

BASE ADAPTATION INSPIRATION BOOK

23 EUROPEAN CASES OF CLIMATE CHANGE ADAPTATION TO INSPIRE EUROPEAN DECISION-MAKERS, PRACTITIONERS AND CITIZENS





BASE

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OF CLIMATE CHANGE ADAPTATION
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BASE

ADAPTATION INSPIRATION BOOK

23 EUROPEAN CASES OF CLIMATE CHANGE ADAPTATION TO INSPIRE EUROPEAN DECISION-MAKERS, PRACTITIONERS AND CITIZENS

BASE BOTTOM-UP CLIMATE ADAPTATION STRATEGIES TOWARDS A SUSTAINABLE EUROPE

ADAPTATION INSPIRATION BOOK

CONTENT

ADAPTATION INSPIRATION BOOK

FOREWORD & ABOUT THIS BOOK

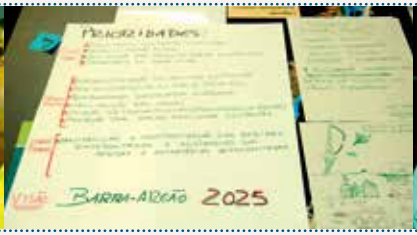
FOREWORD

Climate change is a reality and the extent and speed of change are becoming ever more evident: temperatures are rising, rainfall patterns are shifting, sea ice, glaciers and snow are melting, and sea level is rising.
Climate-related extremes such as heat waves, heavy precipitation and droughts are increasing in frequency and intensity in many regions. These changes, in interaction with economic and demographic developments and land use changes, have already had many impacts on ecosystems, economic sectors, infrastructure and human health and well-being across Europe.
The global Paris climate agreement is a major step forward, aiming to keep the increase in average global temperature to well below 2°C and requiring substantial reductions in global greenhouse gas emissions. The agreement is due to enter into force in November 2016.

However, complementary actions to adapt are also required, to prevent or minimise the impacts.
The EU climate change adaptation strategy of 2013 encourages countries to adopt adaptation strategies, promotes action in cities, mainstreams adaptation in EU policies, enhances research and information-sharing, and provides funding. In 2017-2018 the European Commission will assess whether action being taken so far is sufficient.

An increasing number of European Environment Agency (EEA) member countries have adopted national adaptation strategies and are implementing action plans. Strategies and actions also emerge in many cities and transnational regions across Europe. Technological and ecosystem-based measures, and measures addressing behavioural changes, are being taken. Especially ecosystem-based measures, with multiple benefits, receive attention.

The EEA provides information to support these developments. For example in 2016 EEA published a report on urban adaptation including an overview of actions cities have taken. It recommends taking a wider systemic approach, including for example better urban planning with more green areas that can retain excess rainwater or cool built-up city centres in the summer, or by preventing the construction of houses in flood-prone areas.
This can transform cities into much more attractive, climate-resilient and sustainable places.



The European Commission and EEA have also developed the European Climate Adaptation Platform (Climate-ADAPT) providing for example planning support tools, adaptation case studies and measures.

The BASE adaptation inspiration book gives a very good overview of a variety of in-depth case studies that span across Europe, administrative levels, geographic scales, multiple sectors and trans-disciplines. These can inspire European decision-makers, practitioners and citizens to take action. I do hope this book can indeed inspire people to adapt.

André Jol
Head of group climate change impacts, vulnerability and adaptation

European Environment Agency

ABOUT THIS BOOK

This book is inspired by the positive feedback received by the Adaptation Inspiration Book developed in CIRCLE-2, coordinated by the Faculty of Sciences, University of Lisbon. This inspiration book is a culmination of four years extensive case study research carried out within the EU FP7 Project BASE: Bottom-up climate adaptation strategies towards a sustainable Europe (2012-2016).

Pivoted largely on findings from a meta-analysis of BASE case study research, this book presents a brief overview of 23 diverse in-depth case studies that span across Europe, administrative levels, geographic scales, multiple sectors and trans-disciplines. Case studies range from traditional analytical studies to participatory action research. Depending on the climate change adaptation phase, needs and challenges, each case study focuses on one or a combination of methods applied in the climate change adaptation planning process, namely: economic evaluations of adaptation options; participatory applications; and implementation barriers and opportunities.

A comprehensive description of methods and case studies can be found in BASE publications *www.base-adaptation.eu/publications.*

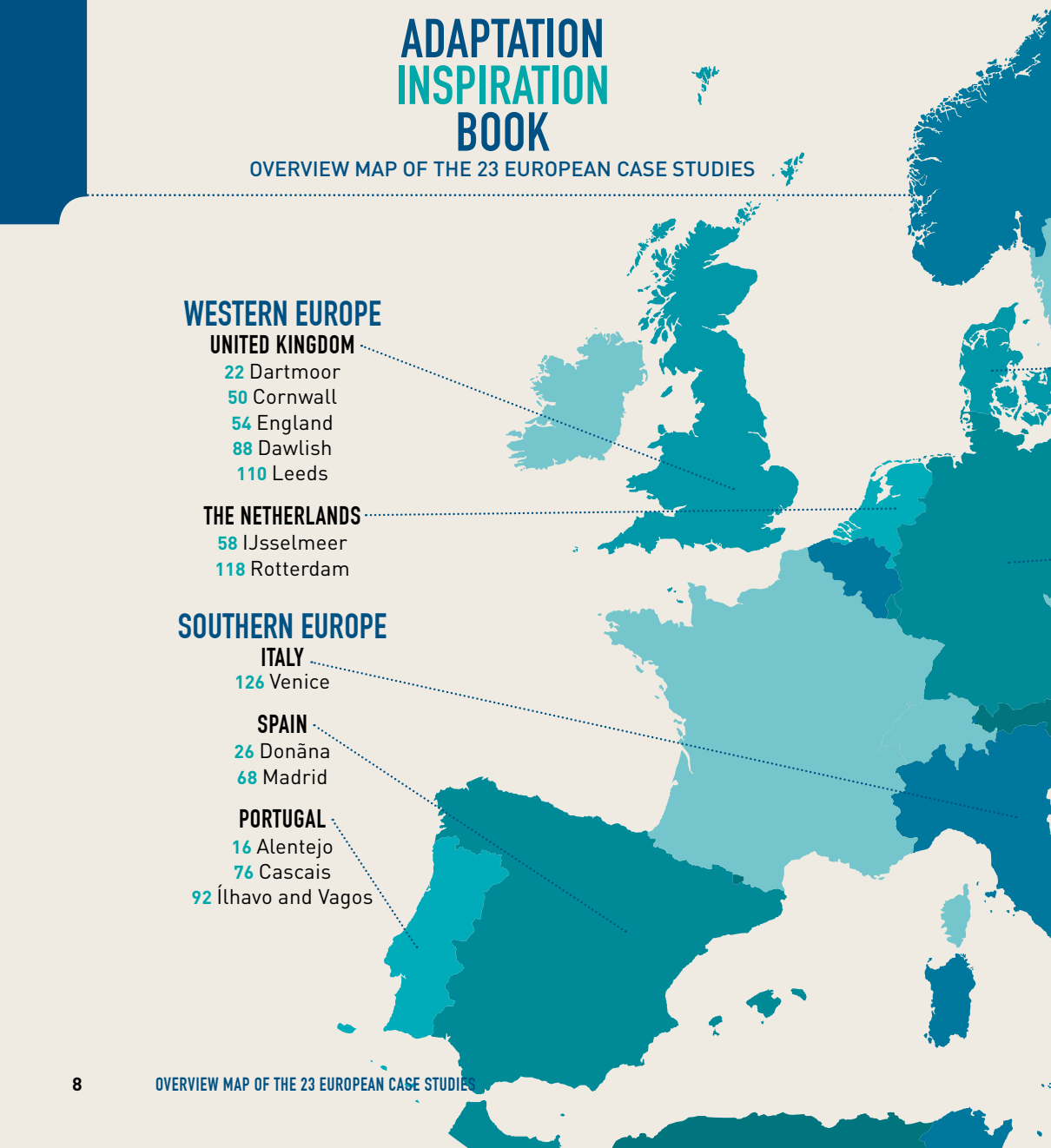
We hope these case studies provide inspiration, motivation and guidance to European decision-makers, climate change adaptation practitioners and citizens to

PONDER, ACT, TRANSFORM & ADAPT

towards a sustainable Europe.

ADAPTATION INSPIRATION BOOK

OVERVIEW MAP OF THE 23 EUROPEAN CASE STUDIES



WESTERN EUROPE

UNITED KINGDOM
22 Dartmoor
50 Cornwall
54 England
88 Dawlish
110 Leeds

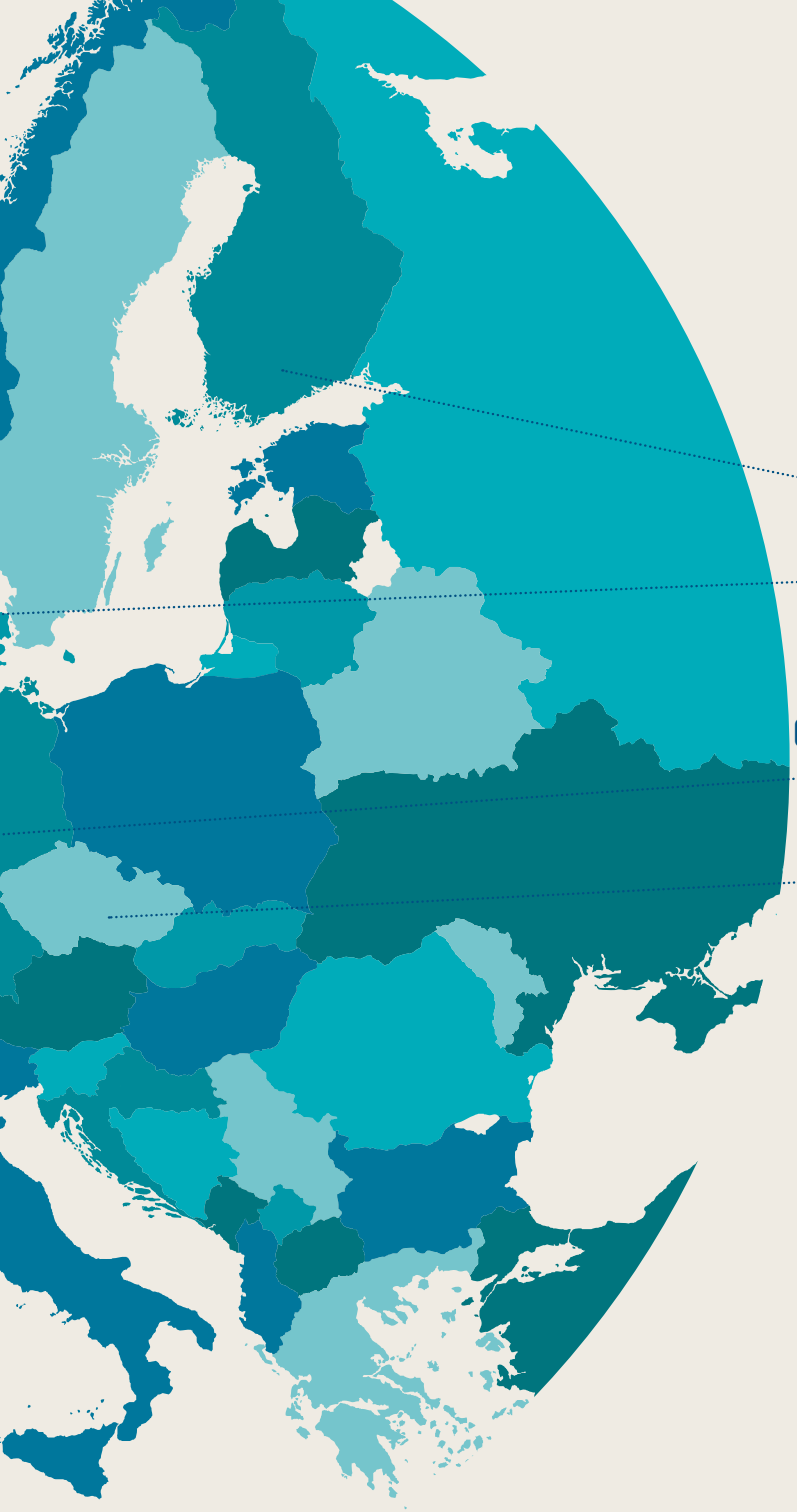
THE NETHERLANDS
58 IJsselmeer
118 Rotterdam

SOUTHERN EUROPE

ITALY
126 Venice

SPAIN
26 Donãna
68 Madrid

PORTUGAL
16 Alentejo
76 Cascais
92 Ílhavo and Vagos



NORTHERN EUROPE

FINLAND
62 Kalajoki

DENMARK
30 Holstebro
82 Copenhagen
104 Kalundborg

CENTRAL-EASTERN EUROPE

GERMANY
98 Jena
122 Timmendorfer Strand

CZECH REPUBLIC
36 South Moravia
40 Šumava
44 Ústí
114 Prague

ADAPTATION INSPIRATION BOOK

INTRODUCTION

INTRODUCTION

Climate change poses a tricky challenge for collective action across the world. The 2015 Paris Agreement was a historical step, and tipped the balance towards the possibility of containing global climate change at acceptable levels. Even if the world's governments jointly succeed in combining their mitigation efforts for holding temperature increases below 2°C by 2100, adaptation is inevitable, as some level of climatic change is to be expected due to lags in the climate system.

Impacts and consequences of climate change span from global to local scales, from regional to context-specific effects, and will take a toll on a variety of communities. To ensure equitable, efficient and effective solutions for climate change, adaptation processes need to be harmonised across levels of governance from central governments to local polities, and scales, involving as far as possible a wide diversity of stakeholder groups and individuals. The losers and winners of these processes need to be thoroughly accounted for and engaged in the design of policies and solutions.

Societies should be equally inspired to turn the climate change problem into a thriving opportunity for change, by promoting innovative solutions towards sustainable, equitable and resilient communities.
At the base of collective action stand a number of policies and strategies designed at global, regional and national scales, which need to correspond to local needs in order to ensure effective implementation and willingness to adapt. With the goal of supporting more sustainable climate change adaptation pathways throughout Europe, BASE research takes on a unique focus by addressing the integration of top-down policies and processes, and bottom-up responses and initiatives.

Through its case study research, project BASE provides the empirical content and data from a diverse selection of top-down strategies and bottom-up experiences throughout Europe.
A set of 23 case studies, each led by one or more BASE partners (henceforth, referred to as case study owners), were selected. In some instances, sub-cases were developed within a case study to

APPROACHES & TOOLS APPLIED IN BASE CASE STUDIES

account for the varying climatic, environment and socio-economic settings, as well as varied dimensions regarding geographical areas covered, and scales and levels of governance. As a result of BASE, four years of case study research are condensed in this book to offer a number of experiences and lessons learnt, which hopefully will inspire policy-makers, practitioners and citizens in Europe and across the globe to continue working towards a sustainable world.

PARTICIPATORY & SOCIAL LEARNING APPROACHES

- Citizen survey
- Questionnaire-based survey
- Stakeholder analysis
- Stakeholder interviews
- Stakeholder workshops
- Focus groups
- World Café
- Systemisation of experiences
- Design workshops
- Fuzzy cognitive mapping (FCM)
- Scenario workshops
- Dynamic adaptation pathway
- Participatory state of the art*
- Participatory add-ons to cost-benefit analysis (P-CBA)
- Participatory add-ons to multi-criteria analysis (P-MCA)
- Participatory benefit-cost analysis (PBCA)*
- Scenario workshop & Adaptation pathway (SWAP)*

ECONOMIC/EVALUATION TOOLS

- Simple cost-benefit analysis (CBA)
- Simple cost-effectiveness analysis (CEA)
- Multi-criteria analysis (MCA)
- Integrated valuation of ecosystem services and tradeoffs (InVEST) model **
- Choice experiments
- Urban heat tool (UrbaHT)**
- Planning kit DPRD flood risk management decision support tool
- VEMALA nutrient loading model
- DREMFIA economic agricultural sector model
- KUTOVA spreadsheet tool
- Water availability and adaptation policy analysis (WAAPA) model
- PRIMATE (an interactive software for probabilistic multi-attribute evaluation)**

** BASE novel approach*
*** BASE novel applications of existing tools*

ADAPTATION INSPIRATION BOOK

INTRODUCTION

HOW TO NAVIGATE THROUGH THE CASE STUDIES?

BASE case studies focus on a variety of sectors and types of climatic adaptation processes across European regions, i.e. Northern, Western, Central-Eastern and Southern. In this book, case studies are organised into three broad chapters based on the most relevant sectors:

AGRICULTURE & FORESTRY/ BIODIVERSITY & ECOSYSTEM SERVICES,
WATER RESOURCES & HEALTH,
and
COASTAL ZONES/ HUMAN SETTLEMENTS & INFRASTRUCTURE.

Within each chapter, case studies are arranged in alphabetical order according to their locations. A set of fast facts is presented at the beginning of each case study, of which the type of adaptation challenges, sector affected and geographic scale are based on a pre-defined list adapted from Climate-ADAPT platform. *www.climate-adapt.eea.europa.eu*

ADAPTATION CHALLENGE:

indicates the most relevant and/or focal climate change impact(s) of the case study, i.e. extreme temperatures, water scarcity, flooding, sea level rise, droughts, storms, ice & snow.

SECTOR AFFECTED:

indicates the most relevant and/or focal sector(s) of the case study, i.e. agriculture & forest, biodiversity, coastal areas, disaster risk reduction, health, infrastructure, water management.

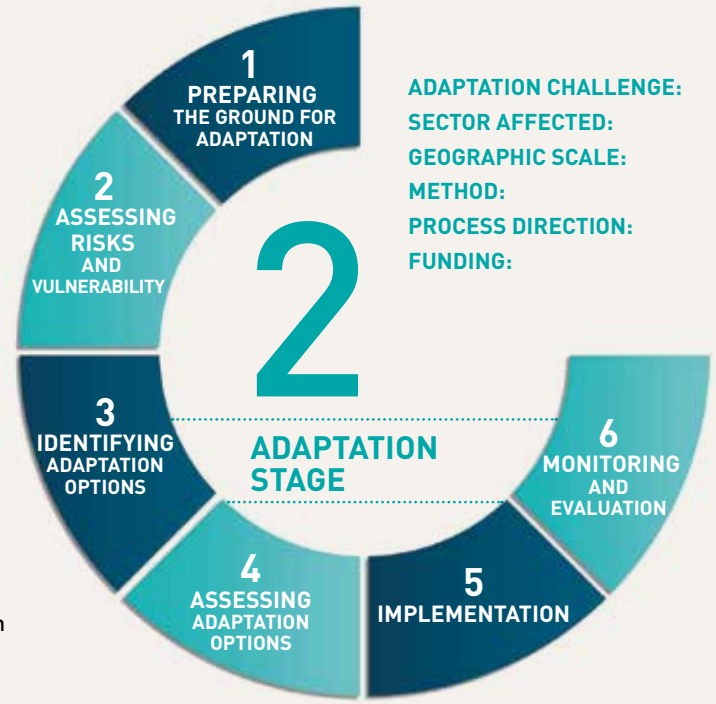
GEOGRAPHIC SCALE:

indicates the spatial extent of the case study, i.e. transnational, national, subnational regions, local.

DIAGRAM:

THE URBAN ADAPTATION SUPPORT TOOL HOSTED BY THE CLIMATE-ADAPT PLATFORM WAS ADAPTED TO DEMONSTRATE THE TEMPORAL ADAPTATION STAGE OF THE CASE STUDY.

Source: www.climate-adapt.eea.europa.eu



METHOD:

highlights the key methods applied in the case study besides the general qualitative and quantitative analysis, i.e. modelling tools, participatory approach, economic analysis, adaptation pathway.

PROCESS DIRECTION:

specifies the starting point and onward direction of the stakeholder initiative in relation to the governance hierarchy. "Bottom-up" and "top-down" refer to the upward or downward direction of an initiative or strategy or adaptation process. Some case studies focused solely on either bottom-up initiatives or top-down strategies, while some started from bottom-up initiatives followed by top-down strategies and vice versa. In most of these case studies, "bottom-up" refers to initiatives or adaptation processes taken by a group of people, such as a local community or a municipality, while "top-down" refers to more centrally driven initiatives from national governments and the European Union.

FUNDING:

indicates the funding source(s) and/or funding needs for implementation.

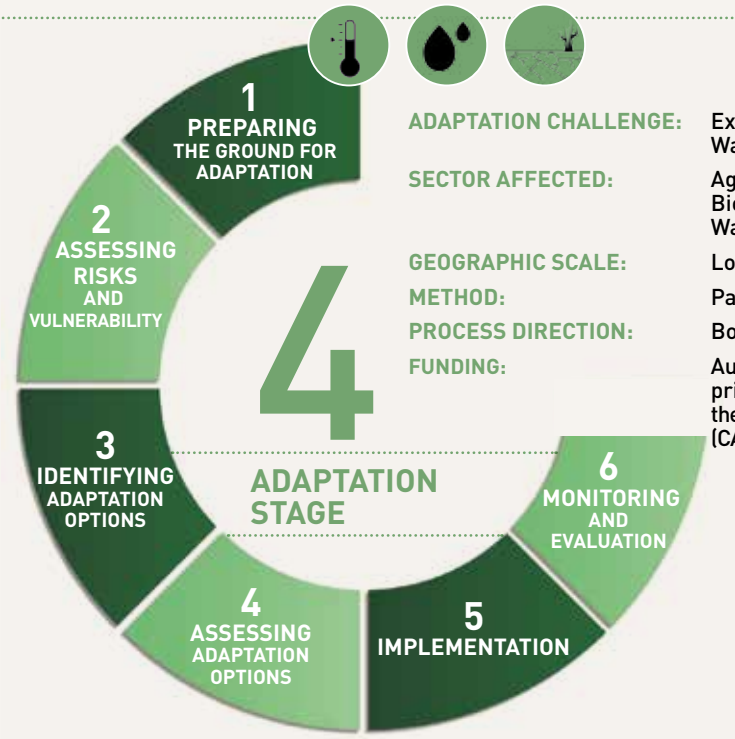
ADAPTATION STAGE:

indicates the adaptation stage of the case study, Stage 1 – 6.

AGRICULTURE & FORESTRY/ BIODIVERSITY & ECOSYSTEM

LOCATION Alentejo, Portugal

ADAPTATION TO DROUGHT IN AGRICULTURE AND FORESTS IN RURAL AREAS



ADAPTATION CHALLENGE: Extreme Temperatures, Water Scarcity, Droughts

SECTOR AFFECTED: Agriculture & Forest, Biodiversity, Water Management

GEOGRAPHIC SCALE: Local

METHOD: Participatory, Economic Analysis

PROCESS DIRECTION: Bottom-Up

FUNDING: Autonomous adaptation with private funding and subsidies from the Common Agricultural Policy (CAP)

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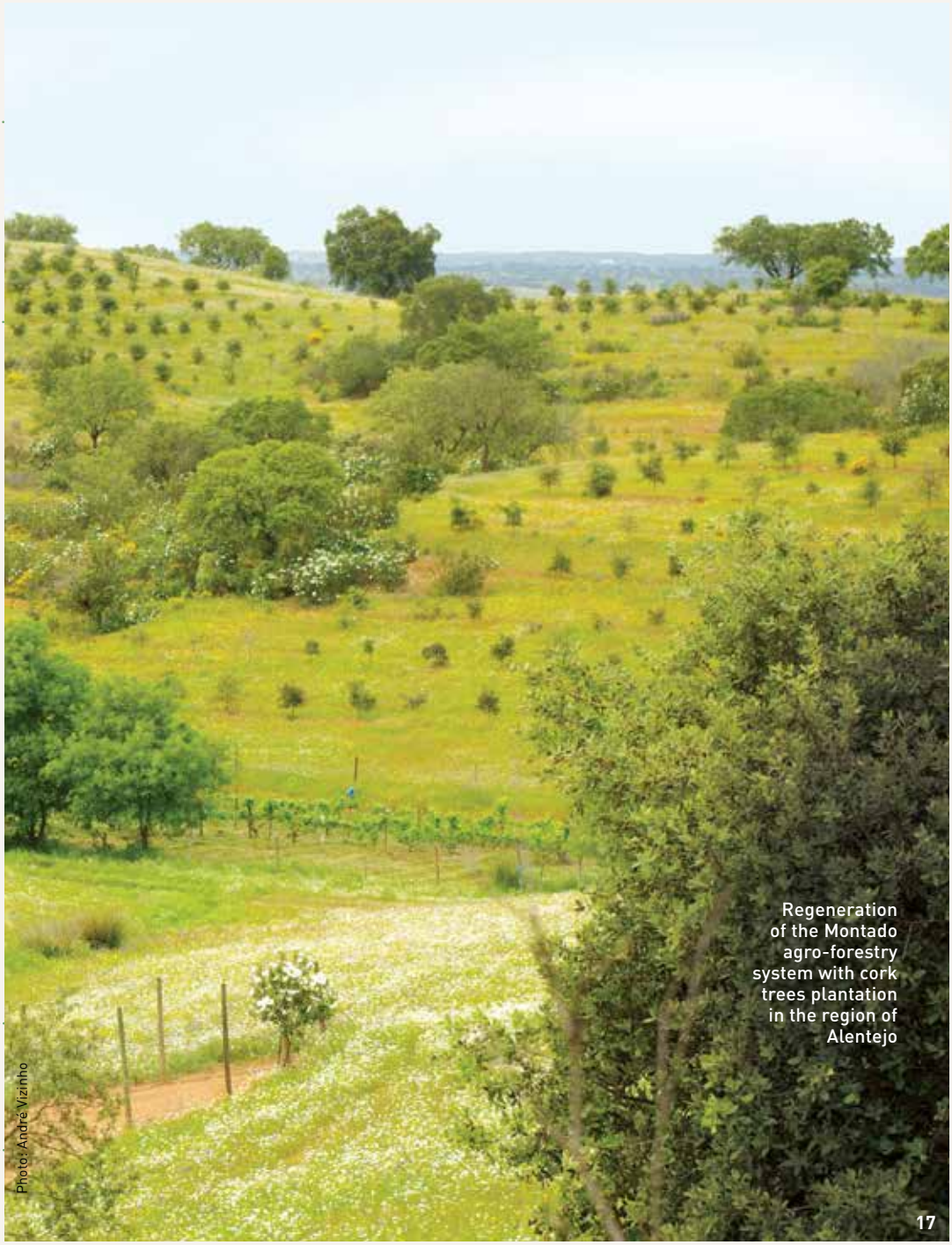
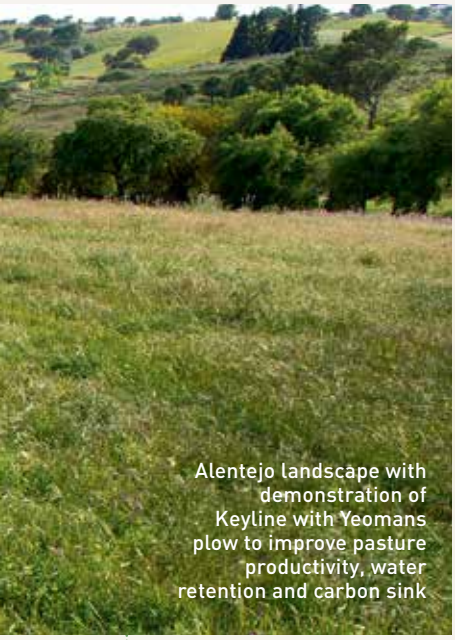


Regeneration of the Montado agro-forestry system with cork trees plantation in the region of Alentejo

Photo: André Vizinho

The case study was conducted in Alentejo, a southern region in Portugal that is characterised by a semi-arid Mediterranean climate. Alentejo is particularly vulnerable to drought and desertification and the area has a low population density which constitutes an additional barrier to economic development. While some users have benefited from irrigation infrastructure and services, other regions depend on rain for their agriculture and agroforestry sectors. Both user-groups (irrigated and non-irrigated) face different challenges in relation to climate change adaptation.

The purpose of the case study was to take a Bottom-Up approach and understand the autonomous adaptation taking place by farmers and communities in the region, while at the same time evaluate the already implemented adaptation measures with different methods such as cost benefit analysis, InVEST modelling, systematisation of experiences, literature review and participatory multi-criteria analysis on barriers and opportunities.



Alentejo landscape with demonstration of Keyline with Yeomans plow to improve pasture productivity, water retention and carbon sink

Participatory State of the Art workshop on Adaptation of Forest and Agriculture in the Alentejo

Photos: André Vizinho

THE CLIMATE CHALLENGE

The region is characterised by a semi-arid Mediterranean climate and is classified as having high vulnerability to climate change and high risk of desertification due to its aridity index, low quality of soils, reduced precipitation and increasing temperatures.

The majority of the region is not irrigated and its agriculture is based on rainfed winter cereal crops, pastures and a silvo-pastoral landscape with cork oak and holm oak as primary trees. Climate challenges in these regions affect the agriculture, agroforestry, and forestry sectors, which suffer from decreased precipitation, increased drought periods and increased temperatures. Other significant areas of the region (thousands of hectares) have irrigation infrastructures, channels and big dams with costs subsidised by CAP funds but they too face adaptation challenges related to heat waves, temperature increase, increase of price of water for irrigation, decrease in water quality, increased dependence on irrigation and eventual water scarcity due to transboundary water conflicts.

THE ADAPTATION RESPONSE

The case study collected over thirty diverse adaptation measures currently being used by different farmers and organisations in the region. Innovative measures include creating microclimates (with lakes, windbreaks, etc) or locating crops in specific microclimates in the farm (shade of hills, etc). Many adaptation responses consisted in implementing good practices to increase farm resilience.
Some examples include conservation tilling (no tilling, zone tilling, keyline, countour, etc.), diversification (of crops,

THE ADAPTATION RESPONSE

species, varieties, genes, creating agro-silvo-pastoral landscapes, etc), improving soil quality (increasing organic matter, mulching, rotating livestock, introducing sewage sludge on soil, etc.).

Other measures focus on harvesting rainwater and using water more efficiently such as off-stream dams, water retention landscapes, precision drip irrigation with organic fertilizer, reusing grey water, using renewable energy for water pumping to reduce the costs of irrigation.
Finally, several measures focused on raising the adaptive capacity namely with awareness raising about sustainability and climate change, training courses in permaculture, and the development of community plans for an eco village.

THE PEOPLE AND INSTITUTIONS INVOLVED

Twenty-one farms and projects were interviewed in this case study and contributed information to its findings. For the farmers, the motivation for participation was mainly due to their interest in improving yields from their farm and thus their income.

Participation also came from local NGOs and community organisations interested in implementing sustainable practices.

In order to gather these perspectives from different stakeholders, the case study organised several participatory events starting with a "Participatory State of the Art workshop on Adaptation of Forest and Agriculture in the Alentejo" with the research community, national and regional stakeholders working on related fields.

THE OUTCOME OF ACTION

The range of adaptation responses varied greatly with the selection of thirty recognised measures and projects each with certain level of success and/or limiting factors.

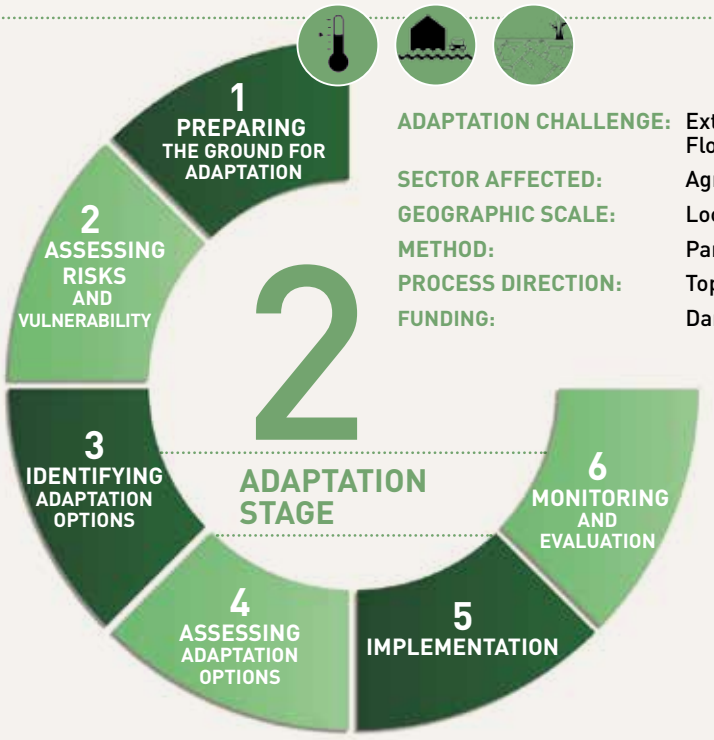
A participatory multi-criteria analysis was conducted to understand these factors on fifteen adaptation measures considered most important for stakeholders.

Typical Montado agro-forestry landscape of Alentejo (Cork oaks, holm oaks and pastures) combined with irrigation fields (irrigated vines and olive trees and horticulture)

Photo: Joaquim Alves Gaspar

LOCATION Dartmoor, United Kingdom

PUBLIC AND PRIVATE CLIMATE CHANGE ADAPTATION INITIATIVES FOR A NATIONAL PARK



ADAPTATION CHALLENGE: Extreme Temperatures, Flooding, Droughts

SECTOR AFFECTED: Agriculture & Forest, Biodiversity

GEOGRAPHIC SCALE: Local

METHOD: Participatory

PROCESS DIRECTION: Top-Down, Bottom-Up

FUNDING: Dartmoor National Park Authority

BASE RESEARCH PARTNER CONTACT
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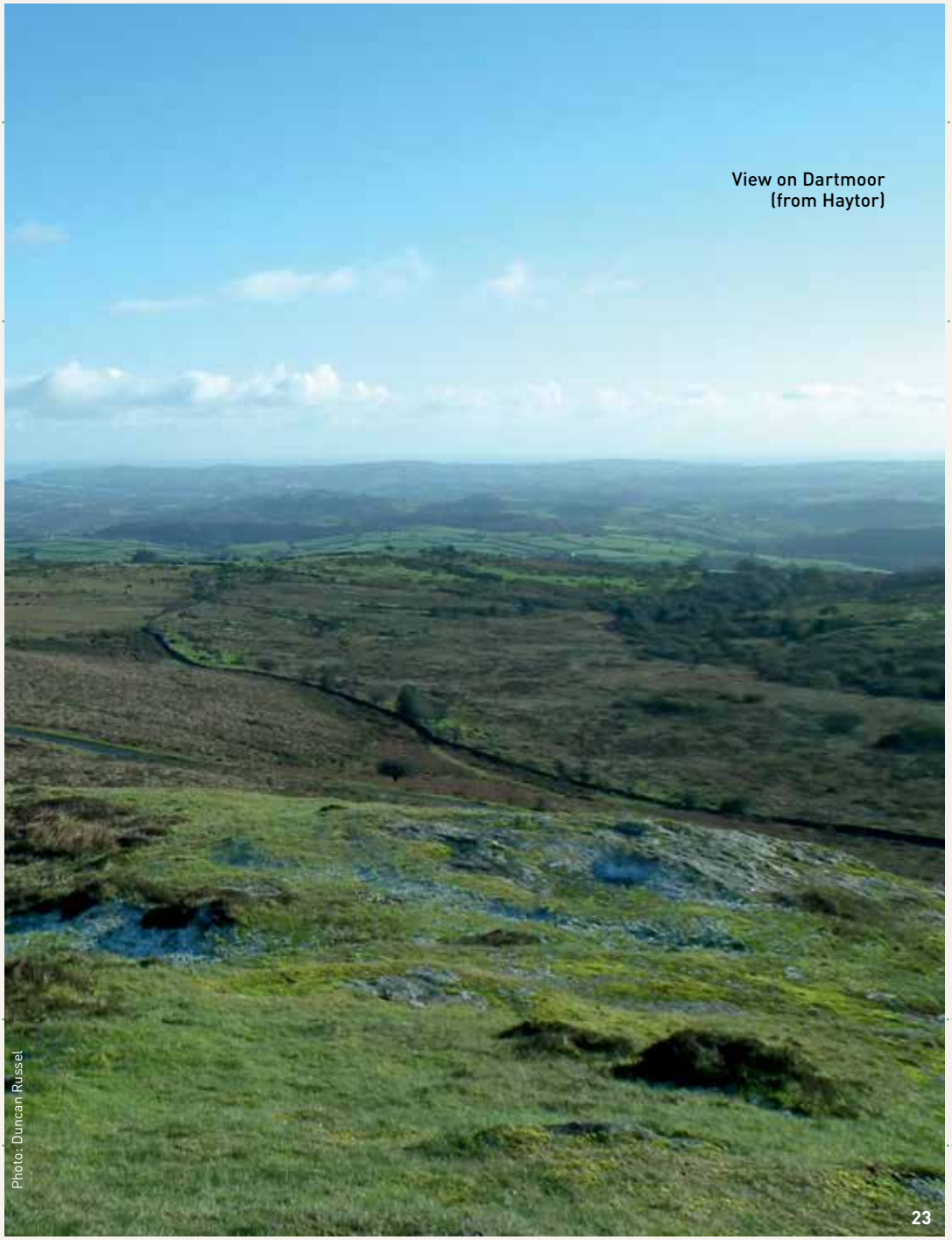


View on Dartmoor
(from Haytor)

Photo: Duncan Russel

A small creek, near Merrivale

Photos: Roos den Uyl

THE CLIMATE CHALLENGE

Dartmoor National Park is an upland located in the South West of England offering numerous ecosystem services. Large parts of the area are covered by moors with a granite-dominated geology and a peat substrate. Recent climate trends have meant an increase in the average daily temperature, milder yet wetter winters and hotter and dryer summers. These climate pressures, exacerbated by human activities such as overgrazing and fertiliser application, threaten the region with peat degradation and erosion. In addition, the accompanying loss of ecosystem services threatens food provision, the regulation of water quality and flow, genetic biodiversity and cultural-recreational services.

THE ADAPTATION RESPONSE

The UK Government mandated the Dartmoor National Park Authority to develop an adaptation strategy in 2011 identifying impacts and potential policy measures. This adaptation strategy was not explicitly implemented, but instead translated into the Management Plan 2014-2019, which aims to, interalia, establish various actor roles; documentation and monitoring; improve water and carbon storage; introduce more sustainable farming to benefit ecosystems; stimulate and protect priority species; and develop conservation-sensitive tourism. Two additional initiatives were started by non-governmental actors. The Mires on the Moor project was set up as a pilot by regional private water company South West Water with the aim of improving water supply from Dartmoor through better managing blanket peat bogs. Dartmoor

Creek on Dartmoor, near Merrivale

Farming Futures is a bottom-up project set up to better manage Dartmoor's distinctive ecosystem through the implementation localised agro-environmental schemes, such as better management of vegetation to prevent wildfires and maintaining beneficial livestock farming.

THE PEOPLE AND INSTITUTIONS INVOLVED

The Dartmoor National Park Authority was suggested as the primary authority responsible for adaptation in Dartmoor National Park. The current responsibility around adaptation is however not that clear. The Mires on the Moor project is not a public policy initiative, but rather initiated by drinking water company South West Water and the University of Exeter, taking place on land owned by the Duchy of Cornwall and (partly) used by local residents and farmers. Dartmoor Farming Futures was initiated by local farmers together with the Dartmoor Commoners Council, the Forest Commoners Council, the Haytor and Bagtor Commoners Council, and the DNPA, together with the Duchy of Cornwall, Natural England, RSPB, South West Water, and the Ministry of Defence.

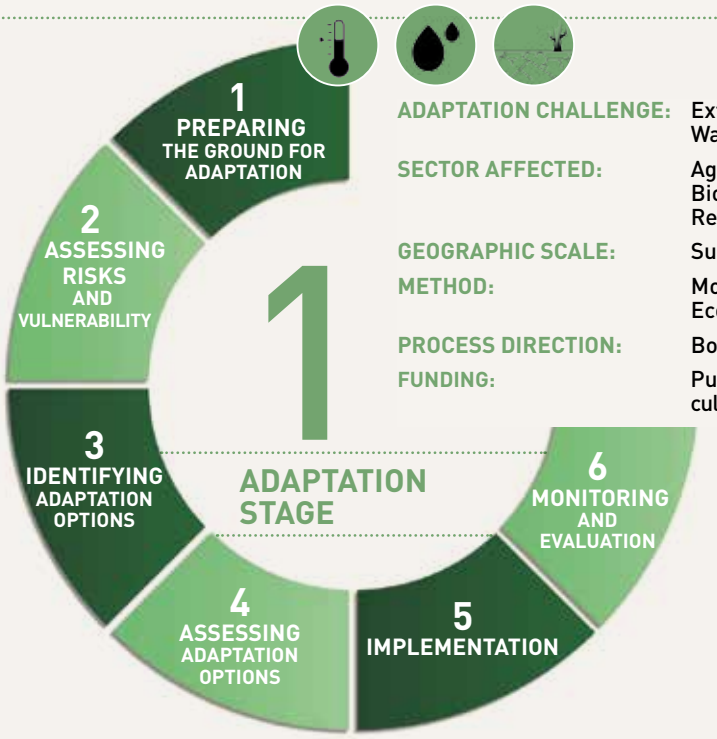
THE OUTCOME OF ACTION

The Management Plan 2014-2019 includes some adaptation measures though not explicitly under a climate change heading. The Management Plan will be implemented and monitored, though it is not yet known exactly how and when, and whether evaluation outcomes will be used. The National Park Authority informed researchers that climate change adaptation is currently not one of their priorities, which may be a reflection of recently reduced funding and changing higher-level political priorities. A first preliminary evaluation has been conducted in 2013, the Dartmoor Farming Futures programme was deemed to have successfully translated national and EU policies into a localised setting. The Mires on the Moor project entailed rewetting bog areas. The project received criticism for not indicating compensation sums and (partly) failing to engage local expertise and feedback.

The project ends in 2015, and South West Water has decided not to fund any continuation of the project on Dartmoor.

LOCATION Donãna, Spain

BALANCING WATER NEEDS AMONG MULTIPLE USERS IN A DROUGHT-PRONE COASTAL WETLAND



ADAPTATION CHALLENGE:	Extreme Temperatures, Water Scarcity, Droughts
SECTOR AFFECTED:	Agriculture & Forest, Biodiversity, Disaster Risk Reduction, Water Management
GEOGRAPHIC SCALE:	Subnational region
METHOD:	Modelling, Participatory, Economic Analysis
PROCESS DIRECTION:	Bottom-Up
FUNDING:	Public funding from Common Agricultural Policy (CAP), private funding

BASE RESEARCH PARTNER CONTACT
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The Doñana ecosystem is a major site for migrating birds

Photo: Ana Iglesias

Rice cultivation contributes to the richness of the ecosystem

Photos: Ana Iglesias

THE CLIMATE CHALLENGE

The Doñana region is a coastal wetland in the Guadalquivir River Basin District of Southern Spain with both natural and artificial wetlands. Droughts have occurred in the region over the past 50 years, but their frequency and intensity are increasing. The Doñana region is also experiencing a variety of other environmental pressures: the coastal area is vulnerable to sea level rise and the potential increase of irrigation demand is very high.The policy strategies undertaken so far have been capable of dealing with extreme situations, but ineffective in solving the budding conflict among users, particularly between agriculture and environment. Rice production in the region is water intensive and requires irrigation.

Agricultural subsidies have financially supported farmers, but they have also propped up the industry and distorted the price consideration between water needs and agriculture production. Freshwater resources are predicted to become further stressed as a result of climate change and other pressures such as population growth, pollution from agriculture intensification and fragmented or uncoordinated adaptation strategies.

THE ADAPTATION RESPONSE

Three relevant adaptation measures were identified. The first was the implementation of existing climate change adaptation plans for drought and water conservation. The second was the reestablishment and restoration of riparian buffers. The third was the restoration and management of coastal wetlands.

THE PEOPLE AND INSTITUTIONS INVOLVED

Four stakeholder groups were identified based on criteria of those most likely to be affected by adaptation policies as well as those with the most influence in the adaptation decision making process.
The four identified groups were farmers who had the most to gain or lose, the local institutions responsible for decision-making, and the citizens and environmentalists.
Some 90% of farmers in Doñana belong to a farmers organisation and these were the main representative bodies involved (i.e. Farmer Advisory Services, Irrigation Communities, Cooperatives, or Rice Farming Federations and Unions).

At the local government level, the River Basin Authorities represented the public officials with control over water resources policy, water management and irrigation planning.
Finally, a longstanding environmentalist organisation represented nature welfare claiming more water for the natural wetland.
In this particular case, the four stakeholder groups had strong disagreements about water management.

THE OUTCOME OF ACTION

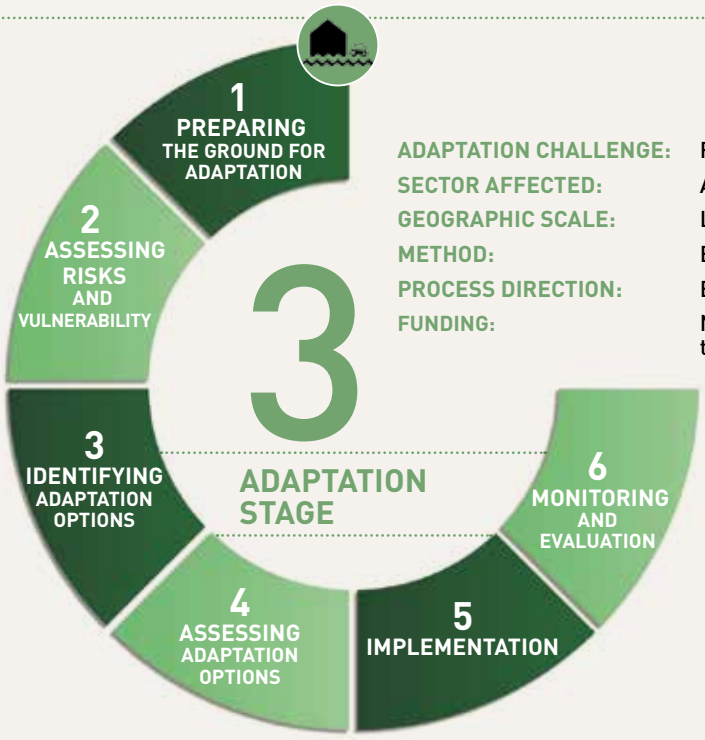
In a first step the study aimed to characterise the shortage of water using the WAAPA model, which helped quantify the potential water availability changes in the larger basin and the locality of Doñana. The simulations of water availability in all sub-basins range from -45 to -93% of current water availability.

Drought period in paddy fields

In a second step, the choices that relevant stakeholders had were explored depending on different agronomic, water management and governance measures.
Measures related to water management were then selected to provide a quantitative estimation of their effectiveness. A major limitation derived from the consultation process was that the sample size of stakeholders was quite small and not comprehensive. The strongly different views of the stakeholder groups on water management may have also contributed to some degree of mistrust and lack of response.
Despite these uncertainties and limitations, the results obtained show a qualitative picture of future water availability in Doñana and the Guadalquivir basin given a choice of adaptation policy options derived from the consultation.
The findings of the case study enhance knowledge of different climate change strategies at the local level by learning more about stakeholders and the conflicts that exist between them over specific adaptation options.

LOCATION Holstebro, Denmark

URBAN-RURAL CO-OPERATION:
FARMERS AS POTENTIAL WATER MANAGERS?



ADAPTATION CHALLENGE:	Flooding
SECTOR AFFECTED:	Agriculture & Forest, Urban
GEOGRAPHIC SCALE:	Local
METHOD:	Economic Analysis
PROCESS DIRECTION:	Bottom-Up, Top-Down
FUNDING:	Need national subsidies to initiate implementation

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Photo: Jakob Stoktoft Oddershede

River flooding
in Holstebro

Storåen flooding, Holstebro

Photos: Jakob Stoktoft Oddershede

THE CLIMATE CHALLENGE

Holstebro is a Danish municipality (population app. 57,000) located on the Jutland peninsula. The second longest watercourse in Denmark, the Storåen, runs through the town (population app. 35,000), which is surrounded mainly by agricultural farmland. The municipality has experienced significant floods on a minimum of nine occasions since 1918. The flooding events have occurred irregularly, but recurrently over the past century and it is predicted that floods will continue to increase in frequency and intensity due to climate change.

The town of Holstebro is one of ten nationally appointed flood risk areas in Denmark under the EU Floods Directive (2007/60/EC), where the risk of a 100-year flood event is high and substantial damages to buildings, housing and infrastructure may result from such events. Holstebro suffered serious floods in 2011 when several months of heavy snowfall were followed by intense rain and snowmelt. The town flooded again most recently in December 2015.

THE ADAPTATION RESPONSE

Holstebro municipality adopted a local risk management plan in 2015 and a climate adaptation plan in 2014. The municipality's Climate Adaptation Plan is a strategic plan that aims to address several policy areas. This first plan for Holstebro

is solely centred on problems related to increased precipitation and higher groundwater levels. One of the potential adaptation measures suggested in the Holstebro Climate Adaptation Plan is to let farmers in the surrounding areas act as water managers, where they can be compensated for letting their fields flood when Holstebro experiences flood events, thereby alleviating the worst impacts of flooding in the town centre.

A network of stakeholders has developed two potential solutions.
The first is a compensation model where farmers are paid to be enrolled in a 'FARMER AS WATER MANAGER' programme.
In the case study, the compensation and other contractual elements are analysed.
A second type of measure called a 'SUPPLY MODEL' would entail authorities appointing flood relevant areas of farmland.
Next, it would be up to the farmers in the area to pick from a list of adaptation measures and apply for compensation from the authorities. Based on this, the authorities would offer the farmers to sign a contract with a given sum for compensation.

This second measure was not analysed in BASE as it requires further development. Aarhus University analysed costs regarding farmers as water managers based on a choice experiment survey among land owners in the Storåen catchment area.

Results indicate that the yearly costs of a farmer as water manager contract would be between 250 EUR/ha and 450 EUR/ha, depending on the elements of the contract. The least expensive contract would involve allowing farmers to negotiate collectively, thereby increasing their bargaining power, and a full compensation in the event of crop loss in addition to a yearly payment for letting the land be available for potential flooding negotiation.
The most expensive contract would entail individual negotiation with the municipality and no compensation in the event of crop loss; only the yearly service payment of making the land available for flooding.
Compared to the current average contribution margins (i.e. income minus variable costs) in the area, farmers appear to demand a relatively high payment for letting their fields flood. This may be due to it being a new and unknown type of measure. A total of 156 ha of farmland would need to be flooded in this particular case and be combined with a flood dam that would protect the town downstream in the case of a flood risk.

THE PEOPLE AND INSTITUTIONS INVOLVED

The idea of potentially using farmers as water managers was an element in the Aquarius international research project (2009-2011) *(www.aquarius.nsr.eu).* After this project was completed, the idea was taken up in a Danish climate change context by the Danish Knowledge Centre for Agriculture (today named SEGES), which established a network of stakeholders.

The involved institutions included experts from the Knowledge Centre for Agriculture/SEGES together with experts from Aarhus University, consultancies, agricultural organisations representing the farmers upstream from the town and farmers themselves

Photo: Anders Branth Pedersen

also participated. In addition public employees from Hostebro Municipality and other municipalities have been involved in developing the farmer as water manager measure.
The adaptation response involved governments at multiple levels.
The Municipal Council of Holstebro developed the local climate adaptation plan and risk management plan.

The Danish Government provided the impetus through the development and implementation of the National Adaptation Plan, which followed the adoption of the Flood Directive at the EU level.

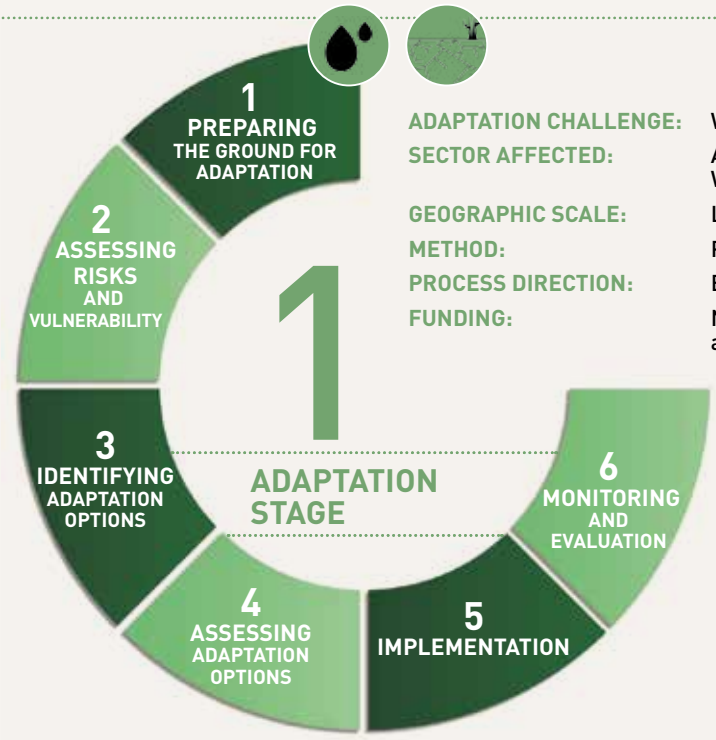
THE OUTCOME OF ACTION

Currently, the climate adaptation measure has only been proposed, not decided or implemented. A number of different barriers to implementing the measure have been identified in the case study. For example, most or all farmers in the relevant area must sign up, farmers fear EU cross-compliance demands if they sign up and farmers don't perceive high risks connected to climate change.

A Danish farm in Jutland

LOCATION South Moravia, Czech Republic

SUSTAINABLE GRAPEVINE PRODUCTION UNDER A CHANGING CLIMATE



ADAPTATION CHALLENGE:	Water Scarcity, Droughts
SECTOR AFFECTED:	Agriculture & Forest, Water Management
GEOGRAPHIC SCALE:	Local
METHOD:	Participatory
PROCESS DIRECTION:	Bottom-Up
FUNDING:	No extra public funding available for adaptation

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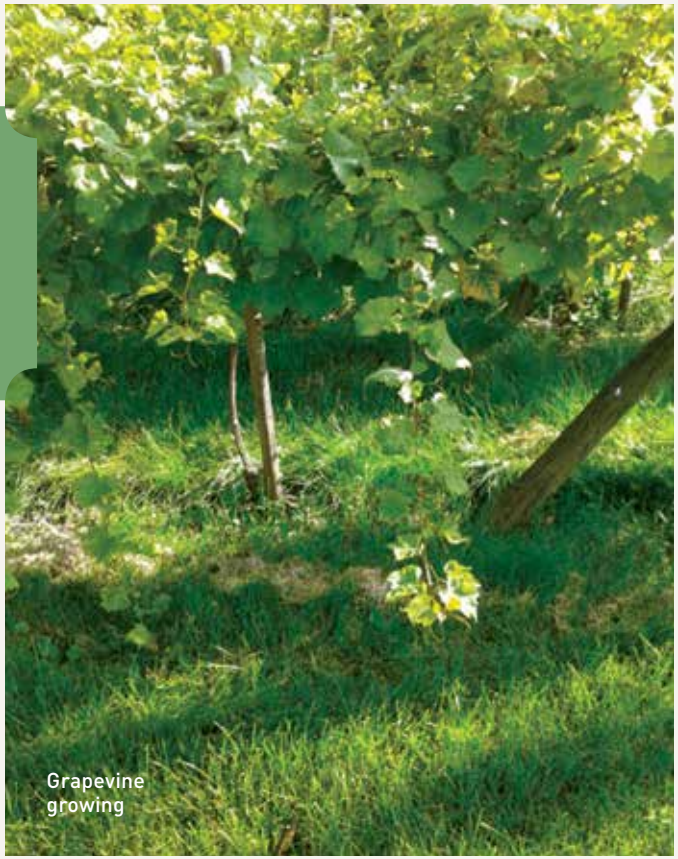
Photo: Eliška Krkoška Lorencová

Vineyards of
South Moravia



Grapevine growing

THE CLIMATE CHALLENGE

The South Moravian Region lies in the southeast of the Czech Republic, and it is home to the country's second largest city of Brno. Agricultural land covers 60% of the area of the region. Vine growing is a specialty in the region, which has more than 90% of the total area of vineyards in the country. Climate change projections indicate the growing probability of drought in the region. In 2011-2012, the region witnessed an extreme drought episode that was classified as one of the worst in the past 130 years. In the autumn of 2011, for example, the total precipitation represented only 10-30% of the long-term average for Moravia. Projections for 2050 indicate the occurrence of this type of drought event every 20 years.

THE ADAPTATION RESPONSE

In order to determine stakeholder perceptions and evaluation of adaptation options, a quantitative questionnaire was distributed among wine growers situated in South Moravian region in November 2014. The potential adaptation measures discussed can be categorised as changes in insurance policies such as risk transfer tools, land use practices like introducing no-tillage technologies and shifting agricultural activities, and water saving practices in the form of increasing water retention and improving the efficiency of irrigation systems.

THE PEOPLE AND INSTITUTIONS INVOLVED

Since the adaptation process in the Czech Republic is mostly top-down, the actual implementation of specific adaptation measures depends on the implementation of National Adaptation Strategy approved recently, in October 2015, which will be supported by the Adaptation Action Plan (to be formulated in 2016). Therefore, the adaptation activity on the regional and local level and specific sectors is currently limited. In the case of agriculture, specifically vine

growing, the non-existence of a cross-sectoral adaptation strategy has left adaptation actions rather fragmented, related mostly to the farm management regime and largely autonomous.However, problems related to climate change impacts, such as drought and water availability are gaining increasing political attention and support.
In July 2015, the Czech Government approved a document titled "Preparation for the implementation of measures to mitigate the negative effects of drought and water scarcity."
This policy document takes into account climate change projections and deals with the risk of drought, water availability and flood risk in the long-term perspective. The drought management plans should in the future become part of the legislation. In this phase, measures and procedures that need to be implemented are proposed, including:

- DROUGHT MONITORING and information (e.g. drought risk classification of CZ, drought and water availability monitoring)
- LEGISLATIVE CHANGES (e.g. drought management plan)
- ORGANISATIONAL measures (e.g. management of current reservoirs, irrigation efficiency)
- ECONOMIC measures (e.g. set up of water pricing tools)
- TECHNICAL measures (e.g. support to construction of new reservoirs)
- ENVIRONMENTAL measures (e.g. ecosystem-based measures)

Vineyards during the autumn time

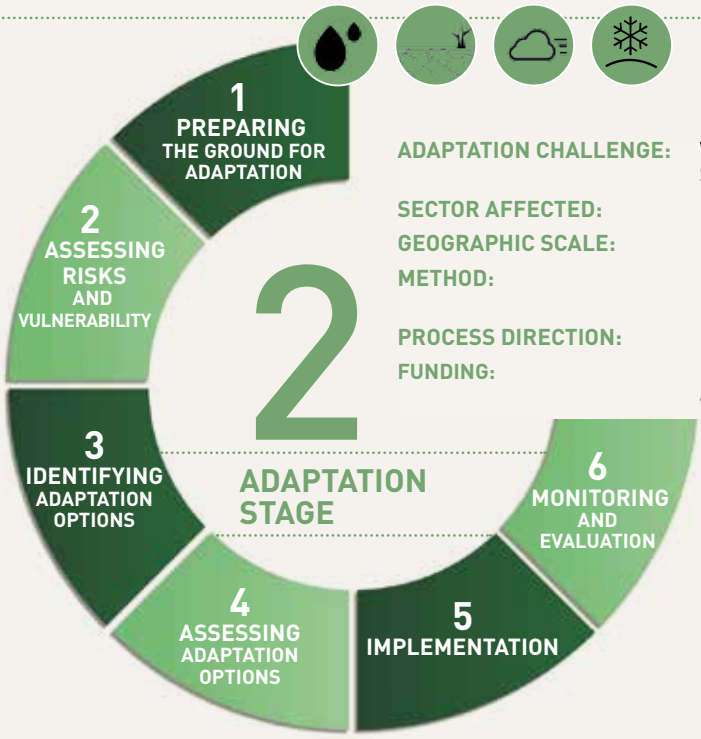
Photos: Eliška Krkoška Lorencová

THE OUTCOME OF ACTION

The outcome of the survey in South Moravian Region among vine growers shows that almost two thirds of the respondents agreed (48% agreed, 26% strongly agreed) that climate change is happening. Only 18% of farmers believed that climate change will have a positive impact on their vine production, 36% believed that climate change will affect them negatively, while 93% of respondents perceived measures to increase water retention as important. The majority of respondents also supported shifts in the timing of agricultural practices and pest management. In terms of barriers to climate change adaptation, 67% of respondents agreed that farming policy regulations may represent an obstacle to climate change adaptation. Furthermore, 73% of respondents perceived economic losses from smaller subsidies as an important barrier. A majority of farmers, 53%, agreed that a lack of information on methods of adaptation might also present a barrier to climate change adaptation. When asking specifically about obtaining information on climate change, on site experience and information from media were perceived as the main sources of information.

LOCATION Šumava, Czech Republic

EXPLORING SCENARIOS FOR A UNESCO BIOSPHERE RESERVE



ADAPTATION CHALLENGE:	Water Scarcity, Droughts, Storms, Ice & Snow
SECTOR AFFECTED:	Biodiversity
GEOGRAPHIC SCALE:	Local
METHOD:	Modelling, Participatory, Economic Analysis
PROCESS DIRECTION:	Bottom-Up
FUNDING:	No extra public funding available for adaptation

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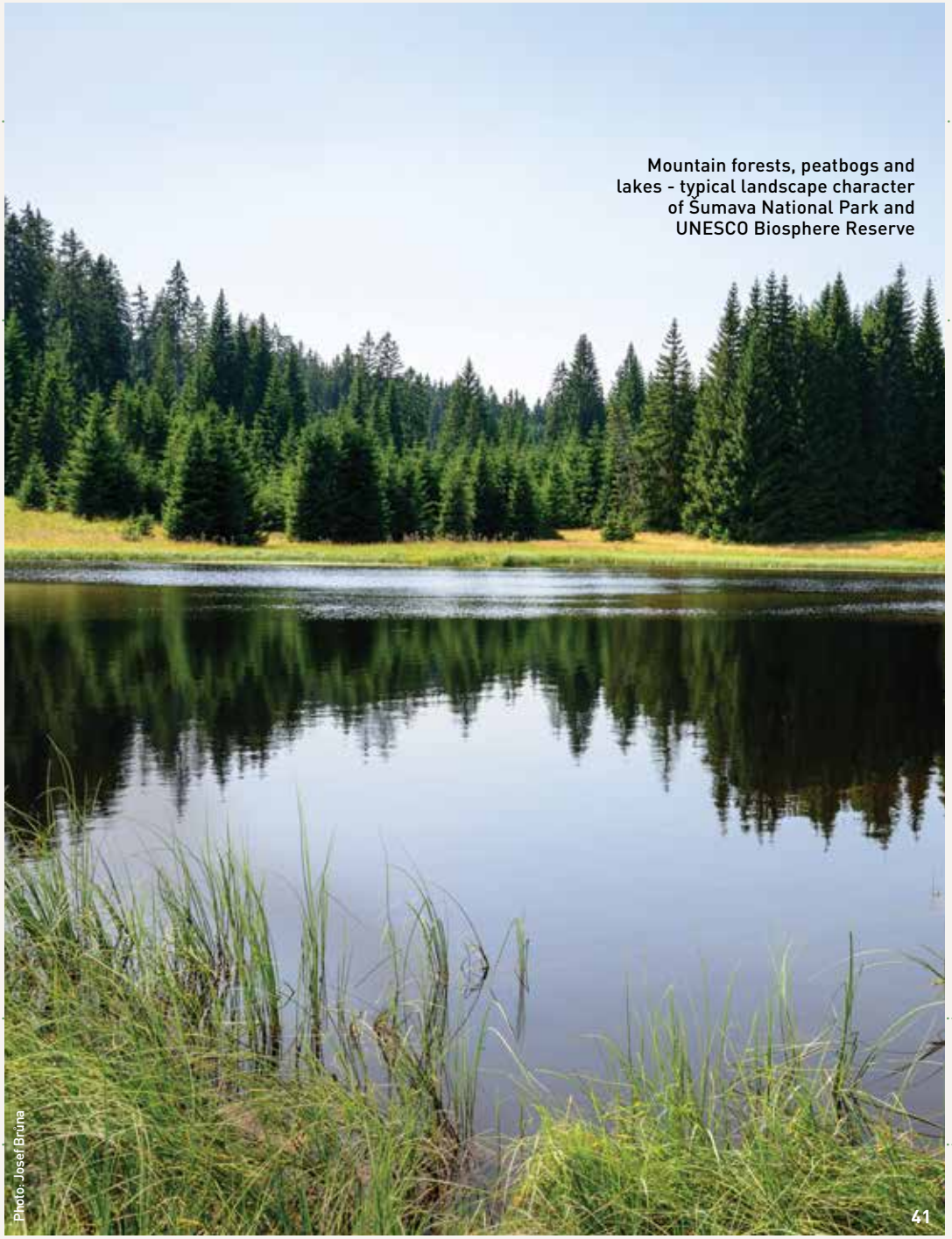


Mountain forests, peatbogs and lakes - typical landscape character of Šumava National Park and UNESCO Biosphere Reserve

Photo: Josef Bruna

Ecosystem-based adaptation measures present a promising adaptation approach in natural areas

THE CLIMATE CHALLENGE

The Šumava UNESCO Biosphere Reserve in the Czech Republic is one of the most extensive forest landscapes in Central Europe. The area is currently challenged by the growing occurrence of extreme weather events such as heavy rains and droughts. Higher winter temperatures are supposed to reduce snowpack and increase evaporation, leading to shifts in annual water outflows. On the other hand, both winter runoff and the subsequent risk of spring floods are expected to increase, since water storage in the form of snowpack will be reduced. Bark beetle infestations, intensive tourism and disputes regarding the optimal adaptation regime are also issues.

THE ADAPTATION RESPONSE

No adaptation measures have been implemented in the study area hitherto. The case study serves as the initial step in a potential future adaptation process, focused on analysing potential adaptation needs and proposing suitable ecosystem-based adaptation measures in collaboration

Photo: Eliška Krkoška Lorencová

with local stakeholders. The first participatory session of the scenario workshop, including key local stakeholders, took place in July 2014.
The aim was to elicit the most strongly perceived effects of climate change in the present and near future and to discuss potential measures, e.g. sustainable forest management, enhancing ecosystem connectivity and resilience. At the same time, the stakeholders created several storylines of potential future development in the area considering plausible demographic, economic and environmental changes. After eliciting this information, future adaptation scenarios were finalised to serve as the basis for ecosystem-service modelling with the InVEST suite of modelling tools.
A second session with stakeholders took place following the finalisation of the results of the Green Roof case study in November 2014 to disseminate the results and discuss their implications.

THE PEOPLE AND INSTITUTIONS INVOLVED

The stakeholders involved in this case study were those participating in the scenario workshops organised by CzechGlobe, who included local authorities and stakeholders from conservation, regional development, science and research, energy, water management, agriculture, and tourism and recreation.

Photo: David Večkář

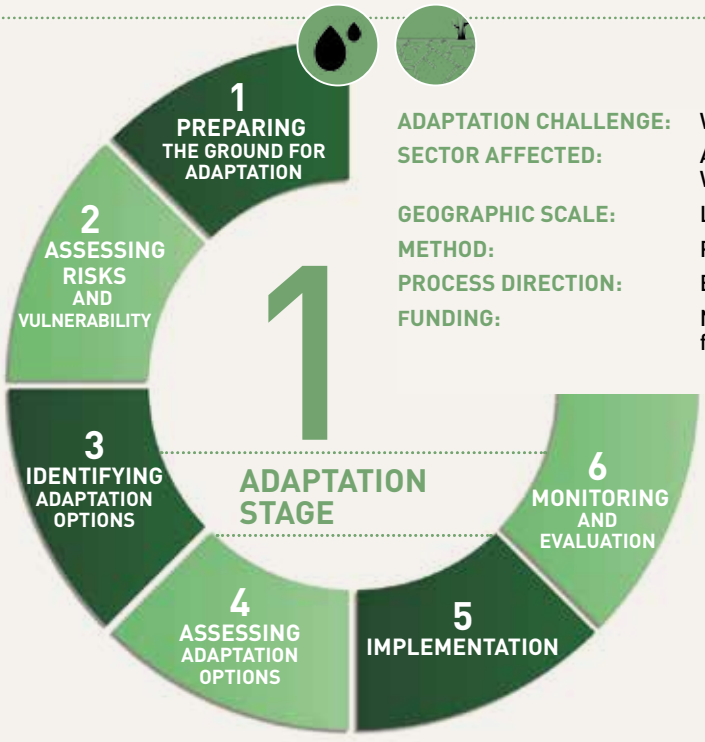
Participatory mapping of potential adaptation measures

THE OUTCOME OF ACTION

Since the adaptation process in Czech Republic is mostly top-down, the actual implementation of specific adaptation measures will depend on the implementation of National Adaptation Strategy, which was adopted in October 2015. The adaptation activity on the regional and local level has been very limited hitherto.

LOCATION Ústí, Czech Republic

REDUCING DROUGHT AND EXTREME WEATHER IMPACTS FOR HOP CULTIVATION



ADAPTATION CHALLENGE:	Water Scarcity, Droughts
SECTOR AFFECTED:	Agriculture & Forest, Water Management
GEOGRAPHIC SCALE:	Local
METHOD:	Participatory
PROCESS DIRECTION:	Bottom-Up
FUNDING:	No extra public funding available for adaptation

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Photo: Josef Ježek

The impact of extreme weather event

Drought on the hop garden

Photos: Josef Ježek

THE CLIMATE CHALLENGE

The Ústí region is located in Northwest Bohemia in the Czech Republic and shares a border with Germany. Ústí is one of the most densely populated regions in the country and has a strong historical tradition in agriculture as well as industry. More than 73% of the total hop cultivation area in the Czech Republic is situated in the Usti region alone. The Ústí region was selected as a case study because it is one of the driest areas in the Czech Republic and is therefore a highly relevant area for climate change impacts and adaptation measures. Based on the climate scenarios in the period 2051-2100, hop yield is expected to decline as much as 7-10% with potential changes in crop quality and an expected decline of 13-32% in α-acid content (an important component in the taste of beer). The concentration of hop cultivation in a comparatively small part of the Czech Republic makes it more vulnerable than if the crop were grown throughout the country and in more regions with different and less dry climates.

The Ústí region faces several climate change risks, particularly hydrometeorological extremes that result in storms, short periods of very warm weather in winter, spring frost, flooding and episodes of drought. An increase in the occurrence of pathogens, pests and weeds is also predicted as well as general shifts in farming conditions.

THE ADAPTATION RESPONSE

The adaptation measures explored in the case study reflect potential activities and measures to deal with drought and extreme weather events in the agricultural sector, particularly hop cultivation.

The adaptation measures, include soft measures (such as insurance policies), changes in agricultural management practices, water saving measures (increase of water retention, change in irrigation practice). The measures were selected as input data for the questionnaire that aims to explore the attitudes of local stakeholders towards these measures, and thus identify potential barriers of implementation.

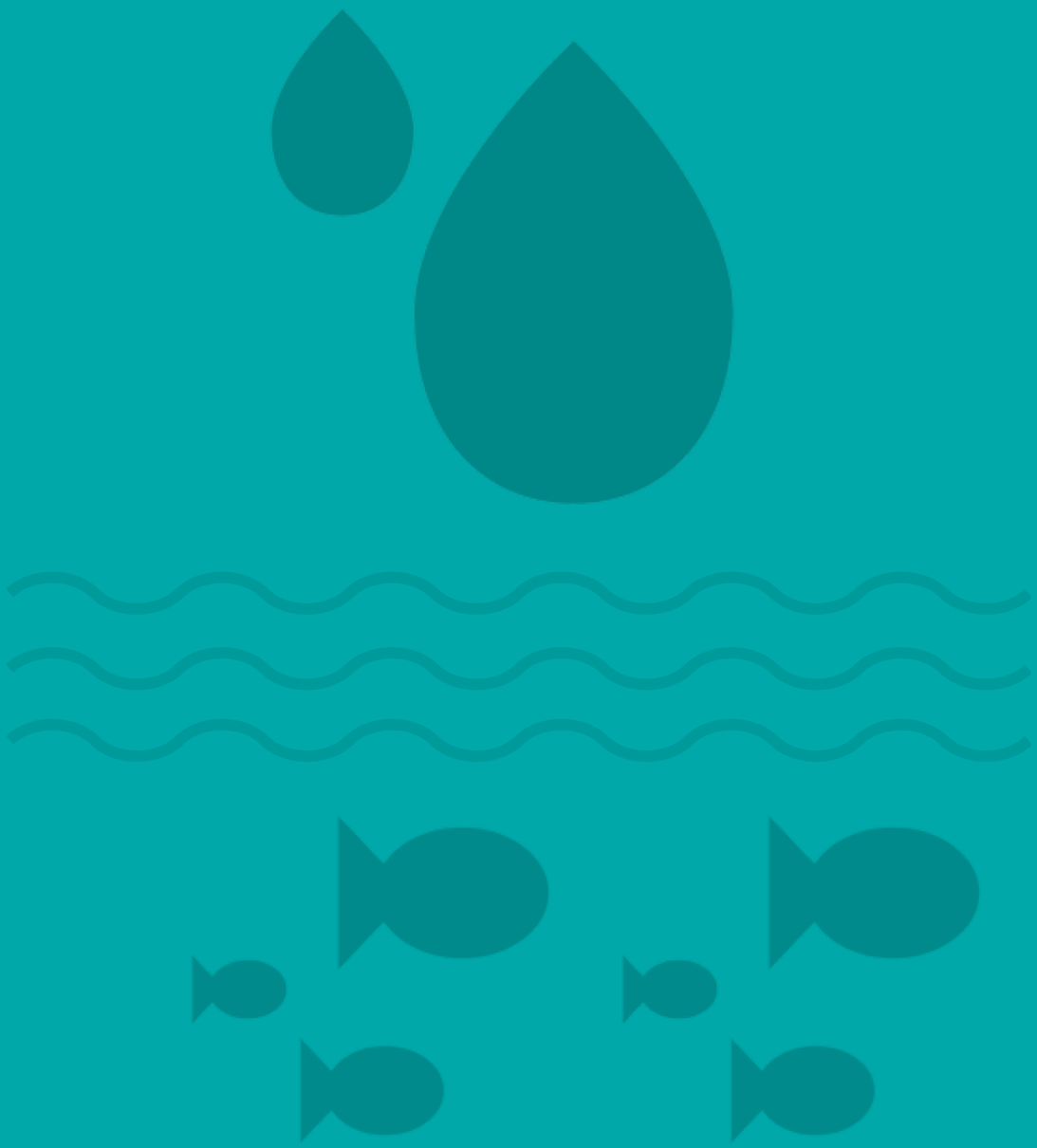
THE PEOPLE AND INSTITUTIONS INVOLVED

The case study had a broad and multi-stakeholder approach including both private and public institutions and local individuals. The local hop farmers were key participants and approximately half of the farmers in the region participated in the survey. Interviews were conducted along with the Hop Growers Union, a farmer union that represents the sector as a whole. Private companies in the region involved in the hop business also participated in interviews, as did the Hop Research Institute, which focuses specifically on the cultivation, harvest, and post-harvest treatment of hops. From the governance sector, water management authorities are engaged as the responsible entity for potential measures to be implemented in the water sector.

After storm: fallen construction of the hop garden

THE OUTCOME OF ACTION

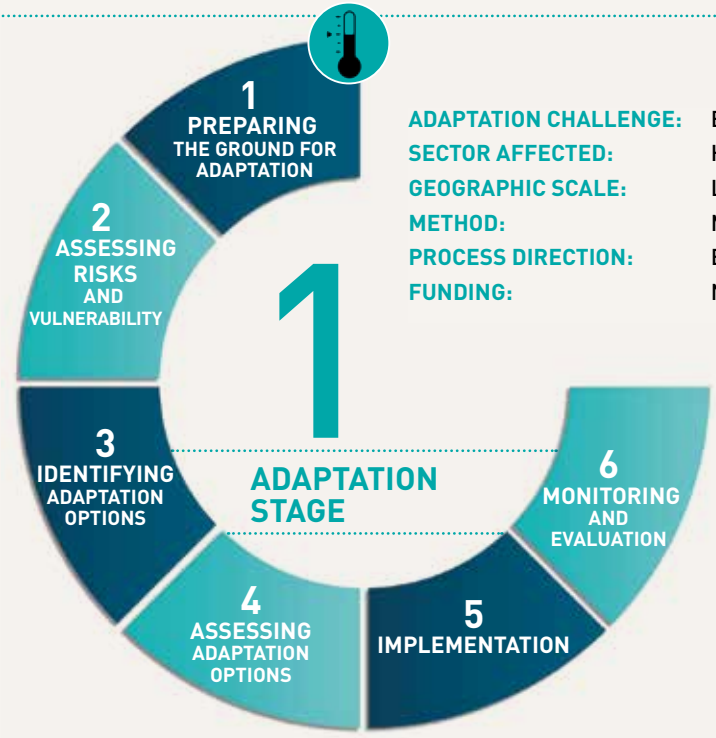
In March 2014, a quantitative questionnaire was distributed among hop growers situated mainly in the Ústí region. Fifty out of 119 hop growers in the Czech Republic responded. From the respondents, 88% were men and 12% were women. Regarding education, 88% had secondary and higher education and had an average of 24 years of farming experience. The majority, 52%, were cultivating hop gardens of up to 25 hectares. One of the topics in the questionnaire asked farmers whether they would be willing to implement particular adaptation measures in order to protect their land against potential negative climate impacts. Measures to increase water retention (such as infiltration zones, buffer strips, hedges and terracing) were highly preferred, and 80% of respondents perceived these measures as important. The majority of respondents also supported the proposed extension of insurance, shifting the timing and organisation of agricultural practices as well as crop diversification.



WATER RESOURCES & HEALTH

LOCATION Cornwall, United Kingdom

RAISING AWARENESS OF THE RISKS OF SKIN CANCER AND SUN EXPOSURE



ADAPTATION CHALLENGE:	Extreme Temperatures
SECTOR AFFECTED:	Health
GEOGRAPHIC SCALE:	Local
METHOD:	Modelling, Economic Analysis
PROCESS DIRECTION:	Bottom-Up, Top-Down
FUNDING:	No public funding

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Summer at a beach in Cornwall

Photo: istock.com/csfotoimages

Photo: istock.com/Silent_GOS

THE CLIMATE CHALLENGE

The Duchy of Cornwall in southwest England, UK has a maritime climate and is expected to be 2 to 3 °C warmer than now in both winter and summer by 2050-2080. Due to climate change, including increased temperatures and higher UV levels, it is likely that individual exposure to UV radiation will also increase, thus raising the risk of developing skin cancer.

The complex interactions between cloud cover, ozone depletion and higher UV levels are difficult to project but some studies tentatively suggested summer UV irradiance will increase in the southern parts of the UK to approximately 12 Wm-2 and/or a slight increase in current UV flux, up to 10% by the end of the century. The southwest of England currently experiences the highest incidence of both malignant and non-malignant melanoma in the UK.

THE ADAPTATION RESPONSE

The SunSmart programme involved a range of actions to increase awareness of the risks of skin cancer and sun exposure and is part of a series of public health campaigns to deliver messages regarding individual risk of UV exposure, particularly in the summer months. The SunSmart campaign included research, public communication, policy development and stakeholder interaction to try to reduce the levels of skin cancer. It ran from 2003 to 2011.

THE PEOPLE AND INSTITUTIONS INVOLVED

Cornwall Council was involved in the initial scoping of this work as part of a risk assessment for climate change impacts. The analysis was conducted by the University of Exeter Medical School.

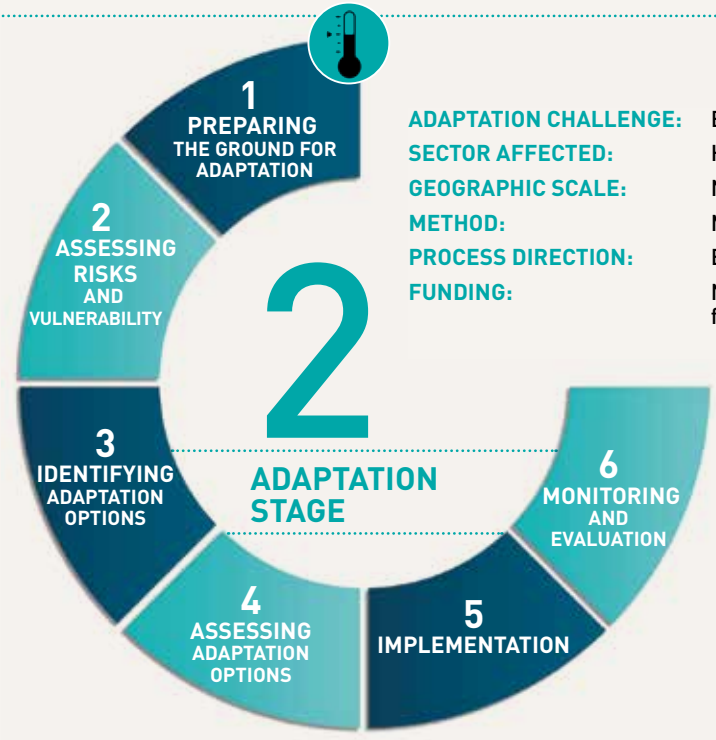
THE OUTCOME OF ACTION

One key difficulty for campaigns was evidencing the outcomes; good evidence exists on knowledge outcomes but whether knowledge results in behavioural change and leads to lower skin cancer risk is less obvious. Previous campaigns achieved significant awareness and behavioural outcomes (e.g. in Australia). Another limiting factor at present is knowledge of the precise climate-skin cancer link.

Photo: iistock.com/Andrey Prokhorov

LOCATION England, United Kingdom

IMPACT OF CHANGES IN TEMPERATURE, PRECIPITATION AND ULTRA VIOLET ON MENTAL HEALTH



ADAPTATION CHALLENGE:	Extreme Temperatures
SECTOR AFFECTED:	Health
GEOGRAPHIC SCALE:	National
METHOD:	Modelling, Economic Analysis
PROCESS DIRECTION:	Bottom-Up, Top-Down
FUNDING:	No funding yet available for adaptation

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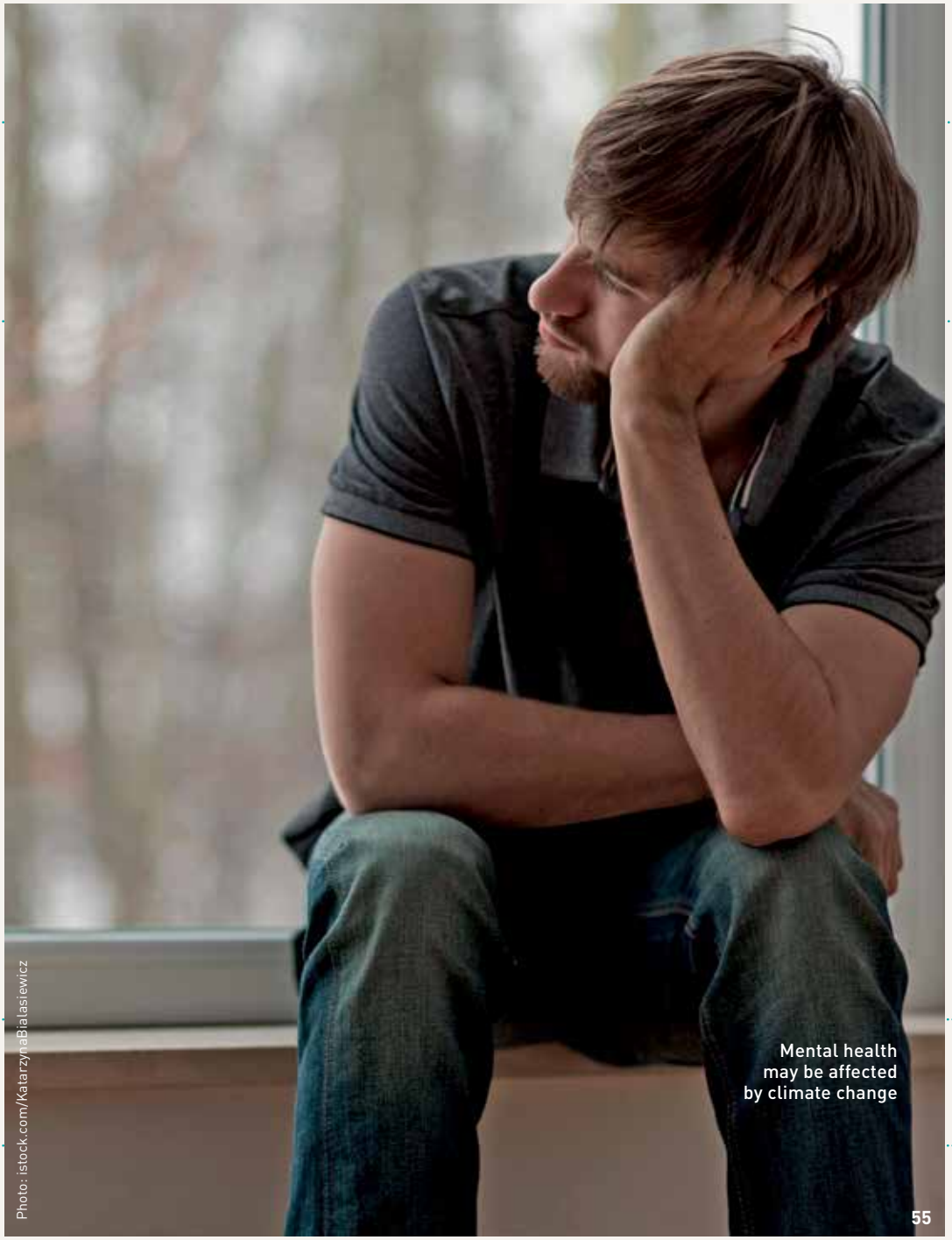


Photo: istock.com/KatarzynaBialasiewicz

Mental health may be affected by climate change

Photo: istock.com/Kwangmoozaa

THE CLIMATE CHALLENGE

In the UK, the key climate-related health threats are likely to include increases in temperature, changes in rainfall patterns and increased extreme weather frequency and intensity. Beyond the direct physical health impacts of these threats there is the challenge of understanding what the short- and long-term impacts of climate change might be for mental health disorders (e.g. depression and anxiety) and the associated economic costs.

THE ADAPTATION RESPONSE

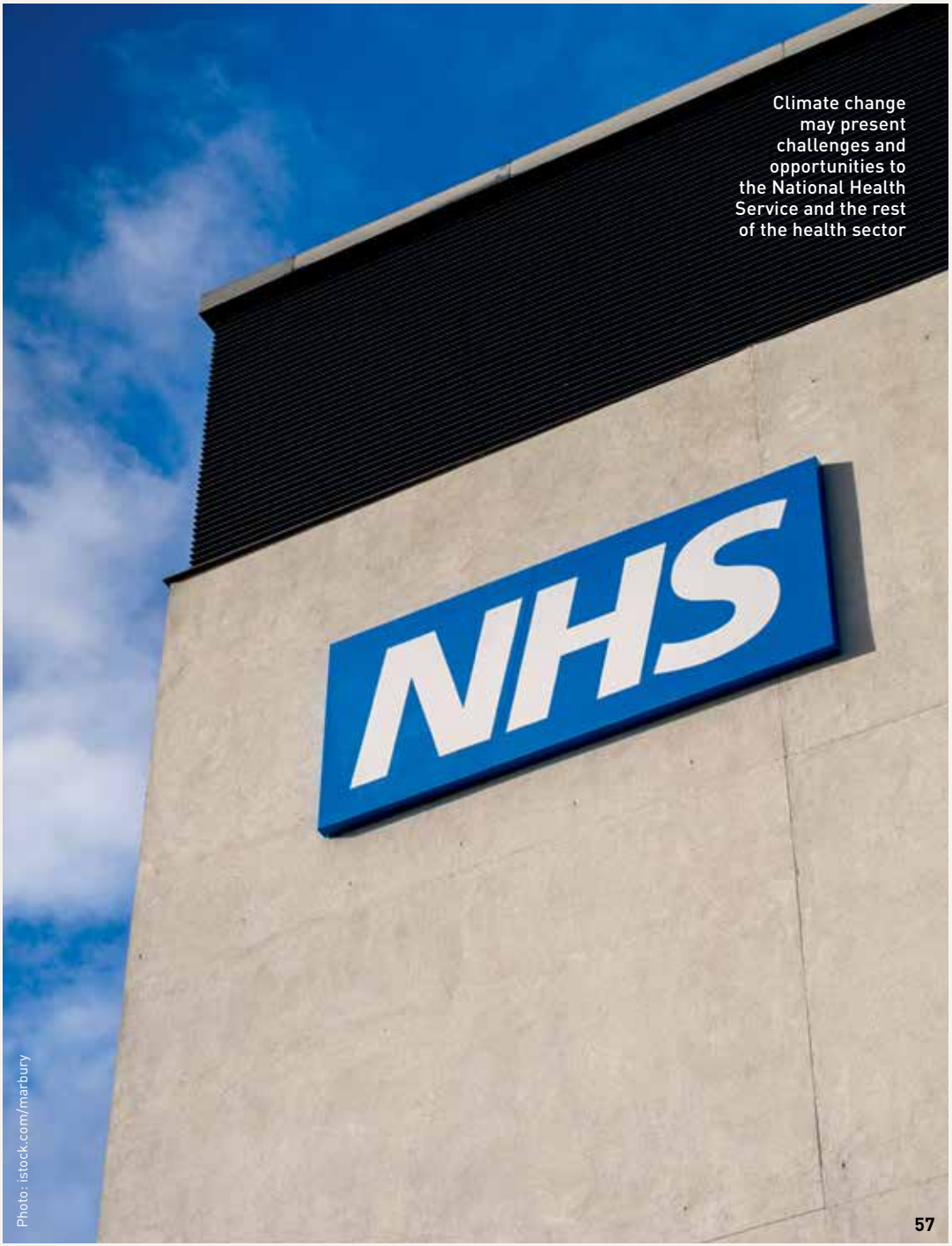
This case study examined the autonomous adaptation of the health care system in terms of drugs prescribed for depression.
It found that, overall, future anti-depressant prescriptions in the UK may fall as a consequence of positive associations with weather (i.e. not related to extreme weather events).

THE PEOPLE AND INSTITUTIONS INVOLVED

Stakeholders from Public Health England were consulted and informed of the case study outcome; namely, that the impact of climate related events on mental health was found to be positive.

THE OUTCOME OF ACTION

This case study suggested that planning in healthcare systems to address the mental health outcomes of climate change should consider the impacts of changes in average conditions as well as in extremes to ensure an efficient allocation of resources.

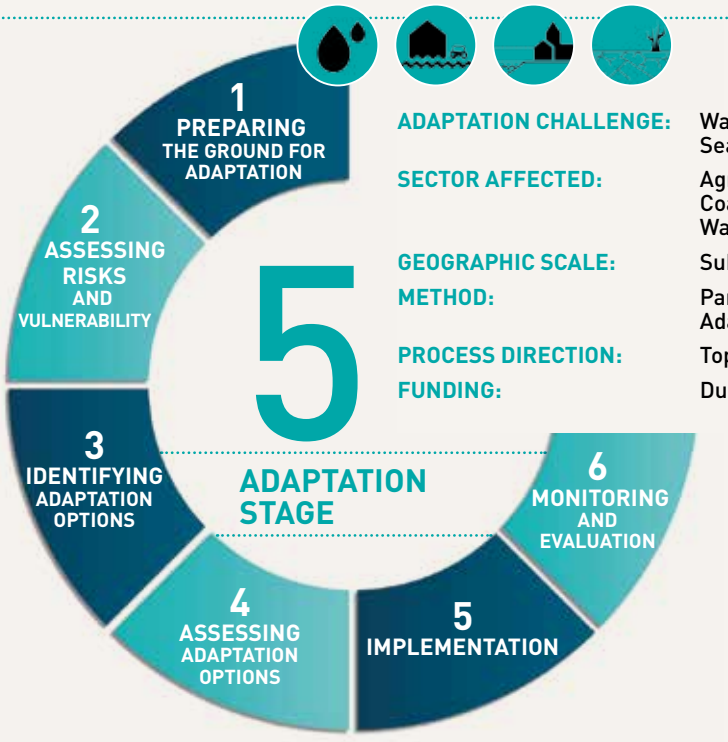


Climate change may present challenges and opportunities to the National Health Service and the rest of the health sector

Photo: istock.com/marbury

LOCATION IJsselmeer, the Netherlands

MOVING WITH CLIMATE CHANGE:
FLEXIBLE WATER LEVELS IN A LARGE MULTI-USE ARTIFICIAL LAKE



ADAPTATION CHALLENGE:	Water Scarcity, Flooding, Sea Level Rise, Droughts
SECTOR AFFECTED:	Agriculture & Forest, Coastal Areas, Water Management
GEOGRAPHIC SCALE:	Subnational region
METHOD:	Participatory, Adaptation Pathway
PROCESS DIRECTION:	Top-Down, Bottom-Up
FUNDING:	Dutch Delta Programme

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Photo: Ewout Staartjes

The historic city of Enkhuizen, of which the cultural heritage would be adversely affected by major water level changes

Locks and other Infrastructure near Enkhuizen

Photo: Ewout Staartjes

Photo: Mark Zandvoort

The ketelbrug between the IJsselmeer and Ketelmeer, adjusting the water level will affect headway for ships passing the bridge

THE CLIMATE CHALLENGE

The IJsselmeer is a large, artificial lake that supplies fresh water to large parts of the Netherlands and also serves to reduce flood risk due to its enclosure of the Wadden Sea. The IJsselmeer region has a number of small and large cities vulnerable to climate impacts such as flooding from sea level rise. A second concern is more frequent and longer-lasting summer dry spells. In case of droughts, the water from the IJsselmeer is essential to supply agriculture and industry in the north of the Netherlands with additional freshwater.

THE ADAPTATION RESPONSE

To maintain the current functions of the lake while simultaneously adapting to sea level rise and drought, the Deltaprogramme IJsselmeer proposed measures aimed at raising the lake's water level in sync with sea level rise to avoid flooding and ensuring the flexibility of the water level during summer droughts and secure freshwater for agriculture, nature and other purposes.

The program carried out a problem analysis based on the delta-scenarios in 2011. In 2012, they developed possible strategies and in 2013 they made more detailed studies of the preferred strategies, leading to a policy decision consisting of five solutions in 2014.

THE PEOPLE AND INSTITUTIONS INVOLVED

The Delta Programme was set up as a national programme, so by definition, all relevant local and regional governments were actively involved: the Ministry of Infrastructure and Environment, the water boards, the provinces and relevant municipalities. Knowledge institutes such as Deltares, PBL (the Dutch Planning Institute) and KNMI (the Dutch Meteorological Institute) assisted in developing delta scenarios and impact assessments. In the IJsselmeer sub-programme, local politicians and officials were involved in a regional collaboration body and in a smaller steering group, both of which formed the most important arena to discuss the progress of the programme. Ten important NGOs in the region were clustered into one representative stakeholder action group representing their individual stakes, including a sustainable fresh water supply, fishery, nature, harbours, tourism and agriculture.

THE OUTCOME OF ACTION

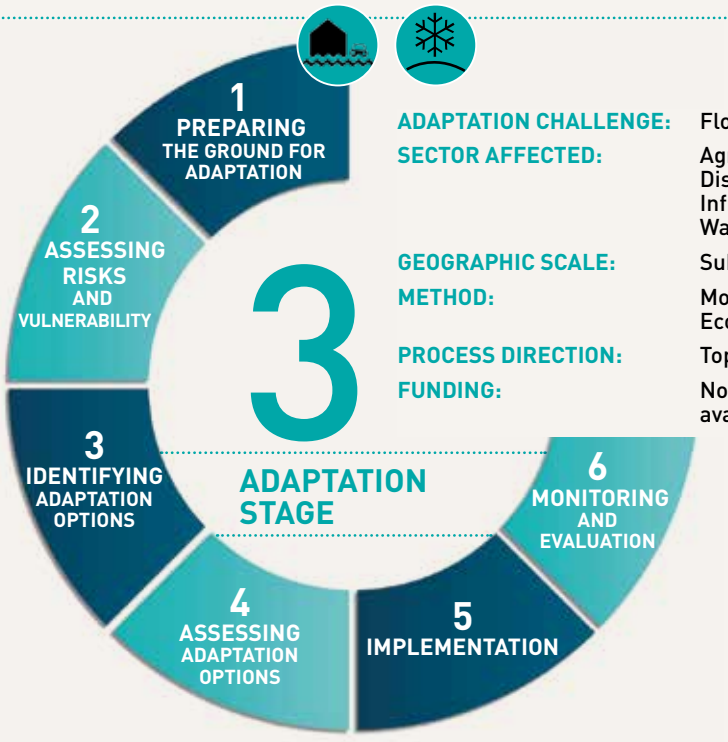
There is a combined package of five solutions implemented, based on a more flexible management regime of the water level. The first two are first and foremost related to flood risk; namely establishing draining and pumping capabilities to manage more flexible water levels as well as dikes. The latter three are focused on fresh water supply, such as facilitating adjustments of assets and spatial design along the lake's shores and reducing freshwater usage.

Photo: Ewout Staartjes

A village along the shore of the IJsselmeer, the waterfront may be affected if the water level changes

LOCATION Kalajoki, Finland

TOWARDS CLIMATE-PROOFING MANAGEMENT PLANS IN A HIGH FLOOD RISK RURAL RIVER BASIN



ADAPTATION CHALLENGE:	Flooding, Ice & Snow
SECTOR AFFECTED:	Agriculture & Forest, Disaster Risk Reduction, Infrastructure, Water Management
GEOGRAPHIC SCALE:	Subnational region
METHOD:	Modelling, Participatory, Economic Analysis
PROCESS DIRECTION:	Top-Down, Bottom-Up
FUNDING:	No extra public funding available for adaptation

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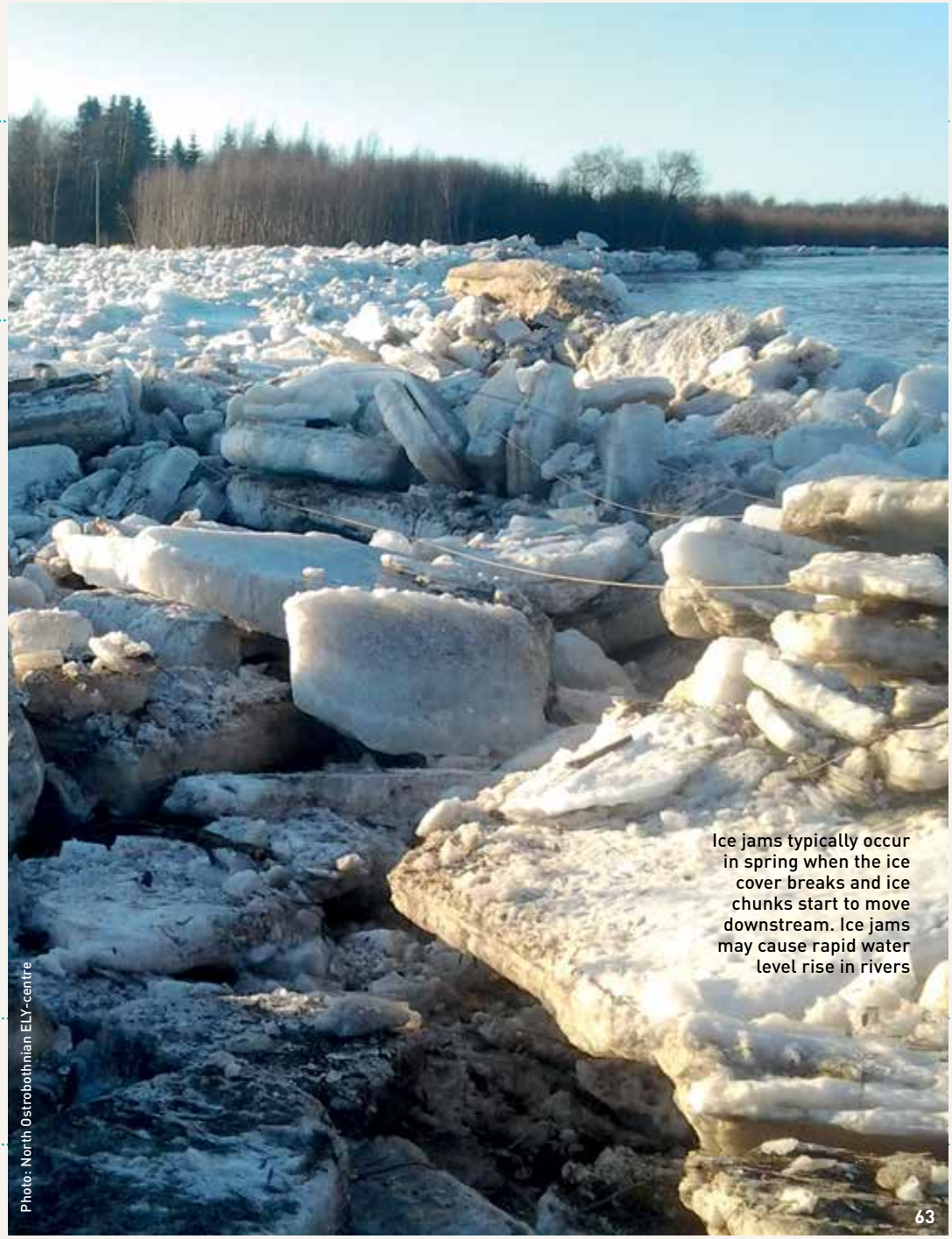


Ice jams typically occur in spring when the ice cover breaks and ice chunks start to move downstream. Ice jams may cause rapid water level rise in rivers

Photo: North Ostrobothnian ELY-centre

Flood in Kalajoki river basin in August 2012 caused significant crop damages

Photos: North Ostrobothnian ELY-centre

THE CLIMATE CHALLENGE

The Kalajoki river basin is a typical Finnish flood risk area that faces the interdependent challenges of managing flooding, caused by snowmelt, heavy rains and ice dams, as well as poor water status, originated mainly from agricultural activities in the river basin. Seasonal changes in discharges in Finland are the most distinct anticipated impacts of climate change. Changes in precipitation and temperature may also increase the nutrient load from catchments to water bodies in future climate. The Kalajoki is a mid-size lowland river that is surrounded mainly by rural land. Currently, 80% of the land in the basin is woodland and peatland and approximately 15% is used for agriculture. Some 48,000 people live in the basin.

The case study focused on the Ylivieska-Alavieska region within the Kalajoki basin. This area has been nominated nationally as a significant flood risk area. Presently, there are in total 620 inhabitants, 530 buildings and 3 vulnerable sites (e.g. hospital) in the area that are at risk in the case of an extreme flood. Most risk sites in the study area are protected by embankments, however, an extreme weather event that exceeds the capacity of the embankments multiplies the estimated damage costs to EUR 15-25 million. Flooding also increases nutrient loading and suspended solids to watersheds, especially during summer and autumn floods when the land is unfrozen.

THE ADAPTATION RESPONSE

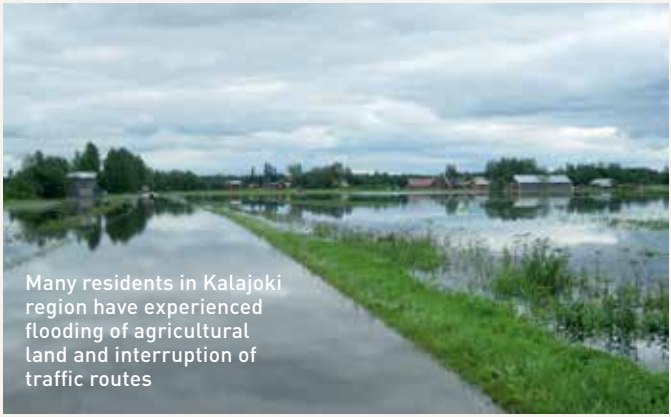
Climate adaptation in this water resources management case study includes an integrated river basin management plan and a flood risk management plan.

THE CASE STUDY LED TO THE IDENTIFICATION AND EVALUATION OF MEASURES, NAMELY:

- Land use planning (i.e. new construction is not allowed in flood risk sites; ensure the resiliency of existing infrastructures)
- Increasing citizens' awareness and preparedness
- Developing watershed regulation to cope with increased variation in hydrological conditions
- Maintenance and heightening of dikes
- Increasing the river basin's retention capacity
- Building permanent flood walls to protect single buildings

Some of the identified measures were left out from the plan due to their small benefits compared with costs and negative side-effects.
The measures based on water retention were found to be too uncertain or their capacity insufficient in case of an extreme flood event.

While other measures, such as using agricultural land as temporary water storage, still require further specification and studies of technical feasibility.
The case study also analysed the cost-effectiveness of the planned river basin management measures aiming at reducing the nutrient loading in different climate change and socio-economic scenarios using hydrological modelling and the KUTOVA-tool. These measures included optimised fertilisation, winter time vegetation, wetlands and buffer zones. The results show that the need for mitigation measures and their cost-effectiveness are influenced by both climatic factors and the level of agricultural adaptation.



Many residents in Kalajoki region have experienced flooding of agricultural land and interruption of traffic routes

Building a permanent flood wall to a single household nearby river channel

For ice jam prevention, a series of submerged weirs have been built in river channel in Ylivieska city centre

Photo: North Ostrobothnian ELY-centre

THE PEOPLE AND INSTITUTIONS INVOLVED

Water authority experts and officials/legislators from the local and national level played an important role in the initiation and development of the plans. Typically, official public hearings and events have not benefited from the participation of stakeholders and citizens. The implementation of measures will rely heavily on municipal politicians, water experts, private actors and officials. The stakeholders invited in two workshops included local municipalities, authorities from different sectors, local enterprises, farmers' unions, fishery collectives and youth organisations. Participatory multi-criteria analysis was used to compare the acceptability of different flood risk management strategies. A questionnaire on the issues of citizen flood awareness, risk perceptions, acceptability of and willingness to pay for flood risk management measures and flood protection was sent to 1,300 citizens in the flood risk area. The questionnaire served both the purpose of informing and consulting the citizens. The results indicate that 22% of the respondents (N=552) could consider implementing flood protection measures in the future and 17% could consider extending their home insurance to include flood damage compensation.

THE OUTCOME OF ACTION

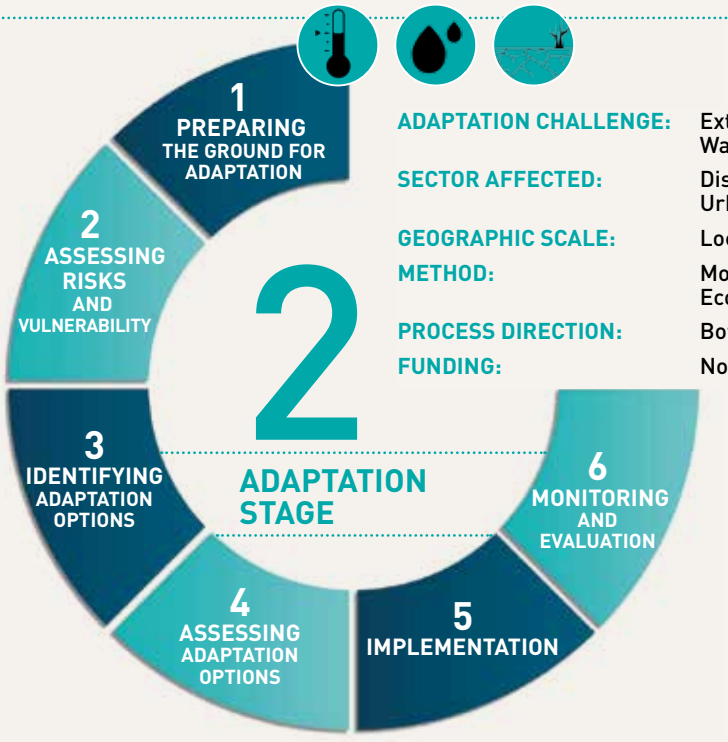
At the end of 2015, the Flood Risk Management Plan for the Kalajoki river basin (2016–2021) was approved by the Ministry of Agriculture and Forestry and the River Basin Management Plan for the Oulujoki-Iijoki River basin (2016-2021) was approved by the Finnish Government.

Photo: Laura Liuska, ProAgria

Discussing on the potential measures in a stakeholder workshop

LOCATION Madrid, Spain

COMBATING HEAT STRESS IMPACT IN A METROPOLITAN INLAND CITY



ADAPTATION CHALLENGE:	Extreme Temperatures, Water scarcity, Droughts
SECTOR AFFECTED:	Disaster Risk Reduction, Health, Urban
GEOGRAPHIC SCALE:	Local
METHOD:	Modelling, Participatory, Economic Analysis
PROCESS DIRECTION:	Bottom-Up
FUNDING:	No public funding

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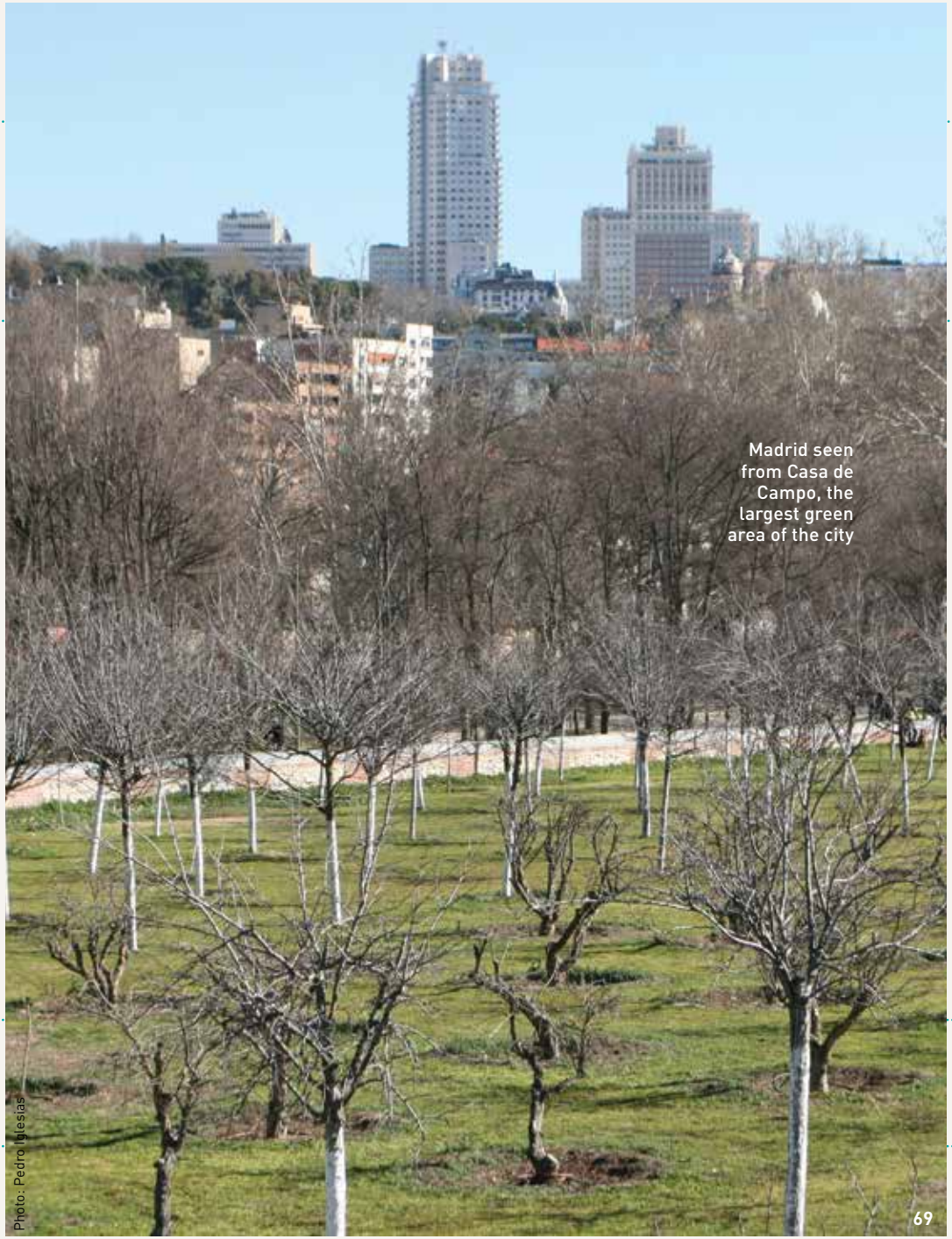
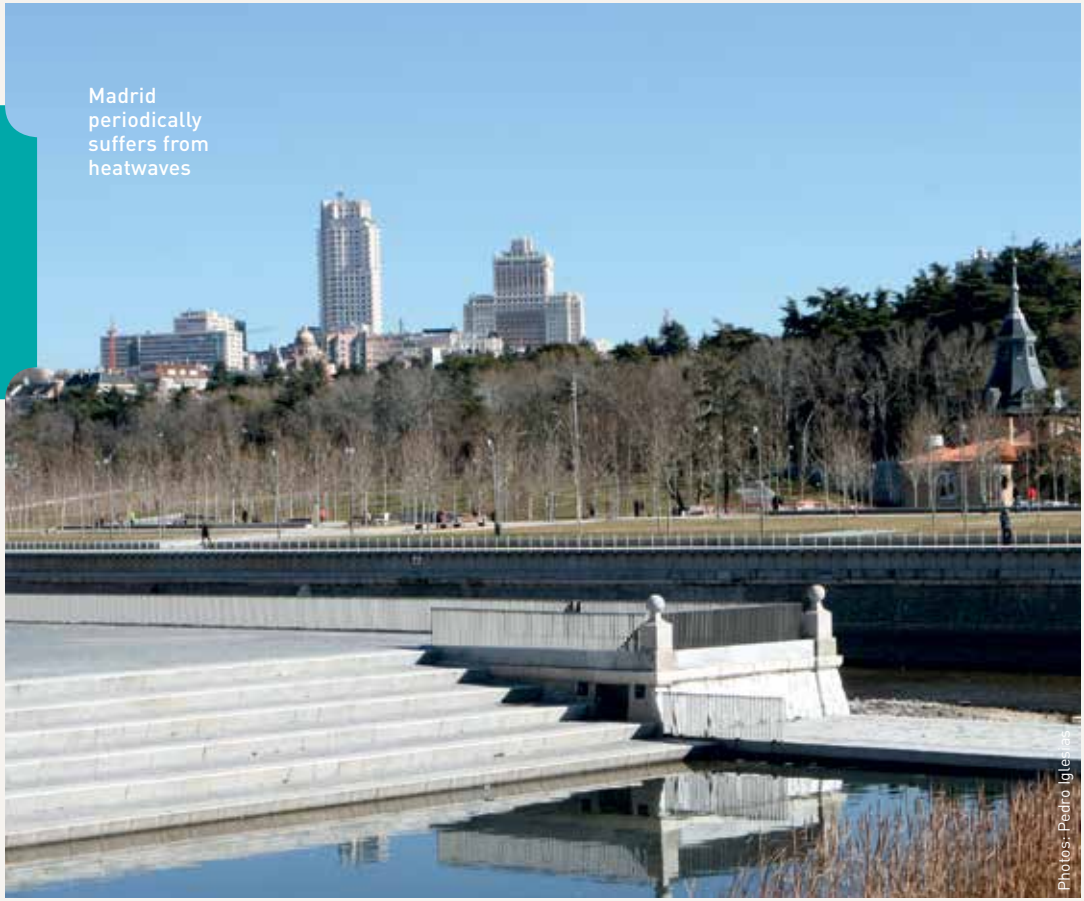


Madrid seen from Casa de Campo, the largest green area of the city

Photo: Pedro Iglesias



Madrid periodically suffers from heatwaves

Photos: Pedro Iglesias

THE CLIMATE CHALLENGE

The case study develops a methodological framework to assess costs and benefits of cross-sectoral adaptation strategies to reduce the impacts of heat waves in the area of Madrid, a city characterised by its large size and population and its drought-prone climate, with multiple vulnerabilities to climate change.

Climate in the Madrid region is characterised by having hot and dry summers and cool winters. Temperatures show a very sharp gradient following a similar pattern of rainfall. Typically temperatures are higher in cities than on the outskirts and this difference increases on stable periods for the presence of the anticyclone, giving rise to the phenomenon called urban heat island, an atmospheric situation that occurs in big cities and involves rapid increase in temperature from the outskirts to the city centre, where buildings and asphalt release the heat accumulated during the day.

The purpose of this case study was to develop a methodological framework

to assess the costs and benefits of selected adaptation strategies to reduce the impacts of heat waves in Madrid and study the cross-sectoral effects of those measures.

TO DO THIS THE CASE STUDY SETS FOUR OBJECTIVES:

- study direct and indirect impacts of heat waves in the city of Madrid;
- establish synergies and tradeoffs between sectors;
- robust understanding of system complexity;
- assess costs and benefits of some selected measures

THE ADAPTATION RESPONSE

A participatory process was used to obtain as much information as possible about the complexity of the urban system, responding to the stakeholder's feedbacks and main drivers.
The method, FUZZY COGNITIVE MAPPING, allows modelling the system in a semi-quantitative way and simulating policy options (running different policy scenarios).
This information that was used to feed the cost-benefit analysis (CBA) of a selection of adaptation measures was also obtained from the process of interviews to the stakeholders.

THE PEOPLE AND INSTITUTIONS INVOLVED

The stakeholder consultation focused on individuals either involved in decision-making or able to influence the decision-making process. Citizen participation was limited to NGOs and Farmer's Unions.

The city center has high building density

A first stakeholder meeting was organised to understand the socio-economic and political context of impacts and adaptation in the region of Madrid, including representatives of the Spanish Ministry of Health, Social Services and Equity, Madrid municipality, Madrid community (regional level), the Spanish Climate Change Office, the Health department of the government of Navarra, the water utility foundation Canal Isabel II, a union of farmers, the electricity company Iberdrola, experts from the Autonomous University of Barcelona and Technical University of Madrid.
A second round held personal interviews with stakeholders to get information to be used in the Fuzzy Cognitive Mapping to elicit information about the perceived impacts and adaptation options from different expertise angles in the city of Madrid.
It involved the participation of 24 stakeholders including researchers and public authorities (only a few of them participated in the first round).

A large recreational and cultural area recently implemented along the banks of the Manzanares River

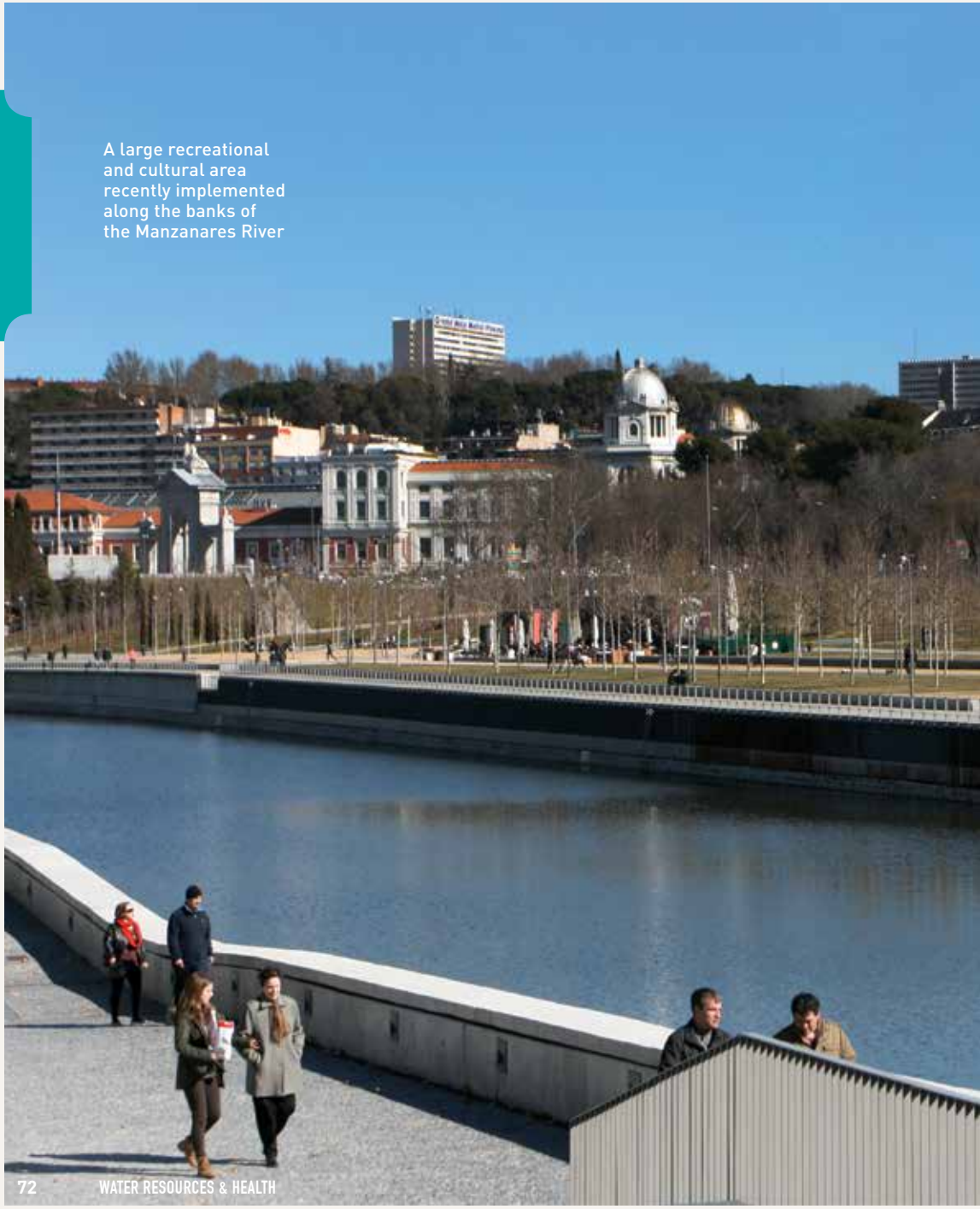
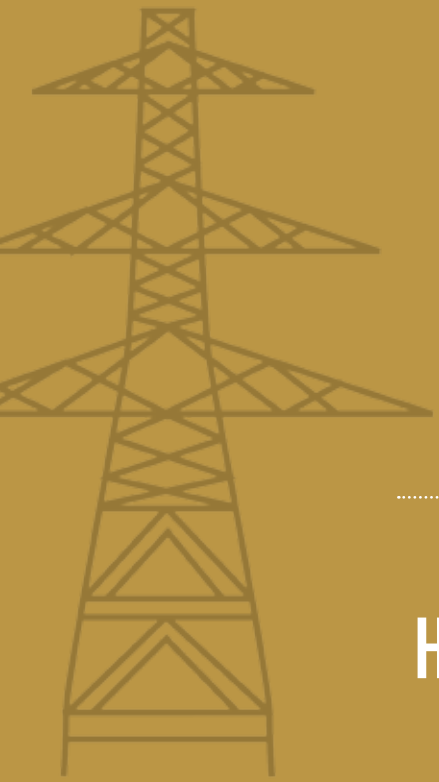


Photo: Pedro Iglesias

THE OUTCOME OF ACTION

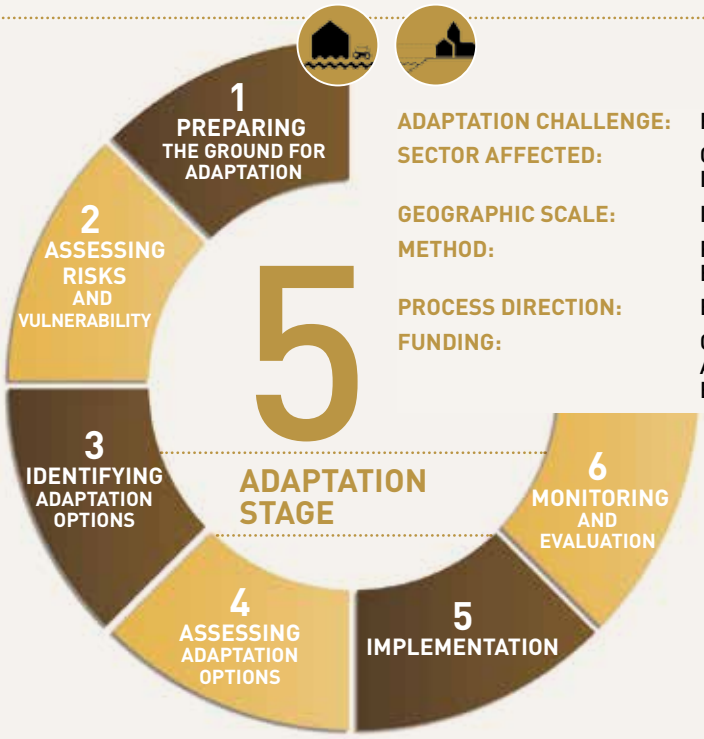
The participatory process helped understand the urban complexity and interconnections between climate change, health outcomes and adaptation measures. The case study collected data from the main sectors affected in a relatively short time through extensive interviews and was able to identify synergies and trade-offs. The case study conducted a cost-benefit analysis of a heat-health warning system and the potential benefits of future green infrastructure.



COASTAL ZONES/ HUMAN SETTLEMENTS & INFRASTRUCTURE

LOCATION Cascais, Portugal

MAKING A CITY CLIMATE CHANGE RESILIENT:
A PARTICIPATORY ADAPTATION PLANNING APPROACH



ADAPTATION CHALLENGE:	Flooding, Sea Level Rise
SECTOR AFFECTED:	Coastal Areas, Infrastructure, Urban
GEOGRAPHIC SCALE:	Local
METHOD:	Participatory, Economic Analysis
PROCESS DIRECTION:	Bottom-Up, Top-Down
FUNDING:	Cascais municipality, Águas de Cascais and Municipal Environmental Company

BASE RESEARCH PARTNER CONTACT
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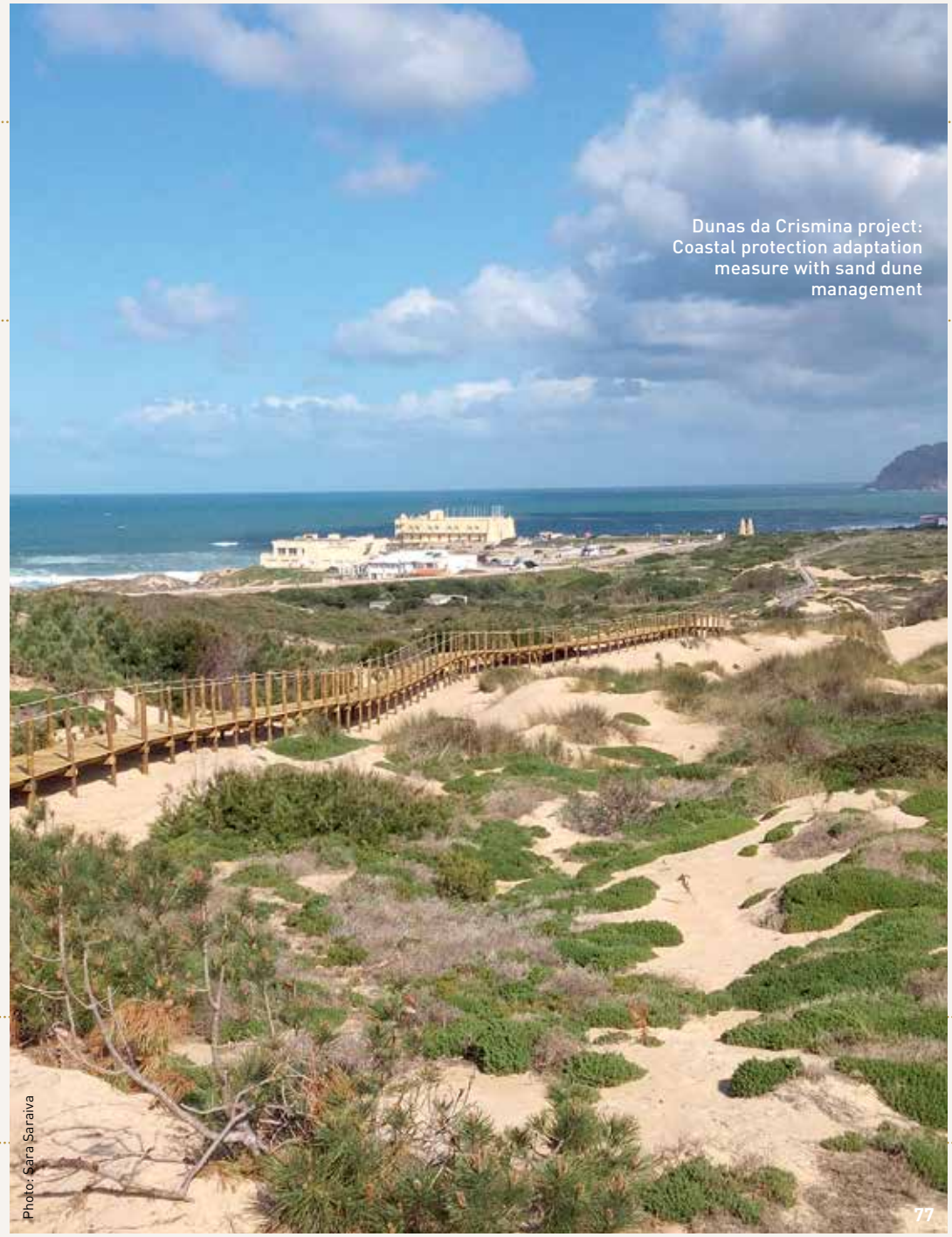


Dunas da Crismina project: Coastal protection adaptation measure with sand dune management

Photo: Sara Saraiva

BASE project meeting in Cascais (2013)

Photo: Cascais Ambiente

THE CLIMATE CHALLENGE

Cascais is a Portuguese city on the Atlantic coast and 30 km west of Lisbon. It is characterised by a mountainous terrain, and 33% of its total area belongs to Sintra-Cascais Natural Park.
It has historically faced both fires and floods as key climate vulnerabilities, however and due to clear signal from the Municipality and the local stakeholders, we have focused on the crucial risk of flash river flooding extreme events which are expected to increase both in frequency and intensity with climate change. Flash flooding is of especially high concern due to extensive urbanisation in areas with strong economic and touristic activity and concentrated physical capital, namely historical buildings.

In the period between 2000 and 2011, there was just over EUR 1 million in private claims to insurance companies, with 40% of that value occurring in a single event in 2008 in two parishes.
In the same year, annual private costs due to flooding in Cascais exceeded EUR 400,000.

Photo: Raquel Santos

Community organic food produce and market at Quinta do Pisão

THE ADAPTATION RESPONSE

In 2010 the municipality developed its Strategic Plan for Climate Change Adaptation (PECAC). In 2013-15 under the FP7 BASE project, a comprehensive participatory revision of the Plan was made together with the Agenda 21 of Cascais in order to reassess and reprioritise the implemented adaptation measures, taking into consideration all major stakeholders as well as all key affected sectors.

Cascais is moving towards the updated Climate Adaptation Action Plan in 2017.

THE MEASURES INCLUDED:

- green spaces and corridors in urban areas;
- beach and shoreface nourishment;
- the rehabilitation and restoration of rivers;
- the establishment and restoration of riparian buffers; and
- awareness campaigns for behavioural change.

THE PEOPLE AND INSTITUTIONS INVOLVED

Participatory methodologies have been extensively used in the Cascais adaptation strategy. BASE research work in Cascais began in October 2012 with preliminary/exploratory meetings with representatives from the municipality. Through nine participatory workshops, one population-wide inquiry (n=1885), one inquiry to the technical body of the municipality (n=99) and several field visits, PECAC 2.0 was completed in 2015. This makes Cascais BASE's case study icon in the use of participatory methodologies.

Cascais Bay

Photo: Cascais Ambiente

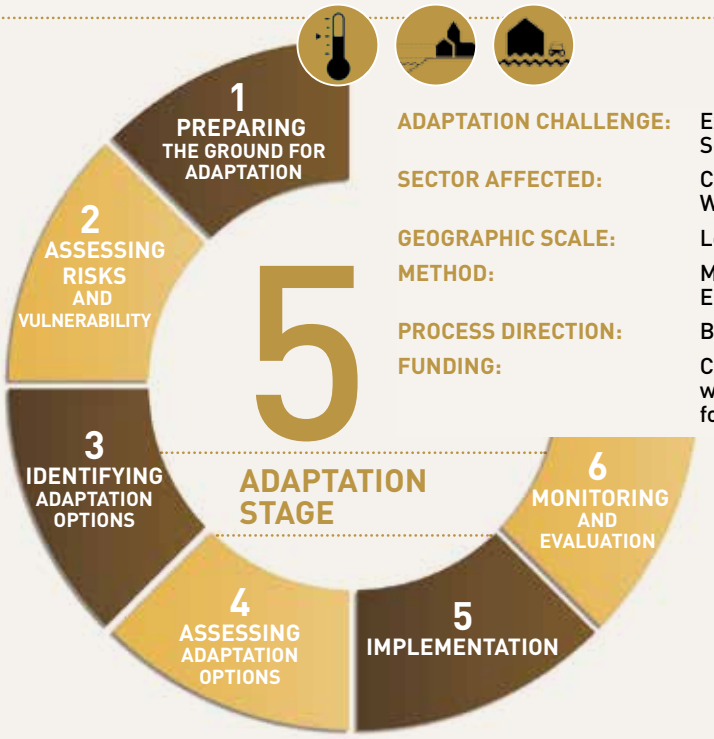
THE OUTCOME OF ACTION

In terms of concrete measures, green corridors, rainwater gardens and rainwater catchments are to be implemented. Green corridors and the re-naturing of Cascais streams is an ongoing adaptation measure that enjoys wide stakeholder consensus and yields positive externalities and socio-political support with relatively low levels of investment needed. Yet its effectiveness in flood risk reduction in this specific case study is still uncertain and a detailed action plan is needed for further analysis.

Green roofs, on the other hand, represent a high investment alternative that did not enjoy consensus among stakeholders and experts, and a life cycle analysis drawn from the literature review also discouraged their use when compared with alternatives such as rainwater gardens. Decentralised, privately owned rainwater catchment solutions turned out to be attractive to local decision-makers and represent a cost-efficient strategy, considering that right fiscal and economic incentives help to stimulate private investments in such solutions.

LOCATION Copenhagen, Denmark

URBAN RESILIENCE AND SUSTAINABLE TRANSITIONS:
A LARGE-SCALE COMPREHENSIVE ADAPTATION STRATEGY FOR A COASTAL CITY



ADAPTATION CHALLENGE: Extreme Temperatures, Sea Level Rise, Flooding

SECTOR AFFECTED: Coastal Areas, Water Management, Urban

GEOGRAPHIC SCALE: Local

METHOD: Modelling, Participatory, Economic Analysis

PROCESS DIRECTION: Bottom-Up

FUNDING: City of Copenhagen, with additional state funding for adaptation

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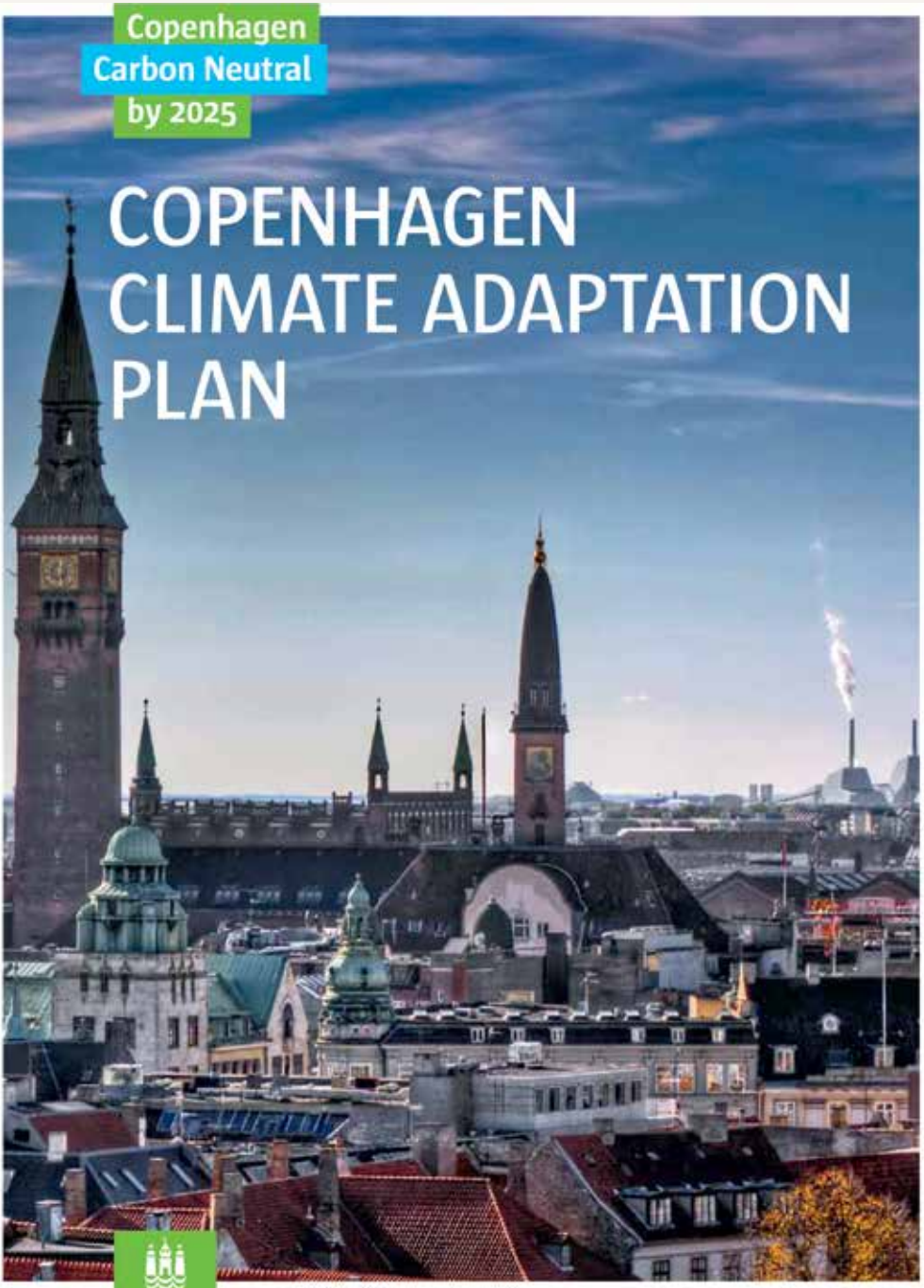


Photo: Municipality of Copenhagen

Scenario workshop

THE CLIMATE CHALLENGE

Copenhagen is the capital of Denmark and a regional metropolis located on flat coastal terrain with canals from the sea flowing though the old city centre. Due to its coastal location, the city is vulnerable to sea level rise and flooding. The city is furthermore vulnerable to flooding from increasing precipitation because of its built-up environment and a century-old underground wastewater system, which collects rainwater and is made to withstand only 10-year rains. In July and August 2011, cloudbursts left central parts of the city flooded and imposed insurance costs reaching EUR 0.8 billion. Additionally, being a densely populated and extensively built area, the city is facing urban heat islands resulting from increasing temperatures.

THE ADAPTATION RESPONSE

By 2011, the city produced a comprehensive Adaptation Plan, adding the Cloudburst Plan in 2012 and making specific allocations in the city budget for adaptation measures. The main adaptive actions comprise separating surface water (rainwater) from the underground wastewater system (making the city resilient up to 100 year rains); refitting urban spaces to create rainwater channels along selected roads that lead to lakes and/or the sea;

greening and 'blueing' public spaces for local retention of water; climate proofing buildings and transport infrastructure; and generally integrating adaptation concerns into other policy areas, including community regeneration. All impacts and potential adaptation responses related to cloudburst were analysed in cost-benefit analyses (CBA) by the municipality. Additionally, Danish Board of Technology (DBT) carried through an analysis of the additional and more intangible costs and benefits of climate change and adaptation, as limitations didn't allow the municipality to include all costs and benefits in the CBA.

THE PEOPLE AND INSTITUTIONS INVOLVED

The Adaptation and Cloudburst Plans and accompanying measures aim to establish the co-sharing of adaptation between citizens and other private actors. The majority of relevant information is available at the city homepage for free, and the Technical and Environmental Administration also offers assistance. The city administration has furthermore included HOFOR, the regional water company, and invited local business and clean tech companies to develop local solutions as a way to concomitantly stimulate green growth and make use of local business expertise. The planning concerning storm-surge adaptation is at an early stage, which allowed DBT, in cooperation with the municipality, to organise and carry through a number of participatory events and workshops, one based on a multi-criteria analysis exercise with stakeholders, concerning four main themes: new climatic data, financial and funding aspects of adaption, legal constraints and, finally, adaptation options for Copenhagen regarding storm-surge protection. This involved a wide array of stakeholders and citizen group representatives, in order to open up for the many different opinions and concerns, which are a reality with so many stakeholders involved in the future development of Copenhagen's port and sea-side.

Adaptation to storm-surges in Denmark: Who pays?

Photos: Jørgen Madsen

The Copenhagen harbour is clean enough to swim in and is the centre of many activities

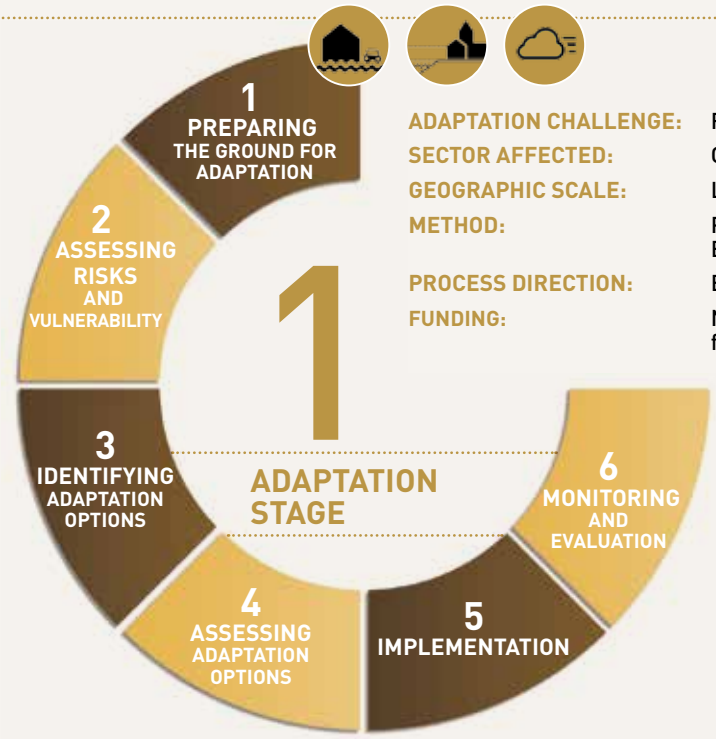
Photo: Polfoto

THE OUTCOME OF ACTION

In December 2015, a list of 300 adaptation actions to be implemented over the next 20 years was endorsed by the City Council.
Adaptation policies and actions have been integrated with city development goals based on strong green growth, liveable public and private spaces and a growing attention to the use of nature-based solutions, while also building adaptation knowledge and skills in the local administration.
In concrete initiatives, the city has established Sct Kjelds Neighbourhood as an experimental urban area where citizens, NGOs, small businesses, etc. are invited to develop local solutions, especially for rainwater retention.
These activities are supported by a local centre for climate and neighbourhood regeneration that facilitates local collaborations, and shares expertise, innovative knowledge and technical know-how.

LOCATION Dawlish, United Kingdom

CONSIDERING COASTAL ADAPTATION OPTIONS AND A VULNERABLE RAILWAY INFRASTRUCTURE



ADAPTATION CHALLENGE:	Flooding, Sea Level Rise, Storms
SECTOR AFFECTED:	Coastal Areas, Infrastructure
GEOGRAPHIC SCALE:	Local
METHOD:	Participatory, Economic Analysis
PROCESS DIRECTION:	Bottom-Up, Top-Down
FUNDING:	No funding yet available for adaptation

BASE RESEARCH PARTNER CONTACT
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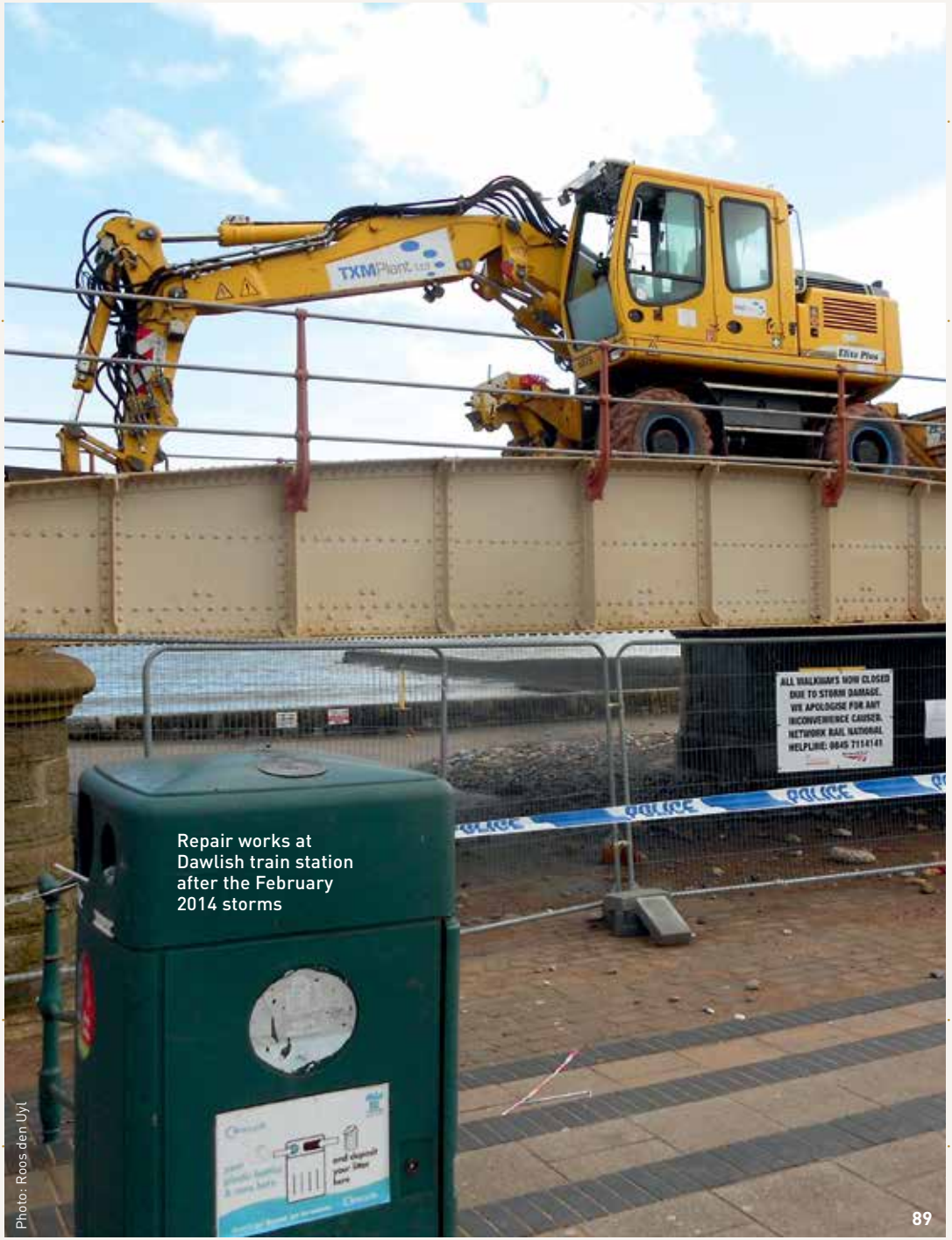


Repair works at Dawlish train station after the February 2014 storms

Photo: Roos den Uyl

A view on Dawlish train station after the February 2014 storm

Photos: Roos den Uyl

THE CLIMATE CHALLENGE

The South Devon Coast, located in the South West of England, United Kingdom, is an important urban, heritage and nature conservation area that includes important railway infrastructure connecting the South West of England to larger cities such as London.
Coastal erosion and sea and river flooding have placed pressure on the area.

The recent extreme storm events at the coast at Dawlish in February 2014, for example, damaged the seawall and the railway, increased flooding risks and disconnected the rail connection of the area to the rest of the country.
Due to the geo-morphological setting of rocky/cliff shores at the South Devon coast, options such as managed flood plains, dikes or managed realignment of the coast are limited.

THE ADAPTATION RESPONSE

Following the February 2014 storms the UK government asked Network Rail, the government-owned company responsible for maintaining the UK's railway infrastructure, to conduct a review on the variability of the railway line and to identify possible adaptation options. The vulnerability study included a financial review (cost-benefit assessment) which was not explicitly framed in the context of climate adaptation and future climate impacts were not factored into this analysis.

There is no clear policy framework driving adaptation in this setting. Beyond the business-as-usual model of merely maintaining the existing seawall defences and conducting rail repairs, proposed options included strengthening and heightening the seawall and stabilising the cliffs through wire netting and bolting as well as rerouting the railway inland away from the vulnerable Dawlish coast.
The UK's National Adaptation Programme (2013) includes a chapter on infrastructure resilience for vulnerable sites, but it does not explicitly indicate actions for local sites like the railway line along Dawlish.

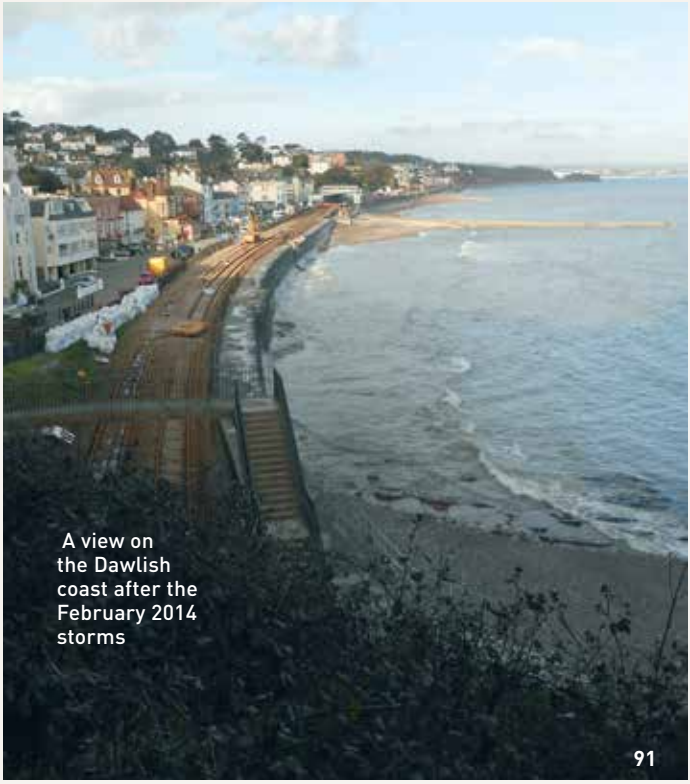
THE PEOPLE AND INSTITUTIONS INVOLVED

The local and regional public (Environment Agency and Teignbridge District Council) and semi-public bodies (Network Rail) are fragmented in addressing climate adaptation. The local authority, which is stated by DEFRA to be in charge of coastal erosion management, is limited in its resources and authority to lead climate change adaptation around this case, and it also does not own the railway or seawall.

The Environment Agency's task is to address erosion and flooding from the sea, but it also does not have a direct public accountability or ownership of the seawall and railway.
DEFRA and the national authorities meanwhile claim adaptation in this area is a matter of the local authorities.

THE OUTCOME OF ACTION

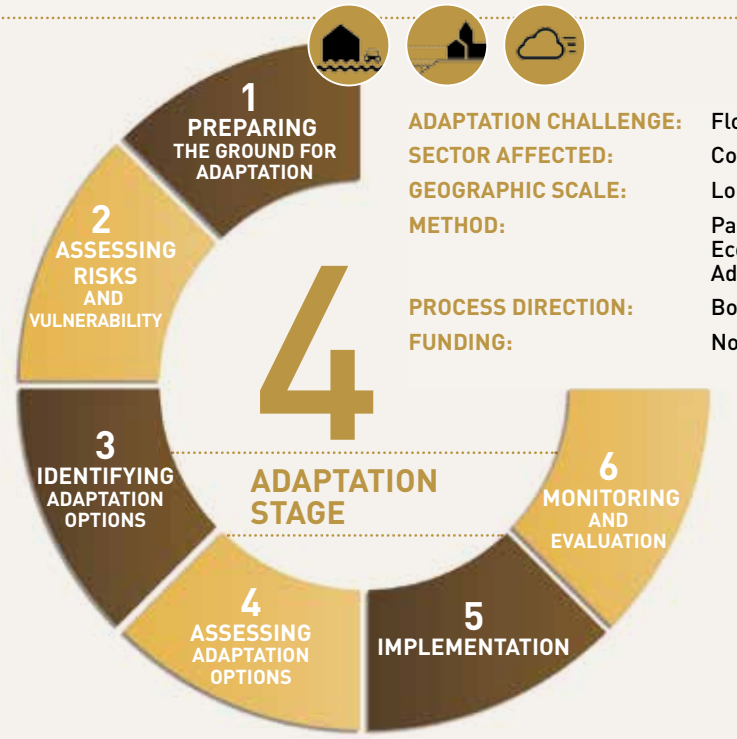
The Network Rail review to identify adaptation options was ongoing in 2016.



A view on the Dawlish coast after the February 2014 storms

LOCATION Ílhavo and Vagos, Portugal

COLLECTIVE DIALOGUE AND GUIDED STAKEHOLDER ENGAGEMENT: A PARTICIPATORY ACTION RESEARCH APPROACH



ADAPTATION CHALLENGE:	Flooding, Sea Level Rise, Storms
SECTOR AFFECTED:	Coastal Areas
GEOGRAPHIC SCALE:	Local
METHOD:	Participatory, Economic Analysis, Adaptation Pathway
PROCESS DIRECTION:	Bottom-Up
FUNDING:	No funding

BASE RESEARCH PARTNER CONTACT
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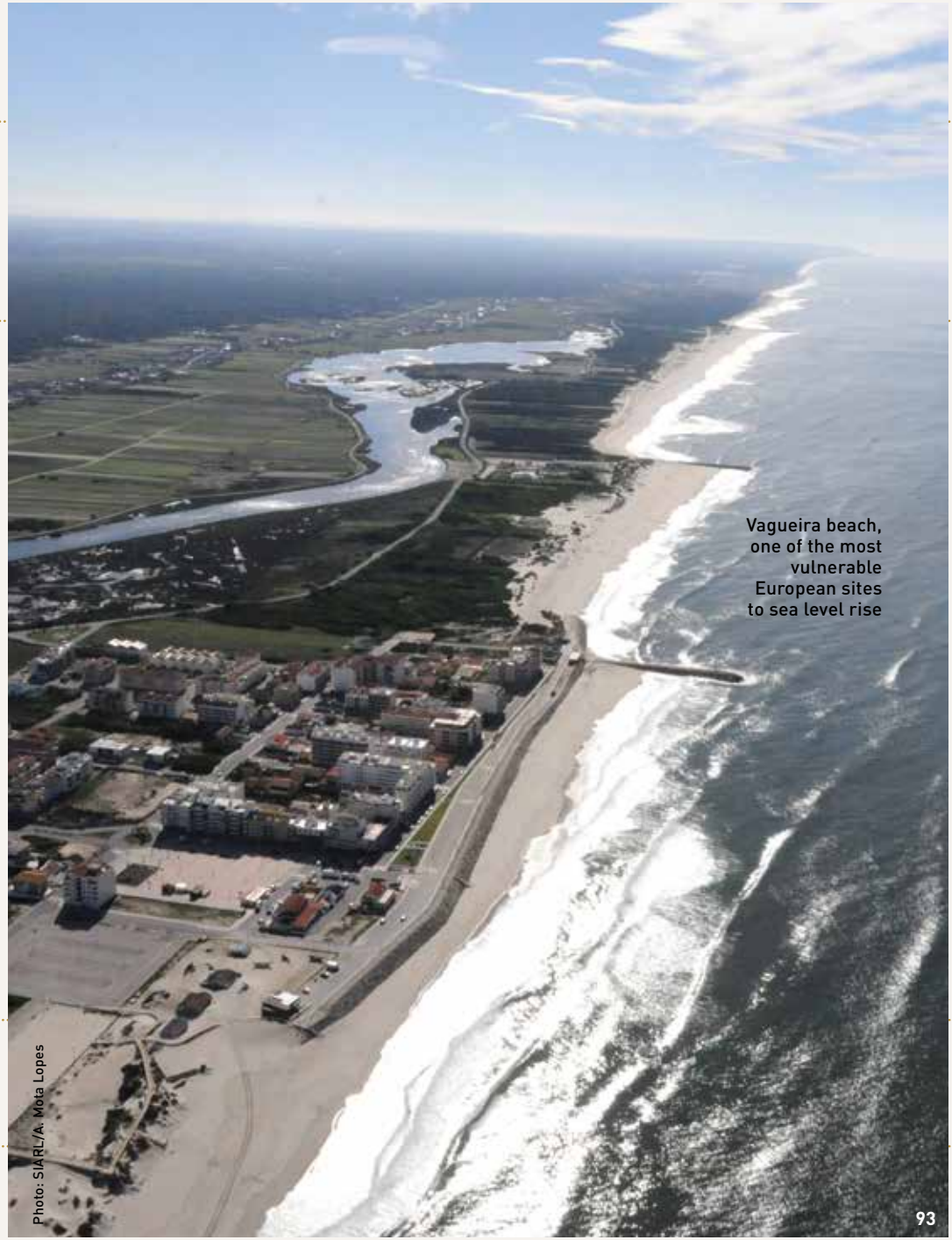


Vagueira beach, one of the most vulnerable European sites to sea level rise

Photo: SIARL/A. Mota Lopes

The SWAP (scenario workshop and adaptation pathways) workshops with local stakeholders

Photos: André Vizinho

THE CLIMATE CHALLENGE

The low-lying coastal stretch between Ílhavo and Vagos in Portugal is one of the most vulnerable coasts in Europe when it comes to storm surges and flood risks.
The territory is characterised by urban settlements with summer residencies, fishing communities and permanent residences. The study area is a dune barrier along a stretch of nearly 20 km that suffers from strong erosion, mainly due to a deficit of sediments associated with a decline in river sediments supply.
Sea level may rise up to a meter by 2100. Changes are expected in wave direction as well as an increase in wave height and extreme events such as storms, which are already frequent in winter.

Photo: SIARL/A. Mota Lopes

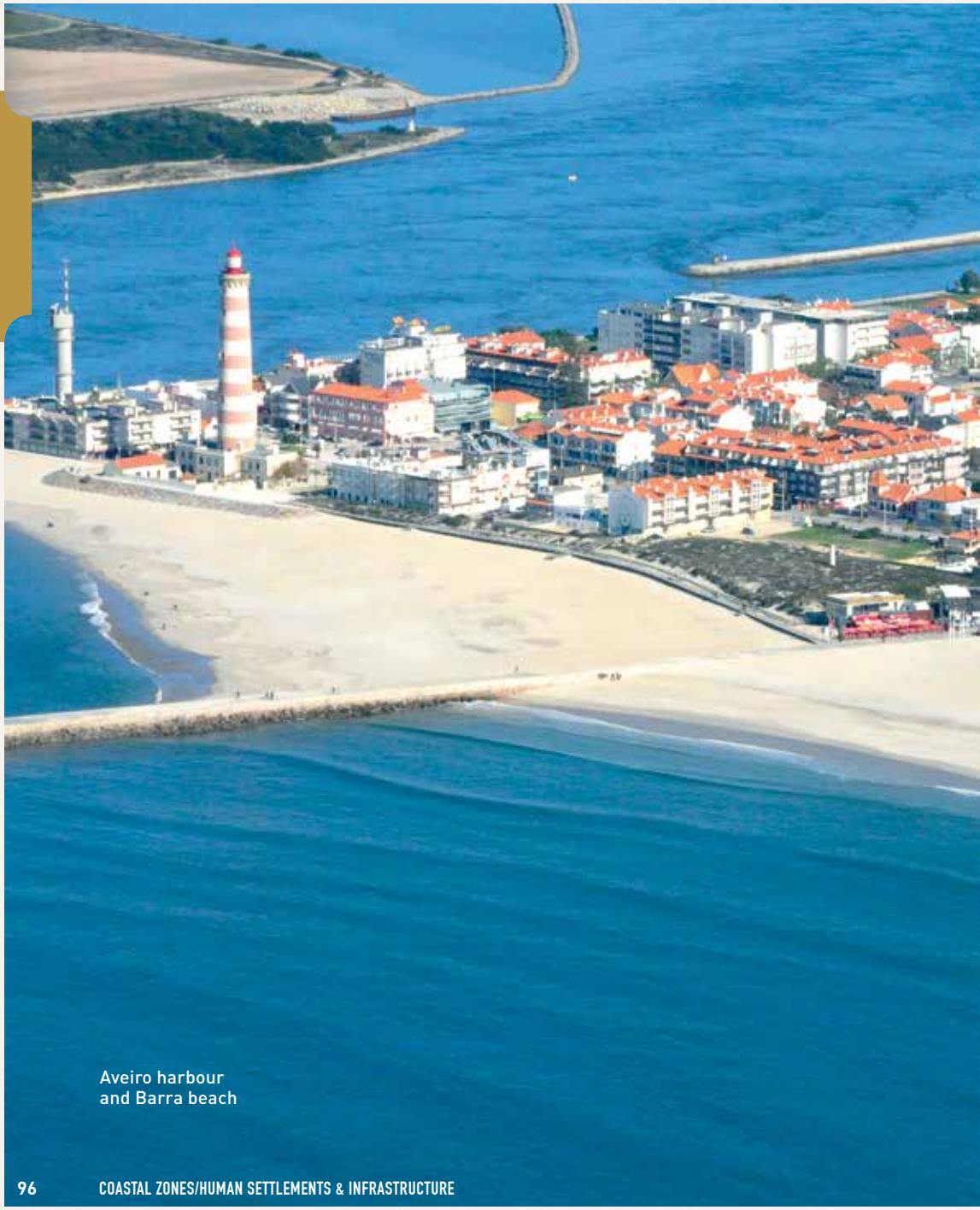
Costa Nova do Prado, between the Atlantic Ocean and the Ria of Aveiro

Photo: André Vizinho

Participants discuss and suggest adaptation solutions for the Ílhavo and Vagos coast, using materials and risk assessment maps

THE ADAPTATION RESPONSE

The study followed a participatory action research approach.
The scenario workshop method engaged different stakeholders and provided the context for the co-design of an action-plan.
The adaptation pathways and tipping-points method was used to produce dynamic adaptation pathways, which were then analysed through a cost-benefit analysis and presented to local stakeholders. To deal with technical uncertainty the participatory process included a multi-criteria analysis.
The first versions of the multi-criteria analysis and of the adaptation pathways were done by researchers, and then presented to participants for discussion and re-design.
The outputs of these exercises were presented to all in a final event.
The suggested adaptation options were sand nourishment operations, a sand dike and a submerged detached breakwater.



Aveiro harbour
and Barra beach

Photo: SIARL/A. Mota Lopes

THE PEOPLE AND INSTITUTIONS INVOLVED

Actors in the region have been largely disengaged, and there has been no concerted action plan for dealing with the coastal problem. Also, various administrative entities are responsible for coastal protection, yet institutional efforts and inter-institutional collaborations have been scarce. Local residents and business owners have claimed their participation in previous studies was never converted into real action, which made researchers especially committed to inclusiveness in this scheme.

THE OUTCOME OF ACTION

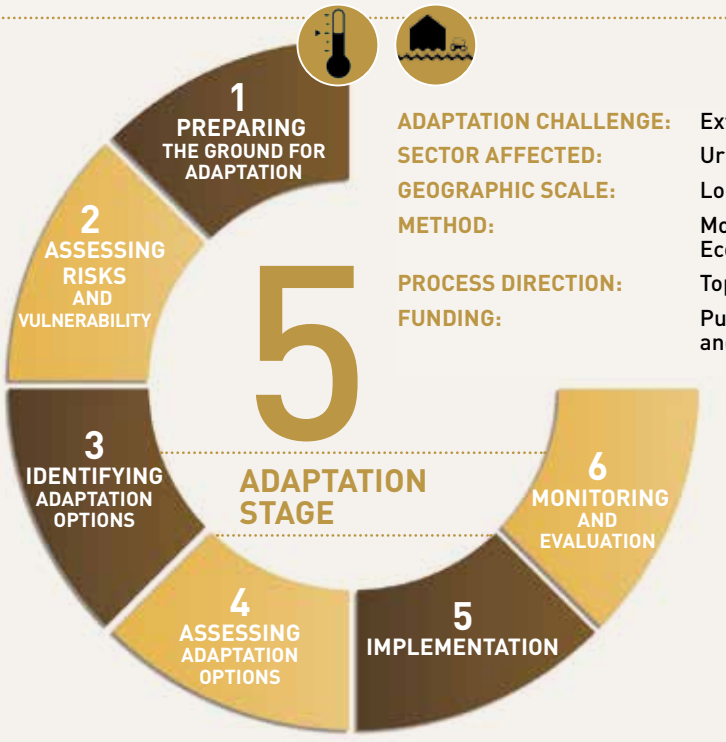
Dune construction and strengthening is the only measure so far being implemented through ongoing sand nourishment operations.

Measures such as the adaptation or improvement of dikes are also foreseen in the action plan and result from the action research intervention.

Local municipalities are currently developing studies for the possibility of building a submerged detached breakwater to protect the most vulnerable spots.

LOCATION Jena, Germany

MAINSTREAMING CLIMATE CHANGE ADAPTATION INTO URBAN PLANNING



ADAPTATION CHALLENGE:	Extreme Temperatures, Flooding
SECTOR AFFECTED:	Urban
GEOGRAPHIC SCALE:	Local
METHOD:	Modelling, Participatory, Economic Analysis
PROCESS DIRECTION:	Top-Down
FUNDING:	Public funding from municipal and federal level

BASE RESEARCH PARTNER CONTACT
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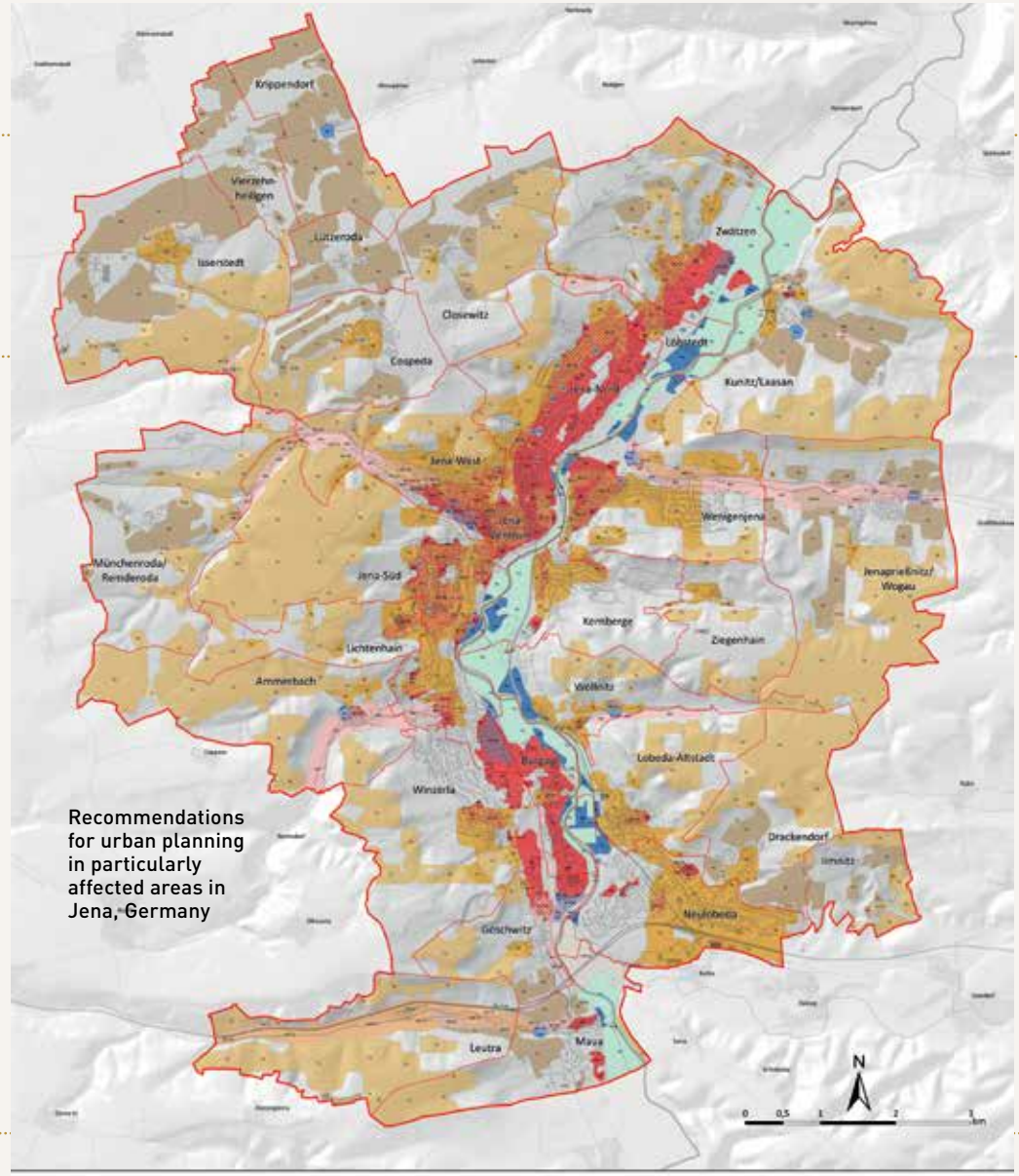


Recommendations for urban planning in particularly affected areas in Jena, Germany

Heat stress

- Limit heat stress, increase amenity value
- Limit heat stress, improve risk consciousness & public health care
- Preserve ventilation corridors

Drought

- Monitor green infrastructure, Optimise irrigation & use adapted species for new plantings
- Intensify monitoring of green infrastructure & use adapted species for new plantings
- Monitor green infrastructure, Optimise irrigation & use adapted species for new plantings

Flooding

- Improve water retention
- Monitor land use, improve flood risk management & extensification (long-term)
- Improve water retention, update flood damage assessments & enhance operational readiness for emergency
- Maintain and upgrade infrastructure & enhance operational readiness for emergency

Erosion

- Reduce soil erosion

Figure: Adapted from JenKAS, City of Jena (2013, Fig. 9.1, p. 72, legend translated)

THE CLIMATE CHALLENGE

Jena is a city of around 100,000 inhabitants. Due to its specific geographic location, Jena is exposed to various climate change-related risks, especially heat stress, fluvial and pluvial floods. The city centre is surrounded by steep shell limestone slopes, which operate as a thermal storage system, making Jena one of the warmest places in Central Germany. By the end of the century, the average maximum temperature in summer is projected to increase by 3 K to 6 K. Aside from heat stress, heavy or long-lasting precipitation events repeatedly caused major floods

Flooded football stadium in Jena, June 2013

and sewer overflows. Numerous tributaries flow from the surrounding plateau, and discharge into the floodplain of the Saale River which crosses the city centre and industrial areas. Peak discharges are expected to further increase, especially for flood events occurring with a medium to high probability.

Photo: Oliver Gebhardt

THE ADAPTATION RESPONSE

Past extreme weather events as well as foreseen future climate conditions have triggered the development of the JENA CLIMATE CHANGE ADAPTATION STRATEGY (Jenaer Klimaanpassungsstrategie, or JenKAS), which was adopted by the City Council in May 2013.
Its backbone is a handbook on climate sensitive urban planning, which includes information on current and future local climate conditions, legal aspects, exemplary economic assessments of adaptation options and selected best practice examples.
Projected impacts are described in detail at the urban district level and related risks are visualised using a traffic-light labelling system.

The handbook is complemented by a local decision support system (DSS) for stakeholders and decision-makers, providing tailor-made recommendations on suitable adaptation measures for specific policy fields and neighbourhoods.
The implementation of JenKAS focuses on mainstreaming climate change adaptation into urban planning.

One way of considering future climate change in today's urban planning decision-making is to use adaptation checks when drafting plans for construction projects.
Assisted by scientists from the Helmholtz Centre for Environmental Research - UFZ probabilistic multi-criteria analyses were conducted for three major construction sites to facilitate the development of climate-proof detailed designs.
It was intended that these drafts should not only suit current and future climate conditions, but also take into account other factors (e.g. financial and aesthetic aspects) affecting decision-making in urban planning.

For the redevelopment of the central urban square Inselplatz from a 3 ha inner-city grey field into a new university campus the following adaptation measures were considered: variation of number, species and crown characteristics of the trees to be planted, colour schemes of the pavements, use of artificial water elements and roof greening. Following these adaptation checks, rankings of the alternative drafts were calculated disclosing their suitability from an adaptation perspective.

Flooded industrial park in Jena-Göschwitz, June 2013

Photo: Oliver Gebhardt

THE PEOPLE AND INSTITUTIONS INVOLVED

The development of JenKAS was stimulated by a pilot study on climatic risks and management options commissioned and financed by the Department of Urban Development & City Planning (DUDCP) in 2009. The subsequent drafting of JenKAS was then steered by the DUDCP, carried out mainly by a local research partner and financially supported by the Federal Government of Germany.

It involved experts from all relevant departments of the city administration and agencies of the federal state of Thuringia, interested stakeholder groups (e.g. associations, cooperatives), scientists and local politicians.

Since then, stakeholders, primarily representatives of public bodies, were engaged in the implementation of JenKAS. Many of these are actively involved in research and consultancy projects, which aim to validate and expand the existing knowledge base on climate change impacts, as well as effective responses.

Planning processes are characterised by various types of formal and informal stakeholder participation. This gives urban planners the opportunity to facilitate an exchange of ideas on potential adaptation options, which have been identified beforehand using the JenKAS handbook and/or DSS. Experience shows that on these occasions

Photo: Google Earth Pro Landsat image (modified), Oliver Gebhardt

Aerial view of the Inselplatz and visualisations of the proposed adaptation measures

stakeholders also propose innovative adaptation solutions themselves. The results of these consultations are considered in the drafting process to make Jena more climate-resilient.

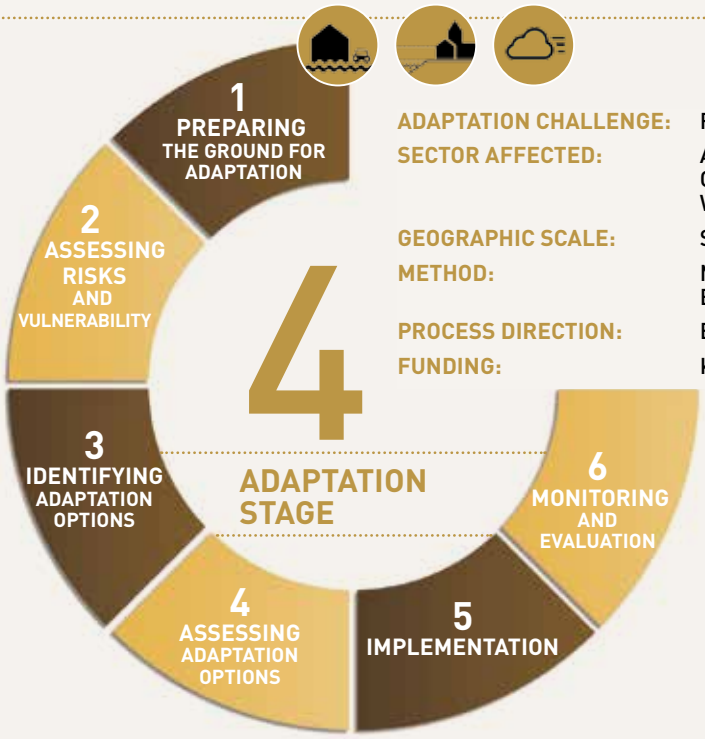
THE OUTCOME OF ACTION

As the main focus of implementing JenKAS is on mainstreaming adaptation into urban planning, DUDCP promotes various in-house activities such as DSS trainings. A notable consequence of these efforts is that a constantly growing number of land development plans refers to JenKAS when making recommendations or substantiating restrictions.

Beyond the actions directed at internal processes, there are several activities addressing local citizens and associations. An example is a nature trail with display boards financed by local businesses that provide information about important aspects of the changing urban climate and the local adaptation strategy. The planning period of the Inselplatz project started in 2012 and hasn't been finished, yet. The anticipated construction period will presumably begin in 2018 and be completed in 2020. The results of the economic assessments carried out in the context of the BASE project for the Inselplatz and for the two other major construction sites informed and continue to add to the administrative and political decision-making regarding these projects.

LOCATION Kalundborg, Denmark

PARTICIPATORY METHODS AND LOCAL INCLUSION:
APPLICATION AND EFFECT IN ADAPTATION POLICY PLANNING



ADAPTATION CHALLENGE:	Flooding, Sea Level Rise, Storms
SECTOR AFFECTED:	Agriculture & Forest, Coastal Areas, Infrastructure, Water Management, Biodiversity
GEOGRAPHIC SCALE:	Subnational region
METHOD:	Modelling, Participatory, Economic Analysis
PROCESS DIRECTION:	Bottom-Up, Top-Down
FUNDING:	Kalundborg municipality

BASE RESEARCH PARTNER CONTACT
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Copenhagen, Denmark
Andreas Hastrup Clemmensen: *ahc@tekno.dk*

Shoreline along the western coast of Zealand, Kalundborg Municipality

Photos: Jørgen Vadsen

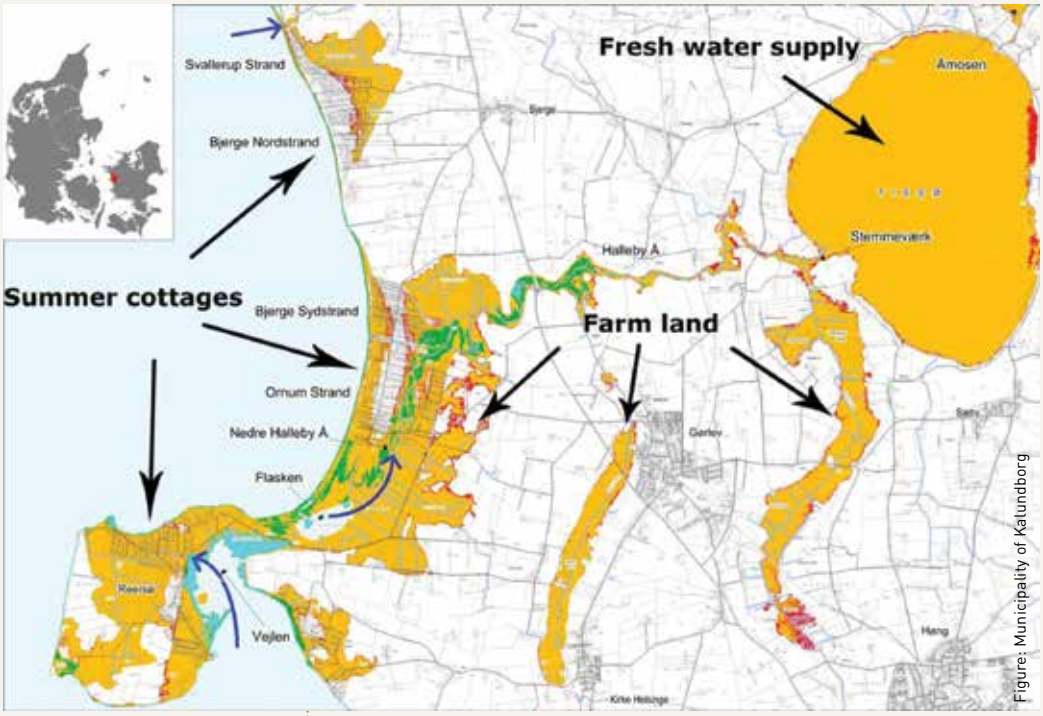


Figure: Flooding in 2090

LIGHT BLUE:
(80 cm above current sea level) areas expected to be permanently flooded by 2090.
GREEN:
(150 cm above current sea level) areas currently flooded at 100-year incidents.
YELLOW:
(210 cm above current sea level) areas expected to be flooded at 20-year incidents in 2090.
RED :
(230 cm above current sea level) areas expected to be flooded at 100-year incidents in 2090.
BLUE ARROWS:
point at the locations where the water will enter first.

THE CLIMATE CHALLENGE

The municipality of Kalundborg has approximately 12,000 residents and is situated on the western corner shoreline of Zealand, Denmark. While municipalities on the west coast of Jutland are accustomed to dealing with storm surges from the North Sea, this and other coastal areas had previously been better protected from surges and had dealt with them less frequently. The land behind the coastline has a delta-like lowland character that makes the area vulnerable to extreme weather conditions like storm-surges, flooding and sea level rise. The study area (14,000 hectare) includes a peninsula, a large lake, a large near-shore and low-lying summer cottage area with additional permanent habitation, large agricultural areas, nature resorts, ground- and surface-water interests, and tourist and cultural assets. The accumulated cost of damages to private properties by 2090 is estimated by a private consultancy, NIRAS, to be approximately EUR 242 million.

THE ADAPTATION RESPONSE

Kalundborg Municipality and the Danish Board of Technology (DBT) carried out a comprehensive and path-breaking participatory approach involving local stakeholders and citizens to prepare for a Municipal Climate Change Adaptation Plan.

The resulting plan was adopted in 2014 by the Kalundborg Municipal Council.

The participatory aspect of the plan was part of the EU-INTERREG project "BaltCICA" on climate adaptation in the Baltic Sea Region, which ran from 2009 to 2012 and included, inter-alia, a two-day scenario-workshop and a citizens' summit.

In BASE, the participatory process itself was examined, as well as the impact of participation on the final adaptation plan.

The focus was on the ability or willingness of the authorities to incorporate local views into their short- and long-term adaptation planning.

THE PEOPLE AND INSTITUTIONS INVOLVED

DBT ensured a close dialogue with the Kalundborg Municipal Committee for Engineering and Environment from the very beginning and throughout the participatory process. After the citizens´ summit, DBT prepared an analysis of the possible political implications of the voting results and presented it to the Committee, which took cognisance of these recommendations and asked the city's Department of Engineering and Environment to include these in the adaptation plan. The Department established a small working group to draft the adaptation plan itself.

Photo: Jørgen Madsen

Citizen summit - citizens and politicians discuss future climate change impacts and response

Scenario workshop where local stake-holders develop future adaptation options and scenarios

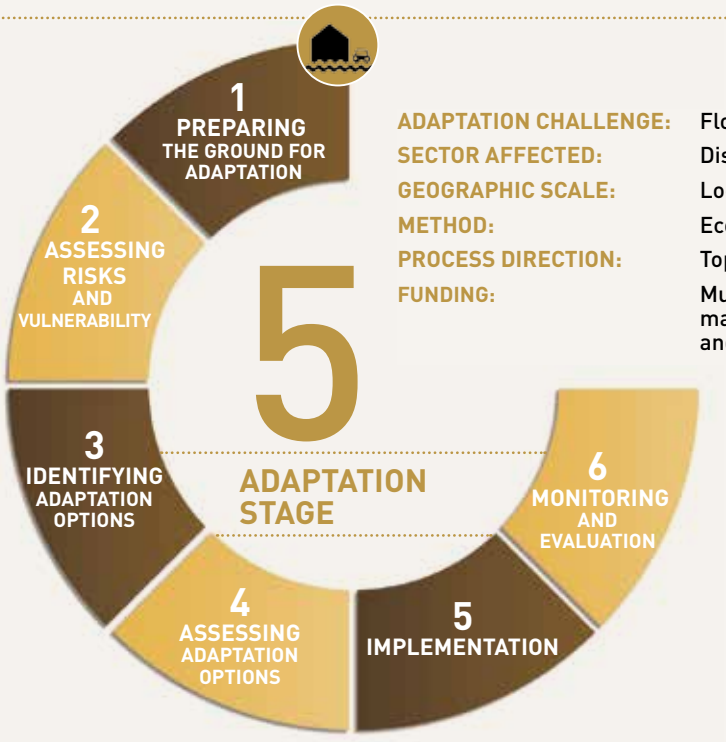
Photo: Jørgen Madsen

THE OUTCOME OF ACTION

The participatory process had a tangible impact on the resulting climate adaptation plan. A very concrete result of citizens' involvement, for example, is that the plan points out by name specific summerhouse areas where climate risks are so high that it may be necessary to reconsider the location. This measure was controversial due to the resulting loss in property value and would likely have never been included by policymakers alone, who might prefer residents to invest rather than divest in their properties. The process also indicated the financial and legal challenge of changing the status of certain areas from summerhouses to wetlands.

LOCATION Leeds, United Kingdom

PROTECTING HOMES AND BUSINESSES:
FLOOD ALLEVIATION SCHEME FOR A CITY



ADAPTATION CHALLENGE:	Flooding
SECTOR AFFECTED:	Disaster Risk Reduction
GEOGRAPHIC SCALE:	Local
METHOD:	Economic Analysis
PROCESS DIRECTION:	Top-Down
FUNDING:	Multiple sources, mainly central government and local city council

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Photo: Dr Martin Dallimer

Building wall defences near Leeds Train Station

View of the River Aire in Leeds city centre

Photos: Dr Martin Dallimer

THE CLIMATE CHALLENGE

The city of Leeds, UK is located in the floodplain of the River Aire. The case study area includes around 320,000 households, with about 3,000 residential properties and 500 businesses as well as key municipal infrastructure at some level of flood risk. The area subject to flood risk is predicted to increase due to climate change, which can increase flood damages/disruptions and decrease the desirability of commercial land uses and investments. Indeed flood risk is a significant deterrent to the regeneration of parts of the city and extensive brownfield plots of formerly-developed industrial land. These areas have been identified as key strategic locations for job creation of regional and potentially national significance; thus, flood risk is currently generating high economic damages in the area and is a deterrent to sustainable economic development in the future.

THE ADAPTATION RESPONSE

This case study looks at the economics of three adaptation measures, two hypothetical and one currently being implemented. The hypothetical measures are ecosystem-based approaches (EBA), including green-blue infrastructure in the urban area and woodland planting upstream of the Aire catchment. The currently implemented measure refers to the initial phase of the (grey infrastructure)

Flood Alleviation Scheme (FAS) extending downstream from the Leeds city centre on the River Aire.
The scheme aims to raise defences, replace two weirs and re-grade/merge the River Aire with the Knostrop Cut basin to maximise the possible flood reduction.

The proposed works at the weirs will furthermore incorporate fish passes to improve the ecological potential of the River Aire and help it achieve Good Ecological Potential as per the Water Framework Directive requirements for 2027.

THE PEOPLE AND INSTITUTIONS INVOLVED

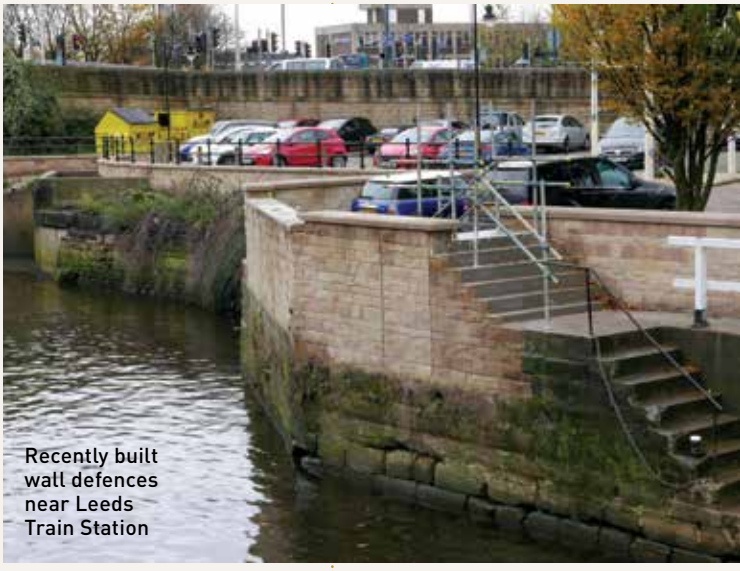
The Leeds City Council developed the FAS proposal in close partnership with project partners such as the Environment Agency, the Canal and River Trust and Yorkshire Water Services Limited.

Local stakeholder groups that have been closely involved with the process include the Waterfront Association, the Planning and Policy Group, the Leeds, York and North Yorkshire Chamber of Commerce and Leeds Civic Trust (Aire Action Partnership Groups).

Individual members of the public have also been engaged by the organisation of public meetings and drop-in events.

THE OUTCOME OF ACTION

The main construction works for the FAS began in January 2015, and the anticipated project end date is May 2017.

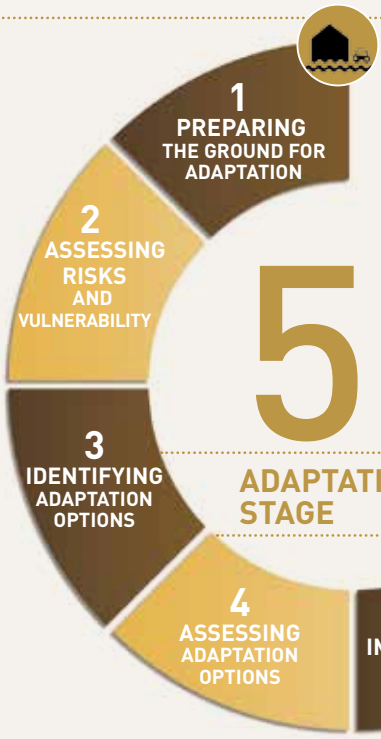


Recently built wall defences near Leeds Train Station

General public dissemination of the FAS scheme in The Calls, Leeds city centre

LOCATION Prague, Czech Republic

ADAPTING TO A CHANGING CLIMATE: FLOOD PROTECTION SYSTEM IN THE CITY



ADAPTATION CHALLENGE:	Flooding
SECTOR AFFECTED:	Disaster Risk Reduction, Water Management, Urban
GEOGRAPHIC SCALE:	Local
METHOD:	Economic Analysis, Adaption Pathway
PROCESS DIRECTION:	Bottom-Up, Top-Down
FUNDING:	Public funding of flood protection system

BASE RESEARCH PARTNER CONTACT
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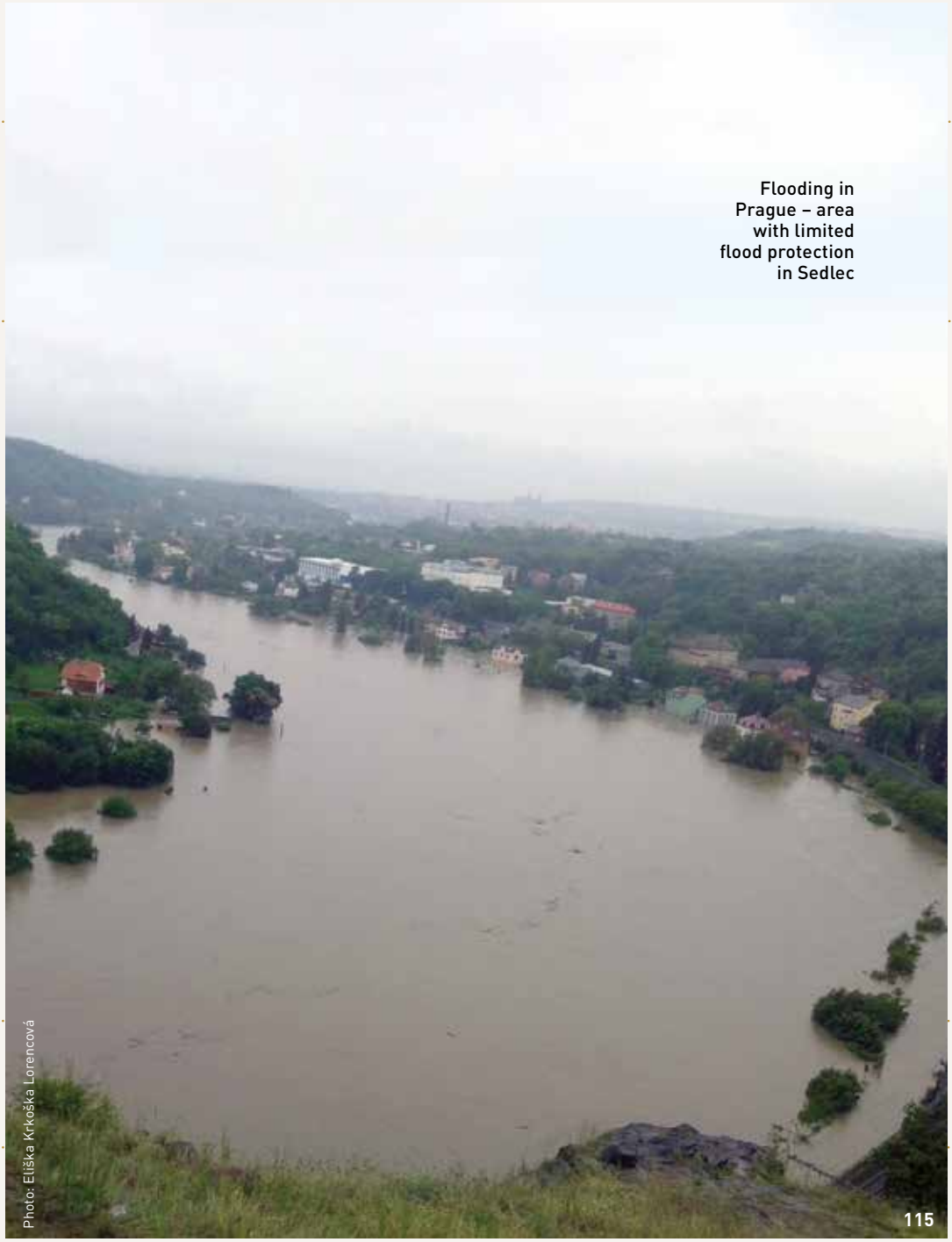


Flooding in Prague – area with limited flood protection in Sedlec

Photo: Eliška Krkoška Lorencová

Prague city centre is protected against floods by combination of fixed and mobile barriers

THE CLIMATE CHALLENGE

Prague, the capital city of the Czech Republic, is located in a temperate climate zone. Vltava River, the longest in the country, flows through its historic centre. In 2002 Prague experienced severe 500-year flooding with total damages of CZK 24 billion (EUR 1 billion). This event was recognised as one of the most expensive weather-related disasters in the city's history.
Future climate scenarios furthermore predict an increase in the number and intensity of extreme events such as flooding. Wetter winters, dryer summers with more precipitation extremes and weather fluctuations in general are also expected.

THE ADAPTATION RESPONSE

A flood protection system in Prague had been developed for decades, but after the 500-year flood in 2002, implementation of flood control measures by the Prague municipality substantially sped up. Moreover, the original plans were upgraded to increase resilience against extreme flood events, to protect most parts of Prague from floods with a 1 to 500 years return period.

The flood control measures implemented include fixed barriers (levees, dikes), mobile barriers and additional measures such as closures and pumping systems in the canalisation. The total length of flood protection measures (fixed barriers, solid concrete walls and mobile barriers) after the completion of all stages is app. 19,255 km, of which mobile measures are 6,925 km.

THE PEOPLE AND INSTITUTIONS INVOLVED

The responsibility for flood protection measures as implemented since 1997 is divided at the national level between the Ministry of Agriculture, which is responsible primarily for the implementation of technical measures, and the Ministry of the Environment, which together with various non-governmental organisations and local initiatives promotes "green" adaptation measures. Governance responsibilities are highly fragmented between these two actors, which results in reduced efficiency in the climate change adaptation process.

At the regional level, Prague City Hall cooperates with the Povodí Vltavy, a state enterprise, in the implementation of flood control measures on the Vltava River. Some environmentally-oriented organisations and local initiatives of citizens raising suggestions are also involved in the adaptation process.

In the case of Prague, the stakeholders involved included Prague City Hall, affected Prague districts, political representation, the Czech Hydrometeorological Institute, Povodí Vltavy - Vltava River Basin and professional companies such as Hydrosoft.

THE OUTCOME OF ACTION

The flood protection system protects most parts of Prague from 500-year floods at Vltava River. It consists of grey infrastructure; that is, mostly of fixed and mobile barriers and safety valves in the canalisation network. Greener strategies or approaches have been largely missing on the Vltava River, as there are limited possibilities for implementation of such measures in densely built-up areas.

However, these approaches are implemented when revitalising smaller streams in the city (e.g. Rokytka).

It is clear that green and blue infrastructure would only serve as additional support to the flood barriers but could still be useful in, for example, tackling flash floods caused by extreme precipitation.

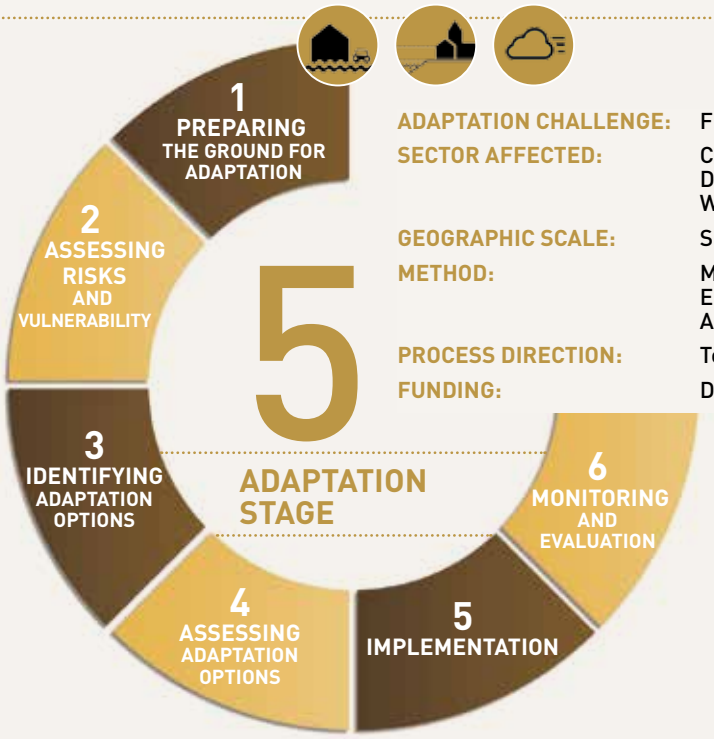
Problems arising during the approval and permit process of the flood control system included questions of property rights and land use.

Vltava river at Charles bridge

Photos: IPR

LOCATION Rotterdam, the Netherlands

TOWARDS OPTIMAL BALANCE IN FLOOD RISK MANAGEMENT IN THE DELTA



ADAPTATION CHALLENGE:	Flooding, Sea Level Rise, Storms
SECTOR AFFECTED:	Coastal Areas, Disaster Risk Reduction, Water Management, Urban
GEOGRAPHIC SCALE:	Subnational region
METHOD:	Modelling, Participatory, Economic Analysis, Adaptation Pathway
PROCESS DIRECTION:	Top-Down
FUNDING:	Dutch Delta Programme

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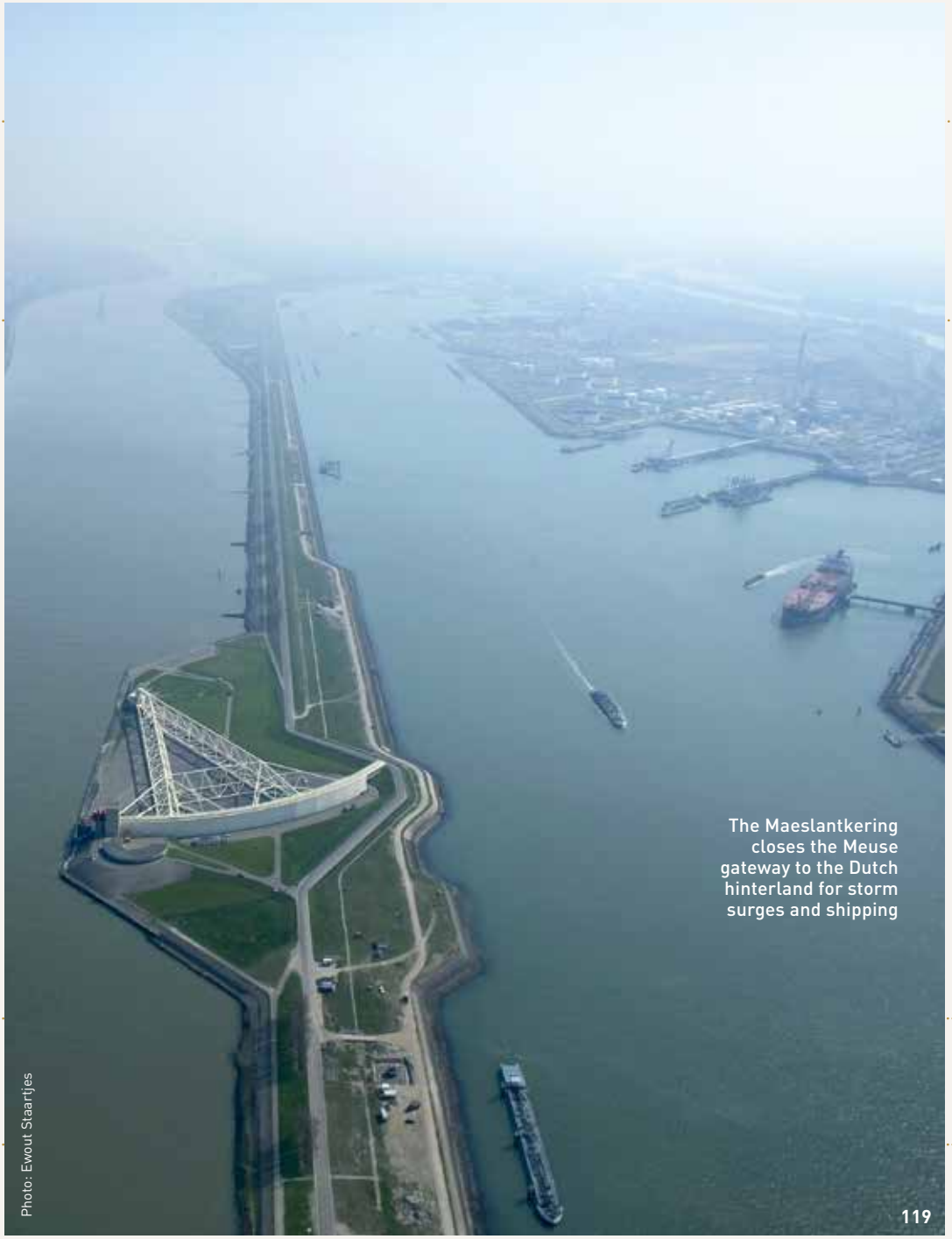


The Maeslantkering closes the Meuse gateway to the Dutch hinterland for storm surges and shipping

Photo: Ewout Staartjes

THE CLIMATE CHALLENGE

The Rhine Meuse delta in the Netherlands is the location of Rotterdam, a populous port city of enormous economic significance. Climate change projections suggest sea level rise and increasing flood risks. Such impacts would cause more frequent closures of the storm surge barrier and limit shipping traffic, with concomitant economic effects. Altered river discharges due to increasing precipitation and melting water from the Alps will affect the closing regime of the storm surge barrier and lead to a decrease of discharges due to drought, which may hamper inland shipping and increase concentrations of pollutants and salinity. The main impact is an increase in flood risk due to higher peak discharges.

THE ADAPTATION RESPONSE

This case reflects on the Deltaprogramme Rijnmond-Drechtsteden, which handled the long-term flood risk management strategies for the city of Rotterdam, the Netherlands and its surrounding area.

The case Rotterdam falls under the umbrella of the nationwide Deltaprogramme, whose objectives are to:

- update protection standards to include both climate change scenarios and increased population and economic value protected from floods, and
- assess measures as to their most optimal balance for the long-term protection of the Rotterdam area in view of rising sea levels and more high and low extremes in river discharge.

Skyline of Rotterdam with unembanked areas along the urban waterfront

THE PEOPLE AND INSTITUTIONS INVOLVED

Participation involved governmental layers, principal stakeholder groups and members of the scientific community. On a regional scale the governmental actors that enable implementation of the adaptation measures are provinces and water boards.
Civil actors were involved via a societal advisory board consisting out of 11 members, each representing a different stake and including all major economic sectors, and advising the steering board of the Rijnmond-Drechtsteden.
Twice a year a large stakeholder meeting was held to both inform stakeholders and receive input for the strategising process.
While participation via delegates was very much present, the inclusion of direct citizen involvement was missing.

THE OUTCOME OF ACTION

Some of the specific solutions and actions planned or in the process of implementation are innovative dike improvements throughout the area; continued nourishment at the seaward side of Rotterdam; project studies and disaster risk management for the Maeslant storm surge barrier; and using the widened river as a tidal park.

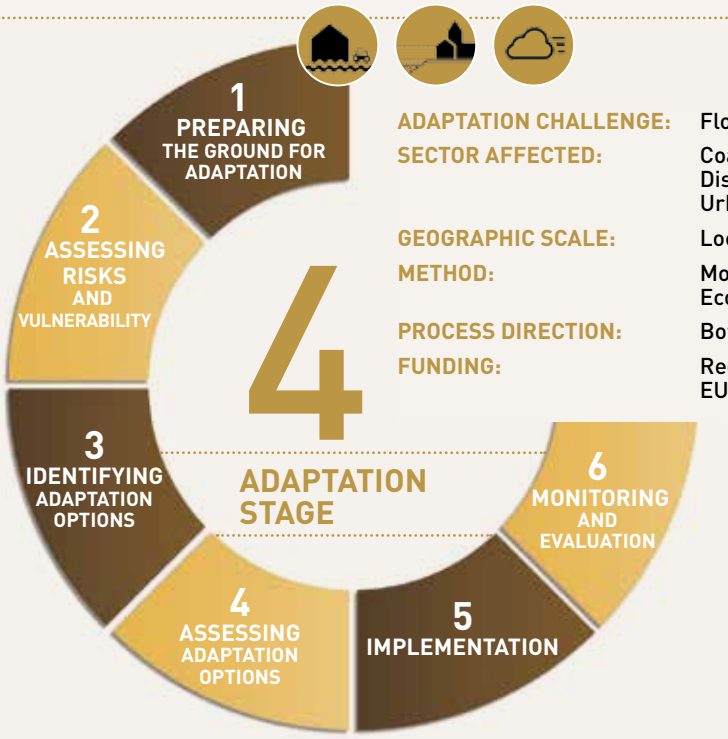
The area of Rotterdam with the port and unembanked areas along the river, lines indicate municipal borders. *Adapted using public data from the governmental PDOK site*

The Maeslantkering storm surge barrier might need to be closed more often due to sea level rise

Photos: Guus Schoneville

LOCATION Timmendorfer Strand, Germany

USING ACTIVE PUBLIC PARTICIPATION IN THE CO-DEVELOPMENT OF COASTAL PROTECTION STRATEGIES FOR A TOURISTIC BEACH CITY



ADAPTATION CHALLENGE:	Flooding, Sea Level Rise, Storms
SECTOR AFFECTED:	Coastal Areas, Disaster Risk Reduction, Urban
GEOGRAPHIC SCALE:	Local
METHOD:	Modelling, Participatory, Economic Analysis
PROCESS DIRECTION:	Bottom-Up
FUNDING:	Regional government and City, EU funding via Cohesion Policy

BASE RESEARCH PARTNER CONTACT
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Berlin, Germany
Nico Stelljes: *nico.stelljes@ecologic.eu*

For protection of the dune trespassing is prohibited

Photo: Ecologic Institute

Finished landscaping measure

Photos: Ecologic Institute

THE CLIMATE CHALLENGE

The municipality of Timmendorfer Strand is a German coastal resort town with around 9,000 inhabitants. Tourism is the main economic sector. About 18% of the municipal area is situated less than 3 m above mean sea level (MSL). The population and their property values are under threat of climate change impacts like sea level rise and storm floods. Before the late 1990s, Timmendorfer Strand had no flood protection measures in place, so rising sea levels and intensive storm events could lead to flooding.

In response, the municipality together with the state authority initiated a participatory process in 1998-2011 that involved the community in developing appropriate climate change adaptation measures.

As part of the participatory approach, extensive analysis of the social and economic particularities of the town were reviewed and the design and implementation of a coastal defence measure was developed. The coastal defence measure was designed in a way so as not to disturb the natural coastal landscape of Timmendorfer Strand and therefore not to bother either the inhabitants or tourists that come to enjoy the seaside.

THE ADAPTATION RESPONSE

The adaptation response was the construction of a seawall that reached a maximum height of 0.8 m above the level of the pedestrian promenade. The natural landscape of undulating sand dunes and ridges as well as the promenade influenced the careful design of the wall. For example, glazed retention walls were installed as an aesthetic consideration, a measure developed as a prerequisite to ensure the acceptance of local stakeholders. The total cost of the project was EUR 30 million. The sea defence wall cost EUR 18 million (of which the community had to pay EUR 3.5 million), and the cost of architectural and landscaping activities amounted to an additional EUR 12 million. Of these, the community had to cover a share of 50%. Other funding came from EU cohesion funds and state funding.

Construction of landscaping measures

Glazed retention walls

THE PEOPLE AND INSTITUTIONS INVOLVED

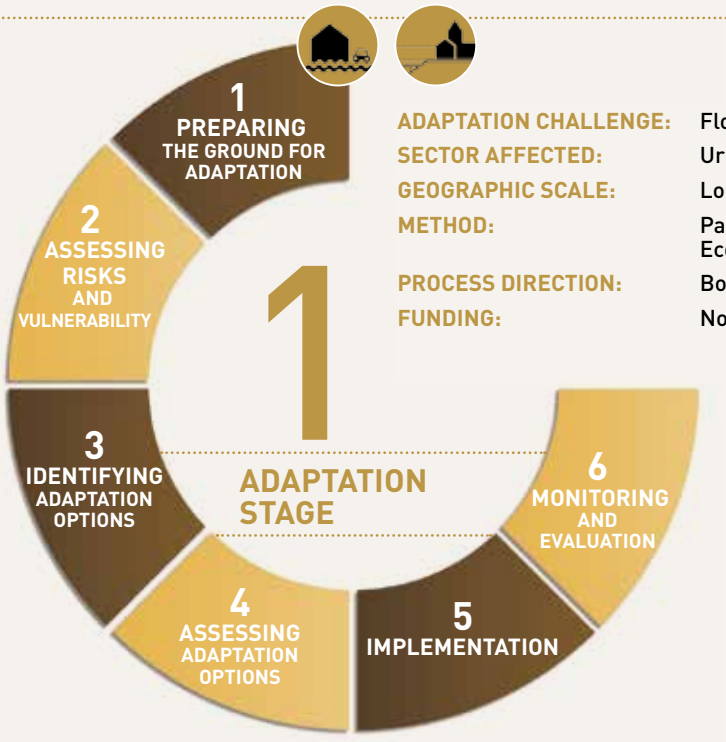
While the initial idea for the project came from the state authorities, the city was in charge of carrying out the planning and implementation. Technically, the city had no prior experience in this kind of adaptation planning; however, the state agency supported the process and initiated the participatory approach, which was a crucial and positive element in the success of the measure. Also, an economic evaluation was undertaken beforehand to weigh the costs and benefits of the measure and to increase transparency.

THE OUTCOME OF ACTION

In summary, three key elements contributed to the success of this adaptation measure. First, an economic analysis of potential damages of the community was compared to the costs of coastal protection. With the participatory approach chosen, stakeholders were successfully involved in the process and their wishes concerning the coastal defence measure were acknowledged by the community. This was possible because the community could ensure funding for the more costly measures from the beginning of the project.

LOCATION Venice, Italy

SPONTANEOUS ADAPTATION BY PRIVATE AND PUBLIC ACTORS IN THE CITY CENTRE



ADAPTATION CHALLENGE:	Flooding, Sea Level Rise
SECTOR AFFECTED:	Urban
GEOGRAPHIC SCALE:	Local
METHOD:	Participatory, Economic Analysis
PROCESS DIRECTION:	Bottom-Up
FUNDING:	No public funding

BASE RESEARCH PARTNER CONTACT
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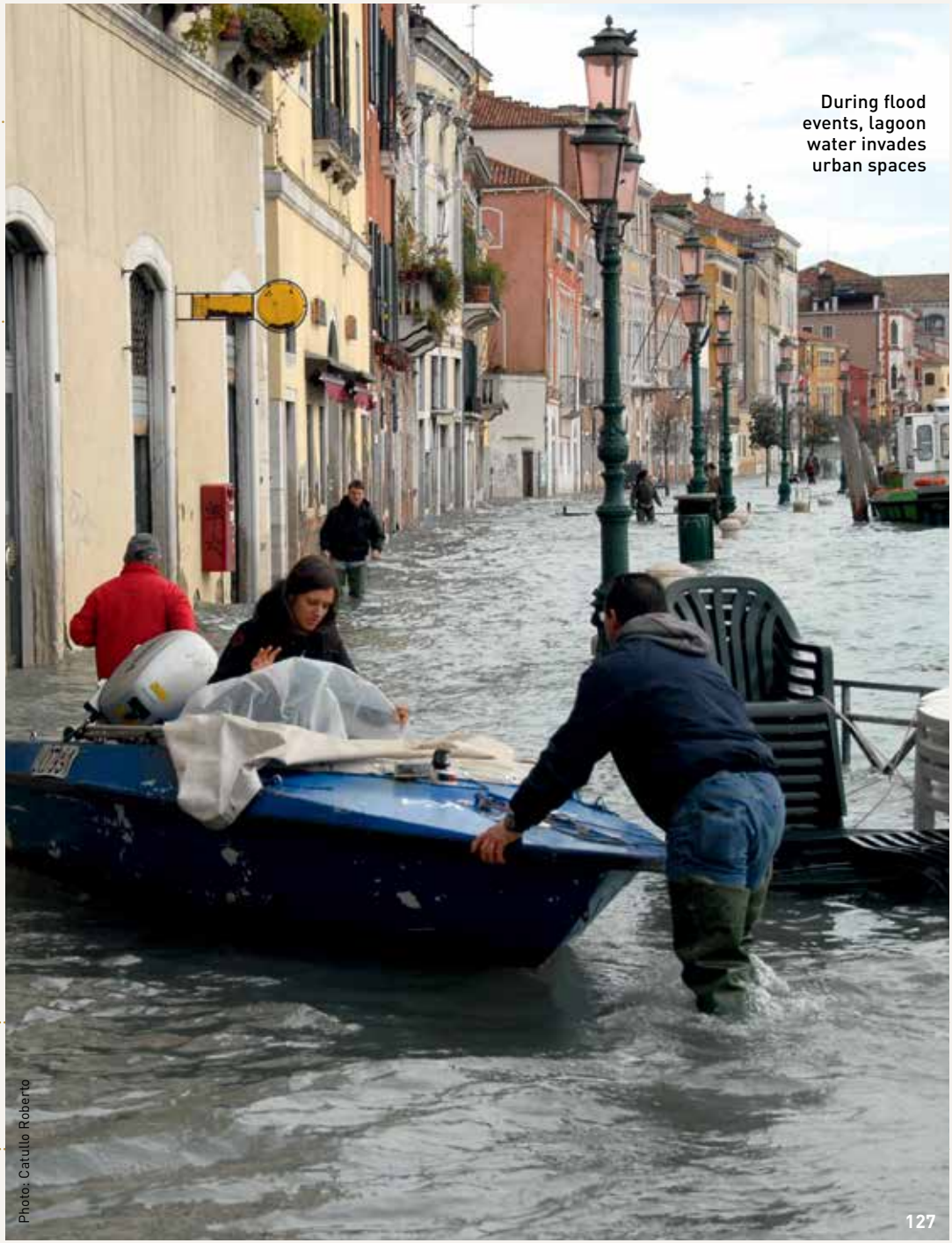

During flood events, lagoon water invades urban spaces

Photo: Catullo Roberto

Inhabitants are used to periodic flood events

Photo: Roberto Trombetta

Photos: Margaretha Breil

THE CLIMATE CHALLENGE

The historic centre of Venice, Italy is built inside a coastal lagoon that is directly connected to the Adriatic Sea. Sea level rise related to climate change will make flooding events more frequent and more intense, and high waters are projected to exceed the historic range of tidal excursion. The occasional flooding of urban areas has significant economic and social impacts, which increase with the severity of the flood event and its duration. Although much of the city is adapted to high waters, flooding and humidity rising from the ground brings higher, non-adapted parts of the buildings into closer and/or more frequent contact with salt water. These damages are expressed mainly in terms of increases in maintenance costs, where plaster and bricks need to be replaced more frequently, and building elements such as doors or floors may have a shortened lifetime.

THE ADAPTATION RESPONSE

Spontaneous adaptation is already being undertaken by private and public actors – about 42% of residential buildings and 36% of commercial buildings surveyed – to adapt their premises to rising sea levels in the historic centre.

The city has historically adapted to periodic flooding events with water-sensitive urban and building design, e.g. choosing building materials resistant to salt water intrusion or humidity rising from the ground, such as impermeable limestome (pietra d'Istria). Raising floor levels, installing vascas (complete waterproofing of the floor and the walls of the unit) or pumps and cutting of walls to insert impermeable barriers are all widespread measures.

Most of the measures employed do not interfere with the aesthetics of the building and can also be employed on cultural heritage buildings. A survey conducted by municipal authorities in the early 2000s indicated that the majority of measures implemented were those preventing less costly damages. According to calculations made in the BASE case study, these present adaptation measures would only help avoid some 5% of the potential damage costs under a sea level rise scenario of 30 cm. Under a scenario of dry flood proofing, this rate would go up to approximately 64%.

THE PEOPLE AND INSTITUTIONS INVOLVED

This case study examines spontaneous adaptation as undertaken by public and private actors in residential or commercial residencies.

Photo: TheWiz83

During flood events, waterborne transport is blocked as boats cannot pass under the bridges

Walkways allow reaching the most important parts of the city

Photo: Giovanni Metto

THE OUTCOME OF ACTION

According to the calculations made in the BASE case study, measures actually in place are able to avoid only a small part of potential damages under present day conditions, with benefits corresponding to approximately 5% of the costs (investment and net present value of residual damages) under a sea level rise scenario of 30 cm. Under a scenario of the most expensive protection measures being applied in all residential units (full impermeabilisation or dry flood proofing), the relation between costs and benefits would be slightly above 25%, with only very small changes under different scenarios of sea level rise.

The study concludes that private flood adaptation for buildings can considerably reduce damages but will not prevent them totally. Furthermore, most options come with a considerable investment cost that may not be feasible for all households.

WHAT LESSONS CAN WE DRAW FROM THE 23 INSPIRING EUROPEAN ADAPTATION CASE STUDIES?

A VIBRANT CO-EVOLVING 'ECOSYSTEM'

BASE provides clear evidence that bottom-up and top-down processes emerge as a regenerative cycle. Research shows there is no conflict between local action and top policies. Relations between bottom-up initiatives and top-down strategies are potentially symbiotic and can form a vibrant and co-evolving ecosystem for collective action towards a sustainable and resilient Europe.

Regardless of the starting point, case study experiences show it is critical to keep the process going. Almost half of BASE European case studies have some form of on-going bottom-up 'autonomous' adaptation. Measures were implemented by individuals or communities in rural and urban areas. Mainstreaming climate change adaptation will benefit greatly from socially innovative strategies, measures or networks that arise from bottom-up processes.

Social innovation and multi-stakeholder involvement are fundamental pillars for collective action towards climate resilience. It is up to local, national and supranational policy, and regulatory frameworks to encourage these initiatives and recognise the need to both capacitate and learn from them.

HOLISTIC SITES

Adaptation may demand deep changes at various domains of social life, from landscape ecology to economic, political, technological and cultural dimensions. A holistic perspective is key to ensure thriving and resilient societies, today and in the future.

Any action taken to adapt needs to be capable of intertwining equity considerations, and distribution of capacity building and vulnerability awareness. Case study research shows that adaptation solutions should not be limited to hard engineering interventions, e.g. dikes and seawalls. Well-adapted societies may need to question dominant social practices and redefine political power relationships, through increased dialogue and public participation in decision-making.

A sustainable way of living in altered landscapes may even mean accepting there are limits to adaptation. For instance, some coastal settlements may face the possibility of re-locating. It is therefore vital that adaptation measures take stock of mixed 'recipes', integrating grey, green and soft solutions, which has been a common trait in most BASE case studies.



BEYOND ONE-SIZE FITS ALL

There is no one-size fits all approach for climate change adaptation. Impacts and their consequences differ across geographies, socio-economic, political and cultural contexts. Adaptation measures cannot be directly transferred to another location without carrying out economic, feasibility and public perception analyses.

Even within the same case study, different stakeholder groups are driven by diverse needs and will be affected in distinct ways by the outcomes of a policy or measure. Similarly, methodologies need to be tailored to particular needs, as well as to the stage of the adaptation process. For example, green roof assessments in Cascais, Madrid and Jena yielded significant cost disparities. Economic analysis such as Cost-Benefit or Economic Valuations need to be weighted by equity, environmental and social considerations, although they are useful to inform decisions. Likewise, global and regional climatic models are difficult to translate into useful data at the local level. Context-specific data and an on-going knowledge exchange between practitioners, researchers, planners and policymakers is of central importance.

SNOWBALLING FROM ACTION TO RESEARCH (AND VICE-VERSA)

Interactions between real life action and research processes are at the heart of sustainable adaptation.

Participatory action research develops at the intersection of science and society, to build on interdependencies between research goals and real life needs and challenges.

In many BASE case studies this methodological approach was of central importance, and even more so when combined with economic and non-economic evaluation tools. It is critical that participation moves beyond the usual suspects and integrates a wide diversity of participants, including those most likely to be bypassed in traditional command-and-control planning practices (e.g. the elderly, farmers, fishermen); and involving diverse knowledge systems (e.g. traditional and local knowledge). More than quantity, it is important to have a representative group of participants, while taking into account diverse socio-political and institutional contexts. Transdisciplinary experiences set the ground for a fruitful knowledge exchange between scientific and local and/or traditional knowledge.

Photos: Jena, Cascais, Alentejo case studies

KEEP TRACK OF CHANGE

Monitoring is a key need for developing adequate funding mechanisms and promote political commitment, but also to ensure sustainability of the measures implemented.

European case study stakeholders recognised that keeping track of adaptation processes, although challenging, is a priority in order to inform decision-making and subsidy mechanisms. Evaluating is tricky and largely dependent on data availability and quality, but also on time, resources (human, material, and financial) and budget constraints.

BASE case studies experimented with methodological approaches that integrate the possibility of future change (e.g. The Dynamic Adaptation Pathways; Multi-criteria Analysis) and are useful for evaluation and monitoring.

Yet, more methods and approaches should be developed and improved to address the challenge of monitoring highly complex and uncertain processes.

CAN'T IGNORE POLICY

Climate change adaptation has to do with political choices and is not only a matter of finding the right technical solutions.

Participatory experiences such as those developed in Kalundborg, Cascais, Ílhavo and Vagos, or Dartmoor, clearly show that adaptation decisions are political in nature, because they affect different stakeholders and citizens in different ways. What might seem to decision-makers as a choice between different technical solutions, often has pros and cons for different groups of people. A number of regulatory frameworks and policies can either hinder or promote local action.

One important strategy is to involve a wide range of stakeholders and citizens at the early stages of making decisions about measures.

Practitioners and decision-makers need to be well informed on local, national and supranational policies, taking stock of potential synergies and addressing potential bottlenecks and constraints posed by public policies.

SHARE BENEFITS AND RISKS

Collaboration, sharing and co-funding are key words for successful adaptation.
Funding mechanisms should rely on a mix of funding schemes, so that beneficiaries and those funding measures can share the benefits and risks. Research shows most European adaptation processes rely on public funding.
There is still a large need for developing alternative funding mechanisms. Innovative solutions, including new funding schemes, require support structures that allow the incubation, maturation and a safe operating space for new initiatives. Different stakeholders will understand risks and benefits differently. For investors the key note is benefits that can be gained and risks avoided, for local beneficiaries the main issue is investing in the future and in securing their livelihoods and well-being.

EVERYTHING IS A STORY

Narratives, framings and storylines that accompany climate change adaptation strategies are important triggers for allocating resources.
In most cities analysed (e.g. Copenhagen, Cascais, Jena, Roterdam) adaptation emerges within the urban narrative of the need for a wider transition towards sustainable, green and smart metropolises. This narrative promoted additional studies (such as economic analysis of measures), and pushed the allocation of financial and human resources for developing the adaptation process. Likewise, in rural regions, climate change adaptation is framed within a narrative for more sustainable rural societies.

TELLING THE STORY IS IMPORTANT!

Dissemination needs to be multidirectional, not only within the scale of the case study and its diverse stakeholder groups, but also in a larger scale, promoting to the 'rest of the world' what a particular locality, region or country is doing, and empowering such action.

Photos: Ílhavo and Vagos case study

ADAPTATION INSPIRATION BOOK

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A multistakeholder group discusses coastal protection measures using high resolution risk assessment maps (Ílhavo and Vagos case study)

Photo: André Vizinho

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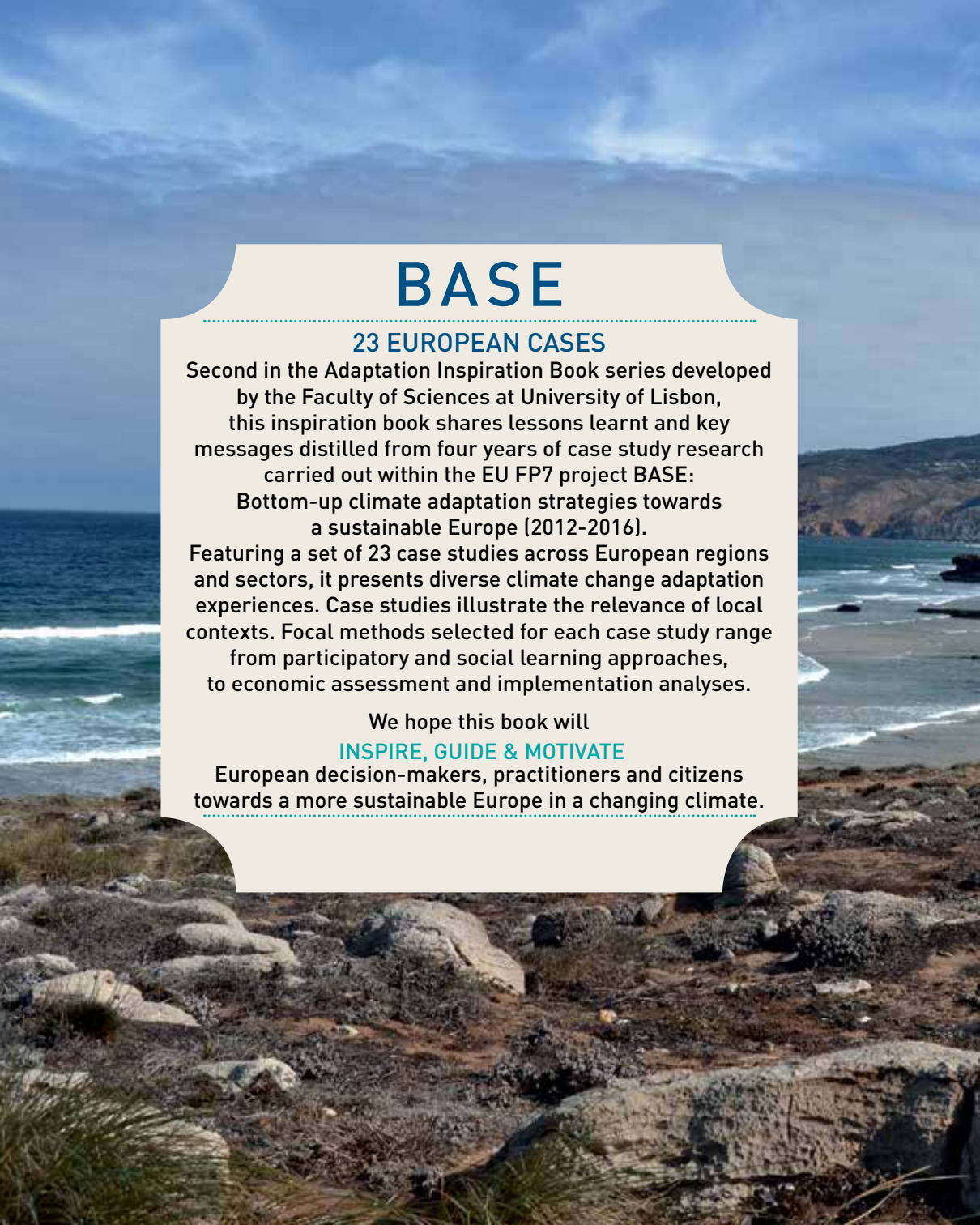

BASE

23 EUROPEAN CASES

Second in the Adaptation Inspiration Book series developed by the Faculty of Sciences at University of Lisbon, this inspiration book shares lessons learnt and key messages distilled from four years of case study research carried out within the EU FP7 project BASE: Bottom-up climate adaptation strategies towards a sustainable Europe (2012-2016).

Featuring a set of 23 case studies across European regions and sectors, it presents diverse climate change adaptation experiences. Case studies illustrate the relevance of local contexts. Focal methods selected for each case study range from participatory and social learning approaches, to economic assessment and implementation analyses.

We hope this book will

INSPIRE, GUIDE & MOTIVATE

European decision-makers, practitioners and citizens towards a more sustainable Europe in a changing climate.