is important that the Government of Albania consider the approach needed for mainstreaming EbA principles and policy protocols for the future. Whilst this issue shall be developed in more detail within the EbA Guidelines document (to be produced later in 2017), it is recommended that early consideration is given to the following three primary considerations:

- the need for shoreline management created by the existing or intended upland use;
- the risks created by shoreline and upland management alternatives; and
- the goal of preserving or enhancing ecosystem services that provide public benefits.

Individual permit reviews begin from the assumption that the intended use represents an informed local decision about the consequences of development options for the shoreline reach and local watershed. From this basis, project review is intended to identify preferred management alternatives that:

1. allow the use permitted by zoning

This step involves elimination of shoreline management alternatives that would prohibit intended use of the site. It does not, however, avoid consideration of altered site planning or reduced intensity of use that may lessen risk and/or minimize impacts to ecosystem services.

2. reduce on-site risks to both use and ecosystem services

This involves preserving and/or enhancing the riparian buffer to the maximum extent possible consistent with the intended use. It also involves consideration of the long term impacts of the site design for water quality, habitat, and sediment stabilization in the riparian and littoral zones.

3. reduce off-site risks to existing uses and ecosystem services

This step seeks to ensure that the on-site shoreline management alternatives do not increase risks on adjacent properties for existing uses. This includes consideration of increased erosion potential, decreased sediment supply, and increased risk to existing defensive structures. This assessment also considers the impacts of alternative management strategies on the ecosystem services (particularly water quality and habitat) currently provided by adjacent properties.

4. maximize the potential for the site provide ecosystem services that benefit the public

Within the constraints of the foregoing considerations, the management alternatives that provide the greatest potential for sustained ecosystem services on-site will be identified as the preferred strategy.

To accomplish this several models can be employed:

a) An **erosion vulnerability model** is often used to classify shoreline "reaches" according to the probability that the intertidal and riparian features will persist in the face of natural events. This model assesses the potential for shoreline retreat due to erosion and/or inundation, and the potential for shoreline features, such as marshes and forested buffers, to persist. This model is used to assess the need for shoreline management to support the intended site use. The erosion vulnerability model is based on the probability that site conditions will permit significant wave energies to strike the shore. This assessment is based on an integration of: fetch (unobstructed distance over open water), nearshore bathymetry (the slope of the bottom next to the shoreline), and orientation (predominate direction the shoreline reach faces), and the existing erosion protection on site whether natural (marsh, reef, sand bar), or anthropogenic (bulkhead or other revetment). The assessment characterizes the shoreline segments as being at high, medium, or low risk for continuing shoreline erosion. As such, the assessment evaluates the relative need for managing a shoreline based on natural processes.

b) A **site development impact model** is used to characterize the potential for a realized site plan to impact:

- littoral zone water quality through alteration of storm/groundwater flows and quality;
- riparian and littoral habitat services through alteration of land use/land cover; and
- riparian and intertidal sediment stability through alteration of storm water flows.

This model is used to identify alternative site development plans that can minimize impacts to a site's long-term capacity to provide ecosystem services with public benefits.

The model is based on existing site conditions. The location and type of existing structures on the site is considered in light of the erosion vulnerability assessment. This determines if there is an obvious need for shoreline management. In the case of new development, the site plan is considered to determine if risk is being unnecessarily created in locating structures. Potential impacts to ecosystem services are evaluated by considering existing riparian and intertidal vegetation, and current bank condition (stable, eroding, undercut). Alternative development strategies are indicated based on: reduction in long-term risk to structures; preservation/enhancement of vegetative cover; preservation/enhancement of contact between vegetation and runoff/shallow groundwater flows; and minimization of any disruption of connections between riparian, intertidal and subaqueous environments.

c) A **management strategy impact model** is used to characterize the potential for any particular shoreline management plan to affect conditions in adjacent properties. This model considers the potential of management alternatives to increase erosion on adjacent properties, diminish beneficial sediment transport, diminish the effectiveness of adjacent existing shoreline management efforts, increase flooding potential on adjacent properties, or create some other detrimental off-site impacts. The model is based on existing management strategies on adjacent properties. If adjacent shorelines are unmanaged, then the preferred management strategy will be one that does not reflect energy or significantly alter sediment transport pathways. If adjacent shorelines have defensive structures, then preferred strategies will be ones that allow structures along the entire reach to work together effectively. This may result in avoidable short-term impacts to ecosystem services on the subject property in the interest of sustained performance of existing management strategies on adjacent properties.

d) **Ecosystem services models** are used to evaluate the potential that a site has for providing beneficial water quality, habitat, and sediment stabilization services to the local system. The models are based on the combination of physical and biological features that create and sustain capacity to deliver these services. As such, the models provide guidance for the maintenance and/or creation of desirable physical and biological features in shoreline systems.

NB: the above "models" shall be considered within the EbA Guidelines Report which shall focus more on mainstreaming principles and how these can be absorbed/ updated into the Government (Ministry of Environments) EIA procedures. These shall also represent key areas for Ministry of Environment staff training topics during 2018.

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APPENDICES

Appendix A: Detailed Costs for forest implementation

<u>**Cost estimate for 8c:**</u>

Area: Pisha e Stavnikut

Species: **0.5 Stone pine + 0.5 Aleppo pine**
Forest economy: **Shëngjin-Tale**
Forested area: **3.1 hectares**
Land plot: **8c**
Planting design: **2 x 2 m**

Sign in the manual	Description of works to be carried out	Measurement unit	Work volume	Daily rate, US$	Work day	Workday wage, US$	Value in US$
222-1	Staking	piece	2500	1000	2.5	15	38
222/2	Hole staking in the plain	piece	2500	630	4	15	60
223-7	Excavation of holes sized 40x40x40 cm in coastal sandpits/sandy beaches	piece	2500	220	11.4	15	171
263-6	Diammonium phosphate fertilization (100 gr/hole)	piece	2500	1000	2.5	15	38
224-16	Planting of seedlings prepared in plastic bags into holes of 40x40x40 cm	piece	2500	80	31.3	15	470
241	Produce + transport of stakes, ≤ 100 ml	No.	2500	500	5	15	75
243/9	Fencing	m^2	320	20	16.0	15.5	248
227-11	Transport of the seedlings (manually) to afforestation blocks of up to 200 meters	piece	2500	300	8.3	15	125
125-8	Support staking	No.	2500	500	5	15	75
126-11	Sapling anchor around the stake	No.	2500	650	3.8	15	57
224/1	Transport and filling the holes with soil	m^3	130	12	11	15.5	170.5
	Amount I						**1527.5**
AN	Purchase of the vegetal soil	m^3	130			2	260
AN	Purchase of aleppo pine seedlings (>2 years)	piece	1250			2	2500
AN	Purchase of stone pine seedlings (>2 years)	piece	1250			2	2500
MP	Purchase of diammonium phosphate fertilizer	kv	3			85	255
Analysis	Transport of auto seedlings	Ton/km	15		1	9	135
	Transport of auto-vegetal	Ton/km	25			8	200

	soil				
	Amount II				**5910**
	Amount I+II				**7377.5**
	VAT	20%			1475.5
	Cost estimate value per hectare			**101.8**	**8853**
Surface area to be afforested in this plot			**3.1**	**316**	**27444**

	Services scheduled for the facility:
First year	2 hoeing works + 2 irrigations+ chemical fertilizer 100 gr/plant
Second year	2 hoeing works + 2 irrigations+ chemical fertilizer 100 gr/plant

Sign of the manual	Description of works	Unit	Quantity	Rate	Work day	Workday wage, $US	Amount in $US
229-4	Hoeing of seedlings planted into holes with a radius of 0.5 meter (4 times)	m^2	7850	250	31.5	14.5	457
AN	Fertilizer distribution after sprouting of seedlings	rood	10	1	10	14.5	145
229/8	Irrigation of seedlings into afforestations with 30 litres of water over a distance of 100 meters, 4 times	piece	10000	75	133.3	14.5	1933
	Amount I						**2535**
MP	Purchase of diammonium phosphate	Kv	3.5			85	298
	Amount II						**2833**
	VAT	%	20				567
	Amount III				174.8		**3400**
Cost estimate value (for two years of cultivation services)		**hectare**		**3.1**	**542**		**10540**

Summary expenditure for the plot 8c;

Plot no	Unit	Area	Cost estimation for the afforestation and maintenance works				Working days
			Afforestation, $US/ha	Maintenance works $US/ha	Sum, $US/ha	Cost in $US/plot	
8c	**ha**	**3.1**	**8853**	**3400**	**12253**	**37984**	**858**

Cost estimate for 21a:

Local name: **Stomi Nikoll Lucës**

Species: **0.5 Stone pine + 0.5 Alepo pine**

Forest economy: **Shëngjin-Tale**

Plot area: **0.5 hectares**

Forest parcel: **21a**

Planting design: **2 x 2 m**

Services scheduled for the facility:	
First year	2 hoeing works + 2 irrigations + chemical fertilizer 100 gr/plant
Second year	2 hoeing works + 2 irrigations + chemical fertilizer 100 gr/plant

Sign of the manual	Description of works	Unit	Quantity	Rate	Work day	Workday wage, $US	Amount in $US
229-4	Hoeing of seedlings planted into holes with a radius of 0.5 meter (4 times)	m^2	7850	250	31.5	14.5	457
	Fertilizer distribution after sprouting of seedlings	Ha	10	1	10	14.5	145
229/8	Irrigation of seedlings into afforestations with 30 litres of water over a distance of 100 meters, 4 times	piece	10000	75	133.3	14.5	1933
	Amount I						**2535**
MP	Purchase of diammonium phosphate	Kv	3.5			85	298
	Amount II						**2833**
	VAT	%	20				567
	Amount III				175		**3400**
	Cost estimate value (for two years of cultivation services)			**0.5**	**87.5**		**1700**

Summary expenditure for the plot;

Plot no	Unit	Area	Cost estimation for the afforestation and maintenance works				Working days
			Afforestation, $US/ha	Maintenance works $US/ha	Sum, $US/ha	Cost in $US/plot	
21a	**ha**	**0.5**	**8456**	**3400**	**11856**	**5928**	**135.5**

<u>Cost estimate for 21b & 21c:</u>

Local Name: **Shulza**

Species : **0.2 Stone Pine + 0.4 Ash+ 0.4 English oak**

Forest economy: **Shëngjin-Tale**

Plot area: **3 hectares**

Forest parcel: **21b & 21c**

Planting design: **2 x 2.5 m**

Sign in the manual	Description of works to be carried out	Measurement unit	Work volume	Daily rate	Work day	Workday wage, $US	Value in $US
222-1	Staking	piece	2000	1000	2	15	30
222/2	Hole staking in the plain	piece	2000	630	3.2	15	48
223-7	Excavation of holes sized 40x40x40 cm in coastal sandpits/sandy beaches	piece	2000	220	9	15	135

263-6	Diammonium phosphate fertilization (100 gr/hole)	piece	2000	1000	2	15	30
224-16	Planting of seedlings prepared in bags into holes of 40x40x40 cm	piece	2000	80	25	15	375
227-11	Transport of two-year seedlings (manual) to afforestation blocks of up to 200 meters	piece	2000	300	6.7	15	100.5
125-8	Support staking	roots	2000	500	4	15	60
241	Produce + transport of stakes, ≤ 100 ml	No.	106	12	8.8	15.5	137
243/9	Fencing	m^2	3333	300	11.11	15.5	172
125-8	Support staking	roots	2000	500	4	15.5	62
126-11	Sapling anchor around the stake	roots	2000	650	3.1	15	46.5
	Amount I						**1196**
AN	Purchase of the vegetal soil	m^3	65			2	130
AN	Purchase of Ash seedlings (>2 years)	piece	800			4	3200
AN	Purchase of Alepo pine seedlings (>2 years)		400			2	800
AN	Purchase of English oak seedlings (>2 years)	piece	800			4	3200
MP	Purchase of diammonium phosphate fertilizer	kv	2			85	170
Analysis	Transport of auto seedlings	ton*km	10		1	12	120
AN	Transport of auto-vegetal soil	Ton/km	25			8	200
	Amount II						**7820**
	Amount I+II						**9016**
	VAT		20%				1803
	Cost estimate value per hectare				80		**10819**
	Surface area to be afforested in this plot	**hectare**	**3**		**240**		**32457**

Services scheduled for the facility:	
First year	2 hoeing works + 2 irrigations + chemical fertilizer 100 gr/plant
Second year	2 hoeing works + 2 irrigations + chemical fertilizer 100 gr/plant

Sign of the manual	Description of works	Unit	Quantity	Rate	Work day	Workday wage, $US	Amount in $US
229-4	Hoeing of seedlings planted into holes with a radius of 0.5 meter (4 times)	m^2	6280	250	25.12	14.5	364
	Fertilizer distribution after sprouting of seedlings	ha	10	1	10	14.5	145
229/8	Irrigation of seedlings into afforestations with 30 litres of water over a distance of 100 meters, 4 times	piece	8000	100	80	14.5	1160
	Amount I						**1669**
	Purchase of diammonium phosphate	Kv	4			85	340
	Amount II						**2009**
	VAT	%	20				402

Amount III		115.12	2411
Cost estimate value (for two years of cultivation services)	3	345.4	7233

Summary expenditure for the plot;

Plot no	Unit	Area	Cost estimation for the afforestation and maintenance works				Working days
			Afforestation, $US/ha	Maintenance works $US/ha	Sum, $US/ha	Cost in $US/plot	
21b&21c	ha	3	10,819	2,411	13,230	39,690	585.4

Cost estimate for 27a:

Local name: Stomi Nikoll Lucës

Species: 0.6 English oak + 0.4 Alepo pine

Forest economy: Shëngjin-Tale

Plot area: 0.4 hectares

Forest parcel: 27a

Planting design: 2 x 2 m

Sign in the manual	Description of works to be carried out	Measurement unit	Work volume	Daily rate	Work day	Workday wage, $US	Value in $US
222-1	Staking	piece	2500	1000	2.5	15	37.5
222/2	Hole staking in the plain	piece	2500	630	4	15	60
223-7	Excavation of holes sized 40x40x40 cm in coastal sandpits/sandy beaches	piece	2500	220	11.5	15	172.5
263-6	Diammonium phosphate fertilization (100gr/hole)	piece	2500	1000	2.5	15	37.5
224-16	Planting of seedlings prepared in bags into holes of 40x40x40 cm	piece	2500	80	31.3	15	469.5
227-11	Transport of two-year seedlings (manual) to afforestation blocks of up to 200 meters	piece	2500	650	4	15	60
125-8	Support staking	roots	2500	300	8.3	15	124.5
241	Produce+transport of stakes, ≤ 100 ml	No.	2500	650	3.8	15.5	59
126-11	Sapling anchor around the stake	roots	2500	300	8.3	15	124.5
	Amount I						**1145**
AN	Purchase of the vegetal soil	m^3	85			2	170
AN	Purchase of wild English oak seedlings (>2 years)	piece	1500			4	6000
AN	Purchase of Alepo pine seedlings (>2 years)	piece	1000			2	2000
MP	Purchase of diammonium phosphate fertilizer	kv	2.5			85	212.5
Analysis	Transport of auto seedlings	ton*km	15			9	135

AN	Transport of auto-vegetal soil	Ton/km	25			8	200
	Amount II						**8717.5**
	Amount I+II						**9862.5**
	VAT	20%					1972.5
	Cost estimate value per hectare				76		**11835**
	Surface area to be afforested in this plot	**hectare**		**0.4**	**30.5**		**4734**

	Services scheduled for the facility:
First year	2 hoeing works + 2 irrigations + chemical fertilizer 100 gr/plant
Second year	2 hoeing works + 2 irrigations + chemical fertilizer 100 gr/plant

Sign of the manual	Description of works	Unit	Quantity	Rate	Work day	Workday wage, $US	Amount in $US
229-4	Hoeing of seedlings planted into holes with a radius of 0.5 meter (4 times)	m^2	7850	250	31.4	14.5	455
	Fertilizer distribution after sprouting of seedlings	rood	10	1	10	14.5	145
229/8	Irrigation of seedlings into afforestations with 30 litres of water over a distance of 100 meters, 4 times	piece	10000	100	100	14.5	1450
	Amount I						**2050**
MP	Purchase of diammonium phosphate	Kv	5			85	425
	Amount II						**2475**
	VAT	%	20				495
	Amount III				141.4		**2970**
Cost estimate value (for two years of cultivation services)				**0.4**	**56.5**		**1188**

Summary expenditure for the plot;

Plot no.	Unit	Area	Cost estimation for the afforestation and maintenance works				Working days
			Afforestation, $US/ha	Maintenance works $US/ha	Sum, $US/ha	Cost in $US/plot	
27a	**ha**	**0.4**	**11835**	**2970**	**14805**	**5922**	**87**

<u>**Cost estimate for the plantation along roads, inside the lagoon**</u>

Area: **Along roads and canals around lagoons**

Wood Species: **0.4 Oleander + 0.3 Ash + 0.3 Tamarisk**

Forest economy: **Shëngjin-Tale**

Surface area: **5000 seedlings along road/canals**

Scheme: **Plantation every 2 or 1 m distance, along road/canals**

Sign in the manual	Description of works to be carried out	Measurement unit	Work volume	Daily rate	Work day	Workday wage, $US	Value in $US
222-1	Staking	piece	5000	1000	5.0	15.5	78
222/2	Hole staking in the plain	piece	5000	650	7.7	15.5	119
223-7	Excavation of holes sized 40x40x40 cm in coastal sandpits/sandy beaches	piece	5000	30	166.7	15.5	2583
263-6	Diammonium phosphate fertilization (100 gr/hole)	piece	5000	1000	5.0	15.5	78
224-16	Planting of seedlings prepared in bags into holes of 40x40x40 cm	piece	5000	80	62.5	15.5	969
227-11	Transport of two-year seedlings (manual) to afforestation blocks of up to 200 meters	piece	3333	350	9.5	15.5	148
241	Produce+transport of stakes, ≤ 100 ml	No.	5000	300	16.7	15.5	258
227-11	Transport of two-year seedlings (manual) to afforestation blocks of up to 200 meters	piece	5000	500	10.0	15.5	155
125-8	Support staking	roots	5000	650	7.7	15.5	119
126-11	Sapling anchor around the stake	roots	160	12	13.3	15.5	207
	Amount I						**4713**
AN	Purchase of the vegetal soil	m^3	160			2	320
AN	Purchase of Oleander seedlings (>2 years)	piece	2000			2	4000
AN	Purchase of Ash seedlings (>2 years)		1500			2	3000
AN	Purchase of Tamarisk seedlings (>2 years)	piece	1500			3.5	5250
MP	Purchase of diammonium phosphate fertilizer	kv	5			80	400
Analysis	Transport of auto seedlings	ton*km	15		1	8	120
AN	Transport of auto-vegetal soil	Ton/km	25			8	200
	Amount II						**13290**
	Amount I+II						**18003**
	VAT	20%					3601
	Cost estimate value per hectare				**305.1**		**21604**
Surface area to be afforested in this plot		**hectare**		**1**	**305**		**21604**

Cost estimate for 1.0 hectare of maintenance works in afforestation

Area: **Shulza**

Wood species: **0.4 Oleander + 0.3 Ash + 0.3 Tamarisk**

Forest economy: **Shëngjin-Tale**

Scheme: **Plantation every 2 or 1 m distance, along road/canals/lagoons**

Services scheduled for the facility:

First year	2 hoeing works + 2 irrigations + chemical fertilizer 100 gr/plant
Second year	2 hoeing works + 2 irrigations + chemical fertilizer 100 gr/plant

Sign of the manual	Description of works	Unit	Quantity	Rate	Work day	Workday wage, $US	Amount in $US
229-4	Hoeing of seedlings planted into holes with a radius of 0.5 meter (4 times)	m^2	15700	250	62.8	15.5	973
	Fertilizer distribution after sprouting of seedlings	rood	10	1.4	7.14	15.5	110.67
229/8	Irrigation of seedlings into afforestations with 30 litres of water over a distance of 100 meters, 4 times	piece	20000	100	200	15.5	3100
	Amount I						**4184.07**
MP	Purchase of diammonium phosphate	Kv	8			80	640
	Amount II						**4824.07**
	VAT	%	20				964.8
	Amount III				269.9		**5788.88**
Cost estimate value (for two years of cultivation services)				**1**		**270**	**5788.88**

Summary expenditure for the plot;

Plot	Unit	Area	Cost estimation for the afforestation and maintenance works				Working days
			Afforestation, $US/ha	Maintenance works $US/ha	Sum, $US/ha	Cost in $US/plot	
Along roads	**5 km**	**5 km**	**21,604**	**5,789**	**27,393**	**27,393**	**575**

Appendix B: Cost Benefit Analysis for EbA approaches

Potential Costs of a selected EbA	Potential Benefits of a selected EbA
Financial costs of implementation Opportunity/ economic costs of implementation	Prevent flooding Preserve and encourage the growth of wetlands and its value Sustained tourism Fish farming and sustained agriculture EbA activities such as mangroves additional benefits to biodiversity
Potential costs of not implementing an EbA ("Do Nothing") approach	
Increased susceptibility to flooding events Loss of wetland/ agricultural/ forest/ fisheries area. Through erosion of sand dunes in the DMRD area, the coastline is retreating by 2.5cm per year in average affecting breeding grounds and loss of habitat Loss of coastal recreational opportunities Subsequent long term loss of economic opportunity (i.e. loss of fisheries as a result of climate change can reduce incomes for local farmers Loss of coastal, marine and estuarine habitats Reduced ecosystem resilience to sea level rise and climate change	

Potential costs and benefits of EbA

How can CBA work for Albania - The economics of climate change and adaptation

By addressing the current economic issues within the DMRD (Drini-Mati River Delta), the KVLS, Shëngjin (and the surrounding Lezhë district), the implications of climate change in the future can be predicted. The figure below (figure 2.5.1.) illustrates the costs of climate impacts over time, for no adaptation (dashed line), with adaptation (solid line), and the baseline scenario of impacts with no climate change (dotted line). The baseline is increasing because the value of production and assets is assumed to increase over time. The difference between the solid and dashed lines represents the benefits of adaptation, while the difference between the dotted and solid lines represents residual impacts which will not be able to be adapted to. Residual impacts will vary both over time and in different places.

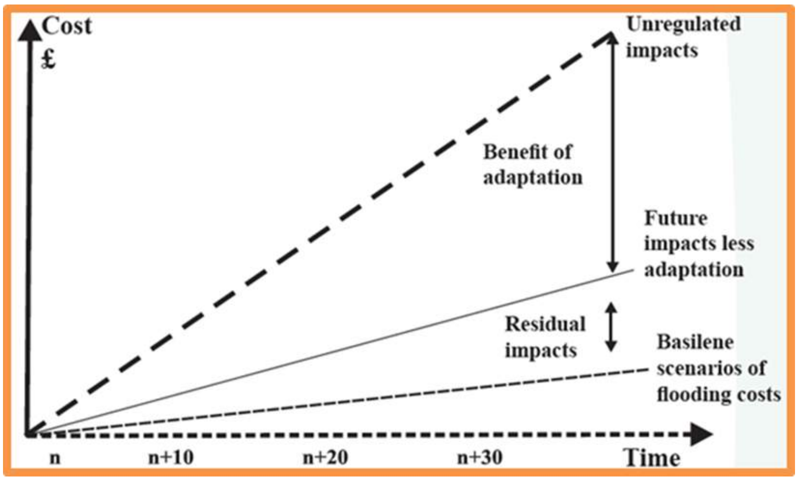

Figure 2.5.1. The benefits of adaptation

Table 2.5.1.1.below (produced by the UNDP Project Synthesis Report), in the context as the DMRD area as a whole, or by considering the different sub areas of the region, shows what net present values are placed on certain categories. What the data leads to is the conclusion that the likely costs of measures designed to conserve the wetland and coastal biodiversity, and safeguarding community assets, is less than the benefits that these systems and assets currently provide, i.e.: the cost of measures to adapt to climate change are a lot less than the cost of doing nothing and allowing them to degrade.

Value Category	Estimate NPV (million Euro)
Wetland loss WTP	0.77
Flood damages	2.8 - 3.1
Agricultural land loss	0.3 – 1.5
Forest carbon	0.00015
Coastal beach recreation	2.5
Fishery loss	9
Total	**15.4 – 16.8**

Table 2.5.1.1. Estimated NPV for coastal variables (UNDP Project Synthesis Report)

The total net present value (NPV) calculated was estimate to be between 15.4 – 16.8 million euro. Hence the present value of benefits of ecosystem services exceed the costs. The estimated range of Euro 15.4-16.8 million for the DMRD region provides an initial benchmark for considering the efficiency of overall adaptation spending.

Table 2.5.1.2 below shows an example of present value (PV) cost and benefits within the Shëngjini region and KVLS.

Shëngjini (Merxhani) Costs	PV costs
Beach nourishment at Shëngjini Beach/Kune	US$ 12,902,490
Construction of a groyne field across the beach nourishment receiver site	US$ 58,570
Dune planting at degraded sites along Kune Spit, phased in after beach nourishment has taken place	US$ 12,960
Terminal groynes	US$ 156,190
Breakwater removal/dredging	US$ 529,220
Total	**Euro 10,244,570**
Total	**US$ 13,659,430**
Shëngjini (Merxhani) Benefits	**PV benefits (Euro)**
Tourist values	6,488,880
Wetland value	1,541,670
Fishing	2,884,800
Total	**10,915,350**
NPV	**670,760**

Table 2.5.1.2. PV costs and benefits for the Shëngjini region (UNDP Project Synthesis Report)

Cost-benefit analysis (CBA) can be used for EbA responses in a similar way to investment decisions. CBA is a rationale framework for considering adaptation options. In essence, the application in this context will compare the costs of appropriate interventions with the anticipated benefit of such interventions

In one approach that can help to choose between adaptation options, cost-benefit analysis, the potential costs and benefits of an action are monetized (i.e. given a monetary value) for a specific time period and then compared to determine which is most economic. Theoretically, if there is a net benefit calculated for a certain project, then it should go ahead.

Stages and methodology to a CBA

1. Identify potential costs and benefits of different options

a) Assess the extent to which different options reduce future hazards by comparing the expected impacts with and without adaptation options implemented. Here, the 'benefits' can be identified as a result of the implemented scheme and a monetary value can be estimated and attached.

i) Impacts of past hazards can inform assessment of potential future impacts

ii) In specifying the impacts of adaptation options, it is important to assess whether the conditions are in in place to enable optimum implementation. The assumptions regarding this need to be made clear.

iii) Scenarios may directly provide information on changes in impacts or they may only provide information on hazards. If only information on hazards is available, changes in hazards may need to be linked to changes in impacts.

b) Gather information on the cost of past damages related to the hazard that is the focus of adaptation, as it can help assess the likely impact of future hazards and the benefits of reducing damage from future climate-related disasters. Information on damage can include physical damage to infrastructure, loss of life, injuries, psychological health impacts, continued water logging or salinity of crops, business interruption, bankruptcies, and long-term migration. Some of this information will already be in monetary value form but some will have to be converted.

c) Linear damage functions (i.e. damage always being proportional to the increase in exposure of hazards) are often used in a CBA for simplicity, though are not always realistic

d) When assessing damages (costs) involved, include secondary impacts as far as possible (monetizing these impacts) in order to provide a more accurate CBA, such as the long term impact on business, income and employment.

e) If the adaptation options include combinations of EbA (e.g. the implantation of dunes) with other adaptation approaches (e.g. hard infrastructure including tidal inlet channels and artesian wells), be clear what role different options play

2. Consider level of protection different options provide

Consider the extent to which each adaptation option shortlisted (e.g. mangrove/ dune/ coral reef/ sea grass/ coastal wetland conservation and restoration) can offer similar levels of protection against the hazard

3. Asses the economic value of benefits and costs

Undertake an economic assessment of the associated costs and benefits of implementing each option. In order to do this:

a) The time period for the analysis should be carefully chosen as adaptation options will have different implementation times, conditions and thresholds of effectiveness. For example, some adaptation options may take longer to get to a level where they start to offer protection, and therefore it should be acknowledged when presenting information on costs and benefits that during this implementation period some of the costs and benefits may not have been fully realised.

b) Estimate the benefits, in monetary terms, which result from the adaptation options shortlisted, i.e. damage avoided plus other benefits that may arise such as a reduction in lost output and productivity losses minimised. Remember to consider how benefits may change over the entire time period of the analysis. When considering 'other positive impacts', these benefits should be as comprehensive as possible, covering economic, social, and environmental benefits. This type of information can be collected through assessments (e.g. ecosystem service assessments may have been undertaken, surveys or through reviewing the existing literature (although the latter is unlikely to deliver as accurate values as conducting field work for the specific location). Another key issue is whether to assign a monetary value to human life/ *how much* should be attached.

c) Estimate the costs. Include as many **cost categories** as possible in order to assess the total cost of implementing an option. Different categories of cost include:

- Predicted implementation cost
- Opportunity/ economic cost – was there a more lucrative but equally resilient use of the area/ land required by the EbA option?
- Environmental cost – there could be the potential to be a reduction in monetary value of the ecosystem services provided by the ecosystems as a result of the adaptation intervention (i.e. restrictions on diving or anchorage reducing tourism revenue in the short-term)?

4. Calculate the overall net present value (NPV)

The net present value is the present value of social benefits minus the present value of social costs.

The benefits and costs identified in stage 3 above will be not all be incurred at the same time. In order to combine future monetary values with current values, **a discount rate** is applied – an adjustment of the future values so that they reflect the value of future benefits today. A discount rate should be applied to both the benefits and the costs. The sum of the benefits minus the costs (both with discount rate applied) can then be calculated and is known as the net present value. The ratio of costs to benefits can also be calculated. Where there is a net benefit overall (the ratio of benefits to costs is >1), then the adaptation option is economically viable.

The Net Present Value (NPV) of an investment is calculated as a function of benefits, costs, and the discount rate (Equation 1):

$$NPV = \sum_{t=0}^{n} \left[(B_t - C_t) \times \frac{1}{(1+r)^t} \right]$$

Where B - represents the benefits, C - the costs, r is the discount rate, and t - is a time index. The discount rate of Equation 1 is expressed in real terms, net of any changes in the price level.

5. Combining economic cost-benefit analysis with other appraisal criteria

When comparing the various adaptation options, combining economic cost-benefit analysis with the other appraisal criteria can identify the most appropriate option. This can be appropriate when things can't be monetized/ struggle to be monetized (such as some cultural, biodiversity and health impacts, and thus can be included in a multi-criteria analysis (that seeks to evaluate options by moving beyond solely using monetary values) rather than to be simply ignored.

During the CBA, **remember to consider:**

- How costs may change over time
- How indirect costs may arise, i.e. costs not directly associated with the implementation of the adaptation option. For example, tourism may be deterred by the construction of a sea wall
- The distribution of impacts across different socio economic groups and how this may impact equality
- Including a **sensitivity analysis** in the CBA which includes assessing uncertainty associated with each variable. A sensitivity analysis regarding EbA strategies in the Kune-Vaini lagoon could include the estimates for expected sea level rise in Albania in the future
- Future economic variables including inflation, the rate of interest and exchange rates can affect costs (although the discount rate helps to 'discount' this)
- Quantifying the cost and benefits of adaptation to climate change is complex

Appendix C: Species commonly used for reforestation

Tamarix parviflora

Common Names: small-flowered tamarisk, early tamarisk

Family: Tamariacaceae (tamarisk Family)

Description

Small-flowered tamarisk is a deep-rooted, wide spreading deciduous shrub or small tree to 15 ft (4.6 m) tall with a similar spread. It has purplish bark and graceful arching greenish purple shoots with scale-like bright green leaves. The foliage looks like it should be evergreen (it isn't), and is similar to that of juniper. The little leaves are 1/8 in (0.3 cm) long with tiny glands that secrete salt, hence the name sometimes seen, "salt cedar." The tiny flowers are rose-pink with four petals, borne in dense clusters about 2 in (5.1 cm) long on branches of the previous year's growth. They appear in early summer and may persist for several weeks.

Location: Tamarix parviflora, the small-flowered tamarisk, is native to southeastern Europe, including Turkey, Crete, Greece and the Balkan states. It occurs naturally in dry, almost desertlike regions, in dry riverbeds, on salty soils inland, and along Mediterranean shores. Small-flowered tamarisk and other species of Tamarix have become naturalized in many areas, replacing native vegetation.

Culture: The salt cedars thrive in dry, infertile soils, and may actually decline if given too much fertilizer and water. Small-flowered tamarisk should be pruned regularly to prevent it from becoming leggy and top-heavy. This species produces flowers on the previous year's growth, and should, therefore, be pruned immediately after blooming. Other species of Tamarix bloom on new growth of the year and can be pruned in winter before new growth starts.

Light: Full sun.

Moisture: Small-flowered tamarisk is fairly drought tolerant, though not quite so tolerant of drought as other species of tamarisks. This one thrives also in humid environments.

Hardiness: During extreme events, young branches are sometimes killed in very cold winters, thus eliminating flowers for the following year.

Propagation: Propagate small-flowered tamarisk from greenwood cuttings in summer or from fresh seed, which usually germinates readily in a just a few days.

Small-flowered tamarisk

The bright green foliage of the small-flowered tamarisk has a fine texture giving the plant the look of a wispy green cloud.

Usage: Tamarisks have bright feathery foliage that is very attractive in summer. They make excellent hedges and windbreaks along the seacoast since they are highly tolerant of salt spray and salty soils. They are also useful along sidewalks and roads that get salted frequently to control winter ice. Small-flowered tamarisk is a useful hedge inland, too, especially on poor, sandy soils. Use in a mixed shrub border for its interesting texture that is fine in summer and coarser in winter when the leaves have dropped.

Fraxinus ornus

Common Names; manna ash or South European flowering ash

Family: Oleaceae

Fraxinus ornus (manna ash or South European flowering ash) is a species of Fraxinus native to southern Europe and southwestern Asia, from Spain and Italy north to Austria, Poland and the Czech Republic, and east through the Balkans, Turkey, and western Syria to Lebanon and Armenia.

Description

The manna ash (Fraxinus ornus L.) is a small to mediumsized deciduous tree, growing rarely up to 25m tall and 1 metre in diameter. The bark is dark grey, usually very smooth even in old trees. The crown is often asymmetrical, hemispherical or flattened with a straight trunk, sinuous branches directed upwards and frequently forked, and abundant root suckers at the base. The buds are grey-brown densely covered by short grey hairs. The foliage is olive-green and changes to yellow and deep pink in autumn. The leaf is compound, 25-30cm long, odd-pinnate, arranged in 5-9 leaflets, which are obovate, acuminate, serrated, grooved above and pubescent at the joints, 7-10cm long. The flowers are abundant and grouped in large inflorescences 10-20cm long, which appear in late spring at the same time as the leaves. Flowers are scented and attract a variety of pollinating insects (mainly bees and beetles), even though they do not produce nectar. Wind pollination can also occur. The single narrow flowers are creamy white with four linear petals, 6mm long. The manna ash is androdioecious: trees can have hermaphrodite flowers or have flowers with only functional male organs, so behaving as male plants. The fruits are samaras, 15-25mm long, slender, green in colour until leaf fall, then brown when ripening in autumn. Their dispersion is driven by the wind and by water along rivers

The manna ash occurs typically in Mediterranean temperate colline-mountain forests. In the northern part of its range and in higher elevations it is found commonly on south-facing slopes, where it can find the warmth required to grow. In central and eastern Europe it grows principally on calcareous soils, while in southern areas it also grows on silicate substrates, and does best on soils with a pH around neutral. The mean annual precipitation needed is between 500 and 650mm, although it has a good drought resistance, storing water in densely branched roots, and reducing transpiration. The root system is widely developed, requiring gravelly, well-aerated and drained soils. It thrives better on poor soil, suffering the competition of other broadleaved trees on richer ones.

The buds are pale pinkish-brown to grey-brown, with a dense covering of short grey hairs.

Cultivation and uses

Fraxinus ornus is frequently grown as an ornamental tree in Europe north of its native range, grown for its decorative flowers (the species is also sometimes called "flowering ash"). Some cultivated specimens are grafted on rootstocks of Fraxinus excelsior, with an often very conspicuous change in the bark at the graft line to the fissured bark of the rootstock species. A sugary extract from the sap is extracted by making a cut in the bark; this was compared in late medieval times (attested by c.1400 with the biblical manna, giving rise to the English name of the tree, and some of the vernacular names from its native area ("fresno del Maná" in Spanish, "frassino da manna" in Italian). In fact, the sugar mannose and the sugar alcohol mannitol both derive their name from the extract.

Importance and Usage; Compared to the other ashes, the timber quality is similar, although with a lower density. It is good quality, heavy, with narrow annual rings and a small difference between sapwood and heartwood. However, its timber wood is of low economic interest, as trees develop small and poorly-shaped trunks with many defects, so it is mainly used for small tool handles and household items. Managed manna ash forests usually are coppiced for producing firewood. In southern Mediterranean regions they are also managed by pollarding as a source of fodder for livestock (cattle, goats and sheep). Several ash varieties are used as ornamental trees in gardens and urban parks, appreciated for the abundance of white scented flowers and the autumnal foliage coloration. For this reason, this tree is also called flowering ash. Manna ash occurs principally on slopes, so it is an important component of protective forests and, thanks to its pioneer habit, it is also used for afforestation of degraded sites. Like the narrow-leaved ash, the damaged bark exudes a bitter-sweet tasting sap, which crystallises in the air into a yellow mass called manna. The main manna component is mannitol, a sugar alcohol, which has higher concentrations in trees planted in warmer regions. Manna was traditionally used in medicine as a laxative and digestive. During the last century manna was produced for extracting the mannitol, which is mainly used as a sweetener and for producing medicine.

Scientific name: *Quercus robur* L.

Common name: English oak, pedunculate oak, common oak

Description - English oak is probably the most well-known and best-loved of the tree species native to Britain. This king of the forest can live for more than a millennium according to some sources, and grow up to 40 m high. Mature specimens are usually home to many species of wildlife. One of English oak's most recognisable characteristics is the shape of its leaves. Pale green in colour, they have four or five lobes on each side and are attached to the branches with almost no stalk. In contrast, the acorns are borne on long stalks known as peduncles, hence the name 'pedunculate oak'. Large, old oaks often have dead branches at the top. This 'stag head' is not necessarily a sign that the tree is dying. When water is short the oak simply stops supplying its upper extremities, and as a result extends its lifespan. For such a huge, long-lived and widespread tree, the oak is surprisingly bad at reproducing naturally. First, it can be a full 50 years before the first crop of acorns (seeds) is produced. Second, most of the tens of thousands of acorns dropped are eaten by animals, or simply rot.

Uses - Quercus robur was named for its robust or sturdy nature (robur means strength in Latin), and since iron tools were first made, people have been felling this mighty tree for its strong and durable timber. It can take as long as 150 years before an oak is ready for use in construction, but it is well worth the wait. Until the middle of the 19th century, when iron became the material of choice for building ships, thousands upon thousands of oaks were felled every year. Oak has many other uses; oak bark has been used in leather tanning and in dyeing, insect galls have been used to make black ink, and the acorns are valued as food for livestock. Acorns have been roasted to produce a coffee substitute, apparently quite inferior to the real thing.

Cultivation - The majority of the oaks propagated in the country are grown from seed. This method is preferred for the scientific collections as it is the easiest and safest means of collecting oaks in the wild without damaging their populations. Acorns are collected green and sown directly into the nursery field during the autumn. The seeds germinate the following spring. Oak seed does not store well and quickly becomes non-viable as it dries out. Mice and squirrels present a threat to the seeds, and netting or wire mesh is used to keep them at bay during autumn and winter. Rare oak specimens are sown in pots in a frost-free glasshouse for added protection. Occasionally, young trees are also brought in from nurseries, for example to give instant impact in heritage plantings on the vistas. These are grown in a reputable nursery for 12 months where they can be inspected for pests and diseases before they are transplanted to other places. The fresh foliage of young oaks often suffers from mildew. Trees affected in this way are not treated because once they are planted out the mildew no longer presents a problem. It is often necessary to stake young trees.

Scientific name: *Pinus pinea* L.

Common name: stone pine, umbrella pine, Italian stone pine

About this species; Widely known for its edible seeds, the stone pine is an unusual and distinctive-looking tree, which can grow to achieve an umbrella-like appearance. Mature trees have thick, fire-resistant bark and large cones, which open and release their seeds in response to heat. The seeds are eaten and dispersed by birds and rodents. Stone pines have been widely cultivated in Europe, both as ornamentals and for their seeds and other products, and have been known to live for as long as 300 years. The resin of the stone pine contains turpentine which is used as an antiseptic, a remedy for kidney and bladder problems, and to treat skin conditions.

Geography and distribution; Pinus pinea is native to coastal areas of Mediterranean Europe (Portugal, Spain, France, Italy, Albania, and Greece) and the Near East (Turkey, Cyprus, and Lebanon). It is found on coastal dunes and flats, and also on the lower slopes of hills and mountains up to 600 m above sea level. It is usually an emergent tree above shrubs (in maquis scrubland) or in low, open forests, but it can also occur with P. halepensis and in Quercus ilex maquis-woodland.

Description; With its tall, slim trunk and radiating spray of branches at the top, it is easy to see how the stone pine has also come to be known as the umbrella pine. It usually grows up to 20-25 m tall, either with a single trunk up to 1 m in diameter, or a trunk that forks into multiple stems not too far above the ground. The bark is orange-brown to reddish-brown with grey patches and is thick and scaly, breaking into large, hard plates divided by deep irregular fissures. The leaves (needles) have minutely toothed margins and are borne in groups of two, held by a basal sheath. The leaves are covered with a dull greyish, waxy coating when young, but become dark green and glossy when mature. The pollen cones are yellow and are short and cylindrical in shape. The seed cones are borne singly, or sometimes in groups of two or three on short stem, and persist for several years, ripening in the third year. They are 9-13 cm long and up to 13 cm wide. The egg-shaped seeds are brown, 15-20 mm long and 8-10 mm wide, with a rudimentary wing. The familiar fresh pine fragrance given off by the tree is due to oil released from the leaves. It is thought that the oil may help reduce the amount of water lost from the leaves.

Uses; The edible seeds of the stone pine, popularly known as 'pine nuts', have been enjoyed for thousands of years, and were considered a delicacy by Roman soldiers. Millions of kilograms of 'pine nuts' are harvested each year in the Mediterranean. Whilst still closed, the cones are collected with hooked poles and then heated to release the seeds. The cones take a full three years to mature, making the production of 'pine nuts' a lengthy process – but one worth waiting for. When the seeds are harvested they are kept in their cones to ensure they are fresh when the time comes for eating or roasting them. They are widely used in French and Italian dishes, and are an essential component of pesto, which also contains basil, parmesan, pecorino cheese, garlic, salt, and olive oil. Pine nuts are also used to make baklava, a very sweet pastry dessert popular in Middle Eastern cuisine. The empty pine cones are used as decorative items in flower arrangements, and also serve as good hot-burning fuel for bakeries. The timber is of poor quality being coarse and resinous, but is used locally in furniture-making. The resin is tapped and used for varnishes, waterproofing, and as a source of rosin for waxing violin bows and ballet shoes. A green dye is made from the needles. Stone pine is also valued as an ornamental across the parts of Europe with mild winters.

Cultivation; The preferred method for propagating *Pinus pinea* is by seed, although it can also be propagated by taking cuttings or by grafting. It grows best in sandy loam to loam soil, with a pH of 5.5 to 6.5, and should be placed in full sunlight. Its drought tolerance is high, but it can suffer from damage caused by the fungus Diplodia pinea, which causes new shoots to become brown and stunted, and the fungus Mycosphaerella pini (red band needle blight), which causes red bands and spots on needles, and premature defoliation.

Scientific Name: *Pinus halepensis* Mill.

Family: Pinaceae

Common Names: Aleppo pine, Halepensis pine, Jerusalem pine

Range Description: Occurs in the Mediterranean from Morocco and Spain to Greece and the coast of Libya at Jabal al Akhdar, and in Israel, Jordan, Lebanon, and SW Syria. The extent of occurrence is well in excess of the thresholds for a threatened category.

Habitat and Ecology: Its habitat ranges from the lower arid or semiarid to humid bioclimates favouring absolute minimum temperatures of between -2 and 10°C and precipitation between 350 and 700 mm on marly limestones and marls9, 16. It is a very drought resistant, thermophilous species that grows very well in the hotter parts of the Mediterranean where forest fires are frequent. P. halepensis can successfully colonise limiting dry conditions areas creating highly resilient forest stands, but more often it is found scattered in garrigue or maquis vegetation colonizing abandoned lands and burnt areas. In the absence of fire for long periods it can be replaced by holm oak (Quercus ilex) and cork oak (Quercus suber) as an intermediate step in the successional series to broadleaved trees.

Aleppo Pine grows in the hotter parts of the Mediterranean coast, where brush and forest fires are frequent. Despite this, its seed cones are only semi-serotinous and do open in the absence of fire in the heat of the sun. Although closed stands exist, it is more commonly scattered in maquis or garrigue vegetation on sunny hills and slopes down to the sea shore, most commonly on limestone and dolomite. In stands where fire has been absent for a longer period, oaks (Quercus suber, Q. ilex) invade and will eventually dominate. Presumably increased frequency of fire caused by human activities gives the advantage to Pinus halepensis.

Importance and Usage; P. halepensis is not used in commercial forestry due to its size, shape and poor wood quality. However, being the main source of wood in many Mediterranean countries it is used for various purposes including firewood as well as raw material for the pulp and paper industry. In the past it was also used for mine props, railway sleepers and telephone poles. By being well adapted to drought, poor soil and recurrent fires, Aleppo pine has been used in several afforestation programmes, especially between the thirties and seventies, aiming at soil protection and wind breaks near the coast. It is often used for improving water infiltration on hilly slopes and to prevent soil erosion on dry slopes, although other studies suggest that plantations of Aleppo pine do not improve soil conditions. Seeds are also used for making pastry in several areas, mainly in North Africa. The resin extracted from the plant is still presently used in Greece for wine production. In Greece and Turkey the honeydew released by the sap-sucking insect Marchalina hellenica is still used to produce honey. There is some use for pallets and chipping for particleboards as well as for boat making at a local scale. The wood is frequently planted in rain-fed suburban parks and road lines. P. brutia wood has been used in the pulp industry, carpentry and to produce railway sleepers and telephone posts among others. It has also been widely planted in the Eastern Mediterranean and around the Black Sea, due to its ability to grow in Mediterranean climates. Since ancient Greek times the resin of both P. halepensis and P. brutia has been used to seal amphorae containing wine, and later on to flavour the Greek traditional white wines called "Retsina".

Species commonly used for revegetation – Marram Grass *(Ammophila arenaria)*

This plant is a native of the Mediterranean area that is found commonly on cooler coastlines of Europe, North America, South Africa and Australia. It was introduced to Australia in the 1880s as a primary sand-binding grass. Its rapid growth in response to sand burial made it ideal for stabilising degraded dunes and it has been used extensively for this purpose in NSW, especially south of the Hunter River.

It is very easy to harvest and plant and its tussocky form allows it to begin trapping sand as soon as it is planted. New growth usually appears within a couple of weeks of planting. Although acknowledged as an exotic, its widespread use in NSW was justified in terms of its excellent sand stabilising capability and the expectation that it would die off within a few years and not establish itself.

However, planting of marram grass is now not encouraged. It persists in the landscape for many years longer than expected, encouraging development of a more-hummocky dune surface, and there is evidence from the South Coast that its persistence is impacting adversely on re-establishment of natural dune biodiversity (Webb et al. 2000). Marram planting can now only be considered where severe degradation is affecting a large area.