

Adaptation to climate change using green and blue infrastructure

A database of case studies: Executive summary



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The aim of this database of case studies is to showcase climate change adaptation approaches, with a particular emphasis on those relating to green and blue infrastructure. The database is an important deliverable of the GRaBS project¹. Rather than focus on the physical elements of the case studies, the database describes in detail the process that have supported the implementation of adaptation responses in a range of urban areas across the world. The case studies therefore identify and highlight key factors in different areas (e.g. governance, stakeholder relationships, science and research) that influenced the success of adaptation responses in different locations. It is hoped that the database will meet an important need in terms of progressing green and blue infrastructure adaptation responses, and will act as a valuable resource for a wide range of stakeholder communities engaged in these activities.

Analysis of previous studies on factors influencing the success of the development and implementation of adaptation responses (chapter 2) highlights the following significant issues:

- Collaboration with external stakeholders
- Strong leadership or championship
- Access to funding
- Awareness levels within the organisation
- Outsourcing research and other actions
- Human resources and skills
- Public awareness and engagement
- Quality and availability of information and data
- Position of adaptation on the list of priorities
- Development of local regulations and policies.

The strengths, weaknesses, opportunities, and threats (SWOT) that characterise and face the partner organisations participating in the GRaBS project during their preparation of adaptation responses using green and blue infrastructure (chapter 2) link closely to factors identified in previous studies. The crucial factors were as follows:

- Regulations and policy at the local level
- Access to and quality of data and information
- Cross-departmental collaboration
- Public engagement
- Policy framework at higher levels (national and regional)
- Collaboration with external stakeholders
- Access to funding
- Learning from others (networking, research projects)
- Need for urban development or regeneration
- Existence of a strong sustainability movement
- Public awareness
- Current green space resources.

The results of these two exercises, supplemented by a questionnaire survey gauging the interest of GRaBS partners in different climate change impacts and forms of

¹ The Interreg IVC Green and Blue Space Adaptation for Urban Areas and Eco Towns project (GRaBS) aims to improve the regional decision and policy making process in relation to the planning and development of new and existing urban areas in eight EU member states in the context of climate change. The project aims to facilitate the much needed exchange of knowledge and experience and the actual transfer of good practice on climate change adaptation strategies to local and regional authorities. More information is available at: www.grabs-eu.org

adaptation response to be explored during the project, guided the selection of the 15 in-depth case studies presented in chapter 3. The case studies were selected from around the world, although a focus was maintained on subject matter relevant to European conditions.

The case studies are as follows:

- Toronto: Ahead of the storm – development of the climate change adaptation action plan
- The Netherlands Live with Water: Public awareness raising campaign
- Stuttgart: Combating heat island and poor air quality with green aeration corridors
- Slovakia: Development of open space standards
- Seattle: Using vegetation to limit the hazard of landslides
- New Orleans: preserving the wetlands to increase climate change resilience
- Faenza: Extra cubature for developers in return for green space
- Dorset: Financial contributions of planning applications for prevention of heathland fires
- Berlin: The Biotope Area Factor
- Augustenborg in Malmö: Retrofitting SUDS in an urban regeneration area
- A Climate Change Action Plan for North West England: exploring the position of green infrastructure
- Basel: Building regulations for green roofs
- Chicago: Green Permit Program – incentives for developers to install green roofs
- London Borough of Sutton: Adaptation to flooding via local planning policies
- Nagoya: Adaptation to climate change driven by biodiversity conservation

Each case study offers a description of the geographical location, themes driving the initiative, details of the development and implementation of the initiative, as well as a discussion of the potential of the initiative to deliver climate change adaptation benefits and other positive impacts. There follows a brief summary of each case study.

Toronto: Ahead of the storm – development of the climate change adaptation action plan

In 2008, the City of Toronto became one of the first cities in Canada to develop a comprehensive climate change adaptation strategy. The document, titled *Ahead of the Storm*, details a number of short and long-term actions to adapt Toronto to projected more frequent and more severe heatwaves and flooding. The Strategy highlights the importance of investment in storm water management and in parks and urban forests. The implementation of the actions in the strategy is still at an early stage, and this case study focuses on the process of developing the strategy by the local authorities in Toronto. This included the formation of an inter-departmental Adaptation Steering Group, raising awareness among staff, development of short and long-term adaptation strategies, extensive public consultation, and inclusion of the adaptive actions in budgets of the relevant departments of the City.

The Netherlands Live with Water: Public awareness raising campaign

The climate change projections for the Netherlands project an increased risk of coastal and river flooding. It was acknowledged in 2000 that the current water management system based on technological solutions is inadequate, and that more space needs to be made for water. It was also recognised that citizens do not sufficiently recognise and acknowledge the potential problems associated with water.

Consequently, in 2003 “The Netherlands Live with Water” public awareness campaign was launched. The campaign emphasises the need to store water along both the main national and regional water management systems during times of excessive rainfall or high levels of river discharge. It also promotes the actions that individuals can do themselves to help reduce the threat of flooding. The campaign has used the Netherlands favourite weather presenter as their spokesman. Independent reviewers have assessed the campaign as being an effective awareness raising approach.

Stuttgart: Combating heat island and poor air quality with green aeration corridors

Stuttgart’s location in a valley basin, its mild climate, low winds and surrounding industrial activity has made it susceptible to poor air quality since the 1970s. Development on the valley slopes have made the situation worse by preventing air from moving through the city, which contributes to the urban heat island effect. Consequently, Stuttgart has been planned to exploit the role of natural wind patterns and dense vegetation in reducing problems of overheating and air pollution. A Climate Atlas was developed for the Stuttgart region, presenting the distribution of temperature and cold air flows according to the city’s topography and land use. Based on this information, a number of planning and zoning regulations are recommended which aim to preserve open space and increase the presence of vegetation in densely built-up areas. The planning recommendations build on the legislative framework of the German Building Code and other national, regional and locally developed regulations.

Slovakia: Development of open space standards

In Slovakia, the Ministry for Construction and Regional Development commissioned a group of experts in 2009 to update the set of national standards for land use planning, which were first developed in 2002. The standards include guidance for planning of open spaces and green areas. The standards describe not only the aspects relating to the quantity of open space in towns or in a given development, but also include aspects relating to the quality and character of open spaces, such as percentage of sealed surfaces, percentage of tree cover and accessibility. This exhaustive set of standards builds on examples from other European cities, including Berlin, Graz, and Malmö. The standards will be adopted by the Slovakian Ministry for Construction and Regional Development in December 2010 and will provide a non-statutory guidance for spatial planners and other departments in local authorities when taking decisions relating to land use planning and development control.

Seattle: Using vegetation to limit the hazard of landslides

Landslides are a widespread, frequent, and costly hazard in Seattle (Washington State, USA) due to the area’s post-glacial geology, topography characterised by steep slopes, and climate with wet winters and frequent rain showers. Climate change is likely to increase ground instability in the area by exceeding the safe saturation levels of soil through more frequent and intense precipitation. After disastrous landslides in winters of 1995-96 and 1996-97, the City of Seattle in collaboration with the US Geological Survey and the State of Washington has carried out extensive research to identify the areas prone to landslides, and issued regulations on how landslide risk could be prevented. The regulations within the Seattle Municipal Code include detailed requirements on the maintenance and restoration of vegetation in areas prone to landslides. These regulations are also

presented by the Department for Planning and Development to Seattle residents in form of user-friendly "Client Assistance Memos" and through public meetings.

New Orleans: preserving the wetlands to increase climate change resilience

Following the disastrous failure of structural flood defences during Hurricane Katrina in 2005, the State of Louisiana and the City of New Orleans have undertaken steps to increase the resilience of the city to sea level rise, hurricanes and river flooding. An approach utilising many lines of defence has been adopted, involving structural and non-structural defences. One of the key protection measures is the conservation and restoration of wetlands as a buffer zone between the sea and the city. Detailed actions aimed at the promotion of wetlands are included in the New Orleans Masterplan under the headings of green infrastructure and city resilience. Inclusion of wetland conservation and restoration activities in the New Orleans Masterplan signals a significant change of flood-defence tactics in the region from an emphasis on levees and floodgates to the incorporation of more natural solutions. The focus on wetlands as a natural buffer responds to the calls of research emphasising the importance of wetlands in flood protection.

Faenza: Extra cubature for developers in return for green space

The Municipality of Faenza has implemented a bio-neighbourhood incentive programme for developers. This is included in their Town Planning Regulations. The incentive programme aims to achieve energy savings, promote aesthetic qualities of neighbourhoods, and also create better microclimate conditions to prepare for future rising temperatures associated with climate change. The incentive programme allows developers to extend the cubature of buildings in bio-neighbourhoods in excess of approved standards, if the buildings meet certain criteria of environmental sustainability. These include green roofs, green walls and water retention systems, and also the creation of continuous public green spaces by developers. The unique characteristic of the regulations is that there are no set standards, with the development conditions negotiated on case-by-case basis. The negotiations between town authorities and developers or housing associations significantly shorten the wait for building permits to be obtained therefore providing an incentive to engage in the scheme, and in addition engage a wider range of stakeholders into the town planning process.

Dorset: Financial contributions of planning applications for prevention of heathland fires

The Dorset Heathlands cover an extensive area of South East Dorset, England, and are fragmented by urban development and other land uses. Heathlands are an important habitat and are protected by European-level designations. They are prone to fires, and this risk is likely to increase with climate change, causing habitat loss and putting the fire rescue service under considerable pressure. Development nearby protected sites significantly increases the risk of fires and other negative impacts on the heath such as loss of biodiversity. With these issues in mind, a Joint Interim Planning Framework was agreed in 2007 by South East Dorset local authorities to cover all protected heathland across South East Dorset. It seeks to secure developer contributions toward funding the implementation of a package of mitigation measures to offset the adverse effects of additional residential development on the heathlands. The framework applies to all new housing that results in a net gain in dwelling units within a zone between 400m and 5km of designated European wildlife sites, and no development is permitted within a 400m buffer around heathland sites.

Berlin: The Biotope Area Factor

In Berlin, plans for the development of new buildings now fall under a regulation that requires a certain proportion of the development area to be left as a green space. The proportion of green space to the entire development area is referred to as the Biotope Area Factor (BAF or BFF for *Biotop Flächenfaktor*). The regulation is a part of a larger suite of documents relating to landscape planning, landscape design and species protection. It responds to the need to encourage more green space areas to be developed in densely built-up urban locations. An important advantage of the BAF regulation is that it allows flexibility of the site design; the developer may decide what green space measures are applied, and where, as long as the required green space ratio is achieved. The Biotope Area Factor has generated a significant international interest.

Augustenborg in Malmö: Retrofitting SUDS in an urban regeneration area

The neighbourhood of Augustenborg (Malmö, Sweden) has experienced periods of socio-economic decline in recent decades, and frequently suffered from floods caused by overflowing drainage systems. Augustenborg underwent a significant regeneration between 1998 and 2002. The main drivers for this regeneration initiative were the difficult social and economic situation in the neighbourhood, flood risk management, waste management and biodiversity improvement. Significant physical changes in infrastructure took place as a result, focusing on the creation of sustainable urban drainage systems, including ditches, retention ponds, green roofs and green spaces. The project was carried out collaboratively by the city council and a social housing company, with extensive participation of the residents in Augustenborg. The project has resulted in a successful outcome as the rainwater runoff rates have decreased by half, and the increase in green space has improved the image of the area.

A Climate Change Action Plan for North West England: exploring the position of green infrastructure

In North West England a regional Climate Change Action Plan was first developed for the years 2007-2009. This was then refreshed in February 2010 for the years 2010-2012. The objective of the revised Climate Change Action Plan is not to replace, but to strengthen the vision of a low-carbon and well adapted region, taking into account progress made to date and developments at national and international levels. Green infrastructure plays a prominent role in the plan, both in terms of its role in climate change mitigation and adaptation. Indeed, one of the stated actions is a "regional assessment of the risks, opportunities and priorities for green infrastructure in adapting and mitigating for climate change". This work is being undertaken as part of the Interreg IVC GRaBS project. The strong position of green infrastructure in the plan reflects a history of research on the subject in the region, as well as a coordinated and structured effort by professionals to embed green infrastructure into regional policy, which has facilitated the inclusion of the concept in statutory regional strategy documents. Key lessons offered by this case study include the significant role of collaborative working during the development of the action plan, and previously in the region on the promotion of green infrastructure including the use of economic arguments to support green infrastructure actions.

Basel: Building regulations for green roofs

The city of Basel in Switzerland has the highest area of green roofs per capita in the world. The use of green roofs has been stimulated by a combination of financial

incentives and building regulations. Building regulations have required the use of vegetation on roofs since their implementation in 2002. Initiatives aiming to increase the provision of green roofs in Basel were initially driven by energy-saving programmes, and subsequently by biodiversity conservation. The focus on green roofs was promoted by the researchers from the Zurich University of Applied Sciences in Wädenswil, Switzerland, who worked to influence decision-makers in Basel to amend the building regulations and offer financial incentives to increase green roof coverage.

Chicago: Green Permit Program – incentives for developers to install green roofs

Chicago's Department of Buildings has developed an incentive program that encourages developers to incorporate environmentally conscious design elements, including green roofs on new buildings. This is known as the Green Permit Program. The incentive is an expedited permit process, through which developers can save both time and money. The initiative is a part of larger portfolio of initiatives aimed at making Chicago's built environment greener and more sustainable. The Green Permit Program was made possible due to the strong leadership of the Chicago Mayor and the efficient processing of the applications by the DOB. Additional benefits of the Green Permit Programme include mitigation of climate change through reduced need for heating and cooling in buildings with green roofs, enhancing the image of the city and the emergence of businesses specialising in green roof installation.

London Borough of Sutton: Adaptation to flooding via local planning policies

The London Borough of Sutton, a local planning authority located in the South East of England, has prepared a range of innovative spatial planning policies that seek to ensure future development within Sutton is fully adapted to the impacts of climate change. Whilst impacts such as temperature rise and occurrence of heat waves are also covered by these policies, this case study focuses on how spatial planning policies have been developed to address the risk of all forms of flooding to and from new developments, and to promote the role of sustainable urban drainage systems in managing surface water runoff. Flooding has already caused significant damage in parts of the Borough, and climate change is projected to further increase the frequency and intensity of flood events. The case of Sutton offers valuable lessons on the development of planning policies targeting adaptation to flooding. These include the use of a robust evidence base to develop policy, and the engagement of local stakeholders and residents in the planning process.

Nagoya: Adaptation to climate change driven by biodiversity conservation

Changes in land use associated with industrialisation and the expansion of residential areas have reduced green sites in Nagoya to about 25% of the area of the city. An additional cause of concern is the increase in temperature of Nagoya City associated with climate change. These factors are exacerbating the urban heat island effect and problems associated with high temperatures in the urban areas of Nagoya. Given these threats, the City of Nagoya has undertaken various measures to create more sustainable lifestyles in the city. The main initiative that can help the city become better adapted to climate change (in particular to high temperatures) is the 2050 Nagoya Strategy for Biodiversity, which aims to improve and extend the green areas of the city. Sitting within the Biodiversity Strategy, the Water Revitalisation Plan aims to recharge ground water supplies by increasing infiltration through the use of green

spaces. A crucial aspect of the Biodiversity Strategy is its implementation in close collaboration with the city's residents, business and non-governmental organisations.

A range of lessons have been extracted from the 15 case studies described in this report (chapter 4). These have been organised according to issues relating to climate change adaptation planning and decision making. The issues covered relate to the process of adaptation planning and decision making, for example collaborative working and developing a sound evidence base, rather than guidance for adaptation actions such as green roof techniques. As the lessons are generic, they are broadly transferable across sectors and spatial scales. The lessons are accompanied by practical 'tips' that suggest ways in which organisations can incorporate these issues into climate change adaptation planning and decision making.

Lessons relate to the following issues:

- Triggers for action, or the reasons why an action is considered by the organisation
- Continuing leadership and championship
- Raising awareness within the organisation, amongst stakeholders and with the wider public
- Collaborative working; how internal and external collaboration, and in particular cooperation with research institutes, has facilitated a stronger adaptation response
- Learning from others, in terms of adaptation processes and/or adaptation actions
- Developing a sound evidence base, either using in-house expertise or by outsourcing experts
- Public engagement on adaptation issues
- Embedding adaptation in decision making through policies, plans, regulations or incentives, and via close collaboration with developers
- Funding for adaptation responses
- Monitoring and evaluation of adaptation responses

The database is supplemented by a number of short (1-page) case studies in Appendix 1, and other sources of practical examples and advice on the preparation of adaptation responses with the use of green and blue infrastructure are listed in Appendix 2.