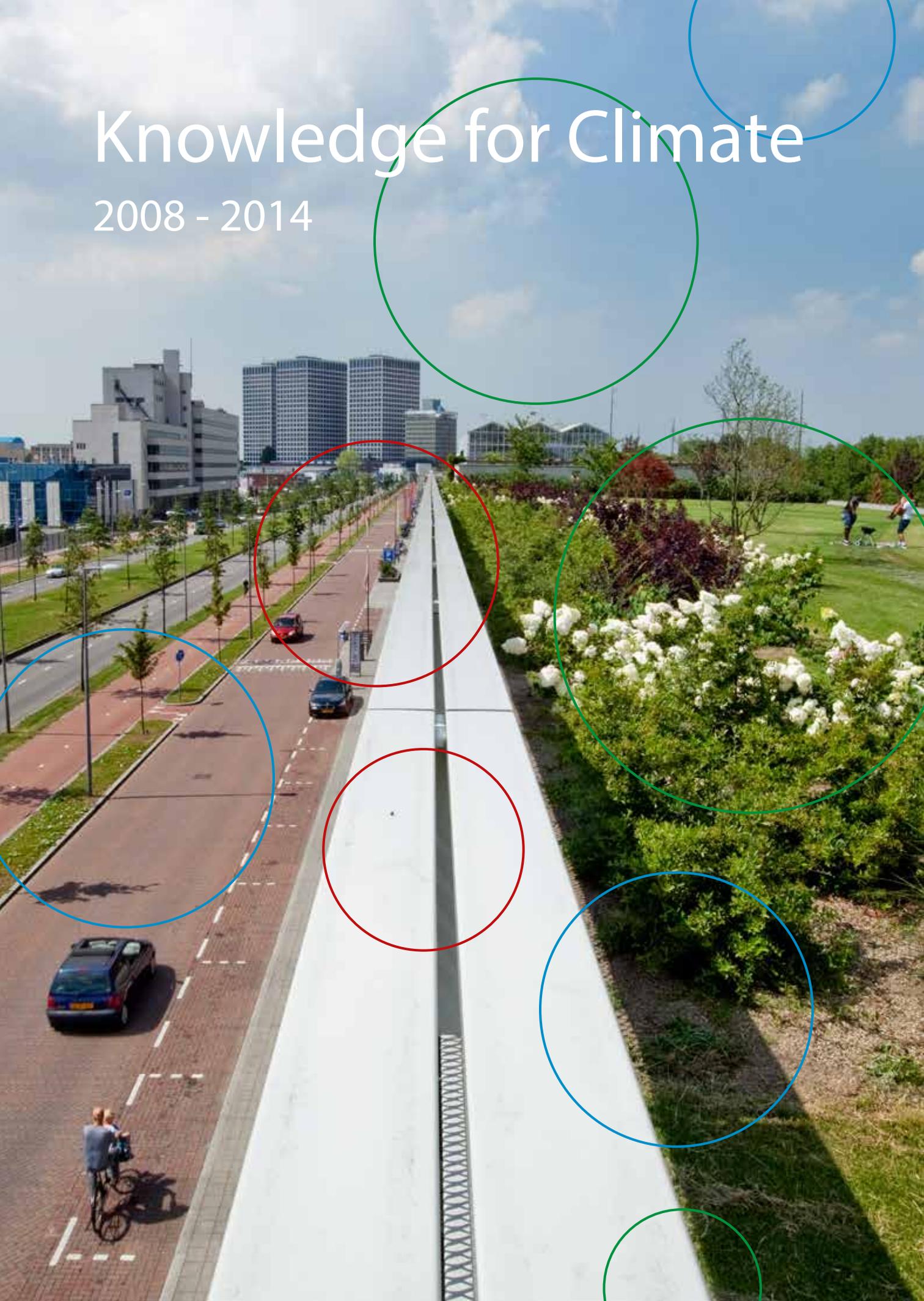


Knowledge for Climate

2008 - 2014



Knowledge for Climate

2008 - 2014



Knowledge for Climate
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Preface Supervisory Board

This is the final report of the national Knowledge for Climate (KfC) research programme. The programme was set up in 2007 to explore the consequences of climate change for the Netherlands and how they should be managed. To that end, an independent foundation was established with the objective of “promoting evidence-based and practice-driven knowledge about climate in the public interest, including making that knowledge available to the public...” (Section 2 of the deed establishing the foundation). The foundation has achieved that objective, together with stakeholders, by organising and funding research and encouraging the processes of knowledge dissemination and application. When the foundation was set up, the fourth Balkenende Government allocated it an initial budget of EUR 50m. Over the past seven years, participating national, regional and local authorities, businesses, and research institutes contributed another 30 million euros to that budget.

The present document comprises the report on the activities of the Knowledge for Climate Foundation, and accounts for the way in which it has utilised the public funds entrusted to it. A draft of this report was reviewed by a scientific panel and a societal panel at a public meeting on 21 November 2014. The results of that review are stated in the report and have been incorporated into it. The Supervisory Board approved the final report of the Knowledge for Climate Foundation at its meeting on 18 February 2015.

As is evident from the review, the results of the programme are extremely interesting for the actual practice of climate change adaptation in the Netherlands. Rotterdam, the Haaglanden region, and various other Dutch regions and cities, for example, are already benefiting from the research results, which have had an impact on relevant adaptation strategies. The research has also provided a number of important components for the national strategy for climate change adaptation and for the Delta Programme. The Knowledge for Climate Programme has also made a major contribution to reinforcing the knowledge infrastructure. As a result, the Netherlands continues to play an important role in internationally oriented climate science, and knowledge generated in the Netherlands can be exported to other parts of the world. Increasingly, that knowledge is also important for the business community, not only because being proactive means that future costs can be avoided but also because the knowledge generated can be marketed more broadly.

During a number of working visits, the Supervisory Board was able to see for itself just how important climate change adaptation is for the Netherlands. That applies both to urban and rural areas. In recent decades, Dutch towns and cities have grown considerably, meaning that they have also become more vulnerable to climate change. In Dordrecht, for example, flood risk management measures are being implemented in the existing urban area. The complex layout of the town means, however, that one cannot simply rely on traditional solutions such

as dykes or evacuation. The concept of “multilevel flood safety” can help in this context. The province of Drenthe finds itself facing increasing risks of water depletion. This is a major problem not only for agriculture but also for nature conservation. In the Dwingelderveld National Park, for example, drastic measures are necessary to preserve this unique area of wet heathland.

Over the past seven years, the Supervisory Board has closely followed and monitored the programme to ensure effective, responsible, and transparent utilisation of the funds provided. The Supervisory Board has also assisted the Executive Board in both word and deed, acting as an advisor and a sounding board. In close collaboration with the Executive Board, the Supervisory Board has determined the broad outlines of the programming, has monitored the quality of the research, and has developed and applied effective strategies in the field of knowledge dissemination and the use of knowledge by relevant public and private parties.

But the conclusion of the Knowledge for Climate Programme does not mean in any way that the task assigned has been accomplished completely. The issue of climate change is so complex and so urgent that the knowledge infrastructure requires constant maintenance and further reinforcement. Knowledge generation continues to provide an important basis for regional and local adaptation strategies and the resulting specific measures, and requires ongoing investment. Nor should the processes of knowledge uptake and knowledge use cease with the conclusion of the programme. Knowledge dissemination and practical applications must be pursued so that the Netherlands becomes genuinely climate-proof. This means that the necessary steps now need to be taken in order to harvest the results of the programme even more, but also to sow the seed for future harvests.

On behalf of the Supervisory Board
Sybilla Dekker, Chair



Preface Executive Board

Remove the hard paving from gardens and industrial sites so that the earth can more easily absorb downpours of rain. Invest in the cultivation of new varieties of potato that thrive in saltwater. Don't just build dikes taller; make them broader and more multi-functional. Store fresh water in the saline soil of Zeeland. These are just a few of the innovations emerging from the Knowledge for Climate research programme showing that small-scale and large-scale adaptation to climate change is possible and necessary – in our gardens and on arable farmland, in cities and across regions.

The Knowledge for Climate research programme was set up to explore the consequences of climate change for the Netherlands and how to manage them. Practical strategies had to be developed for adapting key regions and economic sectors to climate change. Strategies have now been developed for regions such as Schiphol Airport, the Rotterdam region, the Haaglanden region, the area criss-crossed by the major rivers and the south-west Delta, and for sectors such as agriculture, energy and transport.

In the past decade, natural disasters have occurred with greater frequency than ever before on virtually every continent. Hurricane Katrina pounded the United States; large swathes of Eastern Europe experienced the worst floods in decades; Bangkok flooded; and Australia, California and even Russia battled drought and wildfires. Heat waves cost thousands of lives in France alone, and not only among the elderly. Large parts of Pakistan and India flooded, with thousands fleeing the rising waters. The question heard worldwide was whether climate change was behind the increase in weather-related disasters, or whether unbridled urban expansion had made communities more vulnerable. Both causes probably play a critical role.

Nevertheless, climate change – and especially the possibility of adapting to it – remained a relatively unexplored topic in the low-lying Netherlands. It was an abstract, global threat that had to be made real for the Dutch. What impact will 'global warming' have on the Dutch weather system, our farming sector, our infrastructure, our cities, our flood safety? Should we be taking more frequent occurrences of extreme weather into account in our spatial planning? The national government hoped to discover how to make and keep the Netherlands climate-proof by investing 50 million euros in research and innovation.

The programme was undertaken in a turbulent period. Public sentiment had shifted; whereas in 2006 the Dutch listened to Al Gore's warning that the Netherlands would drown if mankind kept pumping greenhouse gases into the atmosphere, by 2009 they were more preoccupied with the IPCC 'Climategate' scandal. On top of this, the economic crisis had hit in the latter half of 2008 and its repercussions commanded the public's and the authorities' full attention. Climate change had taken a back seat. In the wake of these public and political discussions, the Knowledge for Climate Programme quietly continued its steady progress. Its organisation became a knowledge broker that facilitated and stimulated climate research and innovation, leading to numerous new insights into flood risk management, fresh water supply, and urban quality of life. The programme and its methods focused on generating the knowledge and expertise required to make informed investment decisions geared to climate-proofing the Netherlands. It also took every opportunity to place things in an international context. The results are disseminated through scientific publications, reports, books, folders, brochures, news letters, short films, courses, workshops and meetings.

This final report discusses the programme's mission and conditions. We report in general terms on programme execution and spending; the appendices go into more detail about these topics. We conclude the report by offering evidence to support our claim that the funds were well spent and that our mission has been successful.

Prof. Pier Vellinga
Prof. Peter Driessen
Kees van Deelen MSc

Knowledge for Climate Executive Board



1 Run-up, mission and conditions

1.1 The run-up to the Knowledge for Climate Programme

Priority number one in the Netherlands has always been to protect the country against the sea and the rivers. However, changes in extreme weather patterns may also lead to other incidents that can have a major impact on society and result in considerable financial damage.

Bart van den Hurk, researcher at the Royal Netherlands Meteorological Institute (KNMI), worked on the Future Weather project: 'Extreme weather events, for example the storm that hit Vethuizen in 2010, worried people and had them asking "Is this a sign of climate change? Can we expect this to happen more often in future?" The Future Weather project is removing some of the uncertainty about the weather and showing how heavy an extreme local downpour might become.'



There is much that we do not know about the vulnerability, exposure, robustness and resilience of physical and social systems. Back in the 1990s, the Intergovernmental Panel on Climate Change (IPCC) pointed out the need to consider the impact of climate change at local and regional level in particular. The Knowledge for Climate Programme has identified and filled these gaps in our knowledge over the past seven years. It has also made uncertainties manageable and developed options for dealing sensibly with the necessary adaptation to climate change.

The start of the Climate Changes Spatial Planning Programme in 2004 clarified the relationship between climate change and spatial planning in the Netherlands. The Knowledge for Climate Programme has looked at this relationship in greater depth and focused more on knowledge uptake and practical applications.

Harry van Lijptelaar of the Rioned Foundation, the Netherlands' national centre of expertise in sewer management and urban drainage: 'We have to prepare ourselves now for small-scale, extreme rainfall. It's possible to make adjustments that allow us to cope better with large quantities of water, even with limited funds.' Ellen Monchen, Amsterdam Spatial Planning Department: 'We take the knowledge acquired about urban drainage and water storage into account when redeveloping streets or squares. For example, we try to plant more trees, create parks and gardens and reduce the amount of hard paving. We link this to our own energy and water programmes. That way, we can try to tackle urban climate change adaptation from different angles.'

1.2 Mission

The proposal for the Knowledge for Climate Programme that was approved by the third Balkenende Government in 2007 describes its mission as follows:

'To make evidence-based and practice-driven knowledge available so that government and enterprise can join together in making informed spatial planning and investment decisions in the light of the effects of climate change.'

Three main programme aims were derived from this mission:

- 1 To develop expertise on climate-proofing spatial planning investments.
- 2 To reinforce the knowledge infrastructure for climate change adaptation.
- 3 To develop business opportunities in cooperation with the private sector.

Making knowledge work in practice

More knowledge was needed to identify vulnerable areas and potential problems and to reduce and manage uncertainties. The purpose of that knowledge was not to influence short-term policy, but to propose modes of action to all those eager to embark on or needing to take decisions about future spatial planning in the Netherlands. General knowledge about the consequences of global warming had to be converted into specific knowledge relevant to regional and local users, from municipal officials to farmers and from dike wardens to business owners. Research and innovation had to be placed at the service of policymaking. The Knowledge for Climate Programme was decisive in raising awareness of the 'whys' and 'hows' of adapting to climate change.

Marleen van Rijswijk, professor of water law, investigated the legitimacy of climate change policy: 'There are political considerations behind every adaptation measure, but also normative principles such as solidarity. If government fails to communicate and explain this, the public will lose confidence. Government can avoid this by telling its story in the right way and by inviting open discussion.' Heleen Mees (PhD student) compared climate change adaptation programmes in various cities worldwide. 'By communicating clearly about the risks involved in climate change, the authorities made local residents more aware of their own responsibilities.'



The programme focused on developing adaptation strategies for eight regions (the 'hotspots') that are particularly vulnerable to the consequences of climate change. The Executive Board decided to acquire and apply the necessary scientific knowledge in cooperation with the stakeholders in the hotspots.

Policymakers and public administrators needed instruments and concepts in order to take investment decisions that allow for climate change. How could they assess whether a spatial planning investment in a polder, an urban district below sea level, or an area outside a dike protection zone was the right one, and that expensive adjustments would not be required after all in another twenty years?

Ekko van Ierland, leader of the Decision Support Tools Consortium: 'Adaptation measures can be expensive, so you want to pick the best solution.'

Hasse Goosen, climate scientist and co-developer of the Climate Effect Atlas and Climate Ateliers: 'Ultimately, climate change is only one of the many issues on the agenda of policymakers and public administrators. So it's up to us climate researchers to tell our story as transparently as possible and to make the added value of climate adaptation measures clear, i.e. that adaptation creates win-win situations which deliver long-term cost savings, as well as nice projects that fit in with their surroundings.'



More trains are delayed or cancelled owing to extreme weather than people think, according to a study by the Infrastructure and Networks consortium. Disruptions in the railway network are responsible for half of all delays; the other half is caused by the trains themselves. Even then, weather plays a role according to Jos van Ommeren, professor of urban economics at VU University Amsterdam. 'Trains break down more often when temperatures are above 27°C or below -5°C.' The knowledge acquired in the programme can help ProRail anticipate changing weather conditions better.

Knowledge generation that goes beyond the latest fad Co-creation is fundamental to the Knowledge for Climate approach. It means that professionals out in the field join scientists in formulating the research questions and that they work together on research, solutions and results. Scientists are better able than practitioners to look beyond tomorrow, and they can contribute to developing scalable solutions that address more than a specific location or problem. At the same time, practitioners make sure that scientists stay focused and avoid becoming too theoretical and abstract in the way they think and work. This combination strikes the right balance between theory and practice, as envisaged by the Knowledge for Climate Programme. The idea was to use basic and applied knowledge to build an infrastructure that may be highly

conducive to long-term climate change adaptation in the Netherlands. Universities, institutions for applied research and consultants were to build that new knowledge infrastructure together, with the financial and contextual support of the Knowledge for Climate Programme.

Business opportunities for the private sector

Much of the knowledge generated in the Knowledge for Climate Programme is useful for the public authorities in the Netherlands, i.e. the national government, the provincial authorities, the regional water authorities, and local government. But the private sector can also benefit from that knowledge. For example, insights into the effects of climate change are extremely important for the Netherlands' national airport, Schiphol. The same is true for the Port of Rotterdam and for state-funded company ProRail, which manages the country's rail infrastructure, allocates railway capacity and manages traffic on the rails.

But businesses that participate in knowledge generation are not just avoiding climate-related damage. They can also seize opportunities arising from innovative climate-adaptation strategies. Farmers, for example, can learn how to take advantage of higher temperatures and a longer growing season. The potential to market new knowledge has been explored, with Climate Adaptation Business Challenges being organised to encourage innovation and business development.

1.3 Conditions

With climate researchers at Wageningen University and Research Centre, Utrecht University, VU University Amsterdam, TNO and KNMI having produced a well-defined programme, the national government made a 50 million euro budget available in 2007 for a national research programme meant to undertake the intended mission and attain the projected aims. The programme had to meet a number of conditions and requirements. The main focus was on knowledge generation, i.e. the available research funding had to be spent on forward-looking research, and the programme had to improve the national knowledge infrastructure.

Research carried out in the Knowledge for Climate Programme had to explicitly consider those locations in which major investments had been planned, such as Schiphol Airport, the City of Rotterdam and the



Haaglanden Region. It also had to study vulnerable systems and eco-systems, such as the major rivers region, dry rural areas, peat meadows, the South-West Delta and the Wadden Sea. The knowledge and experience acquired through the programme had to be relevant in similar areas in the Netherlands as well as abroad. The programme was also charged with taking climate change adaptation beyond 'flood safety' and exploring the full breadth of the issue. How can policymakers and public administrators in urban and rural areas allow for the consequences of climate change and adapt their plans accordingly where necessary?

Programme governance

The third Balkenende Government set a number of conditions for the programme¹. One requirement was that it should clearly indicate which tasks, responsibilities and competencies were to be allocated to executive, advisory and supervisory boards. As a result, a foundation – the Knowledge for Climate Foundation – was set up in 2008 to develop and adopt the programme's governance structure and to allocate specific tasks and competencies to an Executive Board, a Supervisory Board, a Programme Council and a Programme Office. The deed establishing the foundation also describes the tasks and composition of two advisory councils, one scientific and the other societal.

Funding

Another requirement was that the programme should have a sound budget, proper financial accountability and limited overheads. The Executive Board established the financial rules at the start of the programme, with the approval of the Supervisory Board. The rules were refined further during the course of the programme. Four million of the available 50 million euros was available as start-up capital and to help structure and

plan the research (organisationally and scientifically). Another 46 million euros was available to execute the main programme, set to run from 2008 to 2014, with the proviso that the programme would generate at least 23 million euros in matching funds. In the end, more than 30 million euros in matching funds have been generated (see also Appendix 2). This means that the management was charged with finding project partners that would contribute to the research and the programme funding. Such shared financial responsibility was to lay the basis for strong alliances aimed at co-creation.

Programme positioning and approach

At its core, the programme consists of two components:

- 1 a regional approach, leading to adaptation strategies for eight hotspots;
- 2 a thematic approach, focused on pioneering research on eight different themes

(see Figure 1.1, page 12).

One requirement was that the Knowledge for Climate Programme would work closely together and share information with similar programmes such as Climate Changes Spatial Planning (CCSP) and Living with Water. The idea was to avoid overlaps and explore promising lines of research. The Knowledge for Climate and Climate Changes Spatial Planning programmes were closely allied in the 2008-2011 period. The two executive boards met regularly to coordinate the programming and knowledge uptake. The relationship with the Living with Water Programme was looser because that programme concluded in 2008. However, promising research carried out under this programme was continued in the Knowledge for Climate Programme.

The scope of research in the programme was established in 2008-2009, in close consultation with the Programme Council (whose members included the stakeholders) and the Supervisory Board. The research was then divided into three phases ('tranches'). Because Knowledge for Climate was envisaged as a long-term research programme, the Executive Board did not wish to allocate all the funding at once. Working in phases allowed for adjustments where necessary. Chapter 2 explains the allocation in more detail.

¹ CEKI, 2007

Monitoring and evaluation

The final requirement was to set up programme-wide monitoring and evaluation. This was done by establishing an International Scientific Advisory Council (ISAR) and a Societal Advisory Council (SAC). The two councils both produced two advisory reports during the course of the programme (including a Midterm Assessment in 2012), leading to adjustments in the programming. The final evaluation, in November 2014, has also been undertaken by a scientific and a societal panel.

The Rathenau Institute was asked to perform an independent analysis of the programme's operation in the form of a 'science system assessment'. The aim was to investigate whether the envisaged co-creation actually produced added value. The Rathenau Institute studies how science and technology impact our daily lives. It analyses the dynamics of that process by conducting independent research.

1.4 Reader's guide

The overriding concern in managing the programme has been to achieve the above-mentioned aims. [Chapter 2](#) describes the organisation set up for that purpose, the programme conditions and the relevant execution strategies.

The programme has been structured along two lines. The first involves the development of regional adaptation strategies. [Chapter 3](#) describes the development process and briefly summarises the results of the eight hotspots. The second involves in-depth study of the climate change adaptation issues that are most relevant for the Netherlands. [Chapter 4](#) looks at how the issues were identified, how the research was organised and the most important research results.

Figure 1.1 Hotspots and themes



Chapter 5, which has a somewhat different focus than Chapters 3 and 4, indicates the process of value creation through knowledge generation. In particular, it was the prospect of value creation that influenced the programming and investment decisions taken in the final phase of the programme. Finally, Chapter 6 reflects on programme implementation and the results, including the lessons learned going forward.

The activities and allocation of funding are described in more detail in the appendices. A concept of this report has been reviewed by a scientific and societal review panel during a meeting on the 21st of November. The results of this review and response by the Executive Board are given after chapter 6 and have been incorporated as far as possible in the final version of the report.



Facts & Figures

50 & 30

Basic budget € 50 million; additionally required co-funding 23 million. Realised co-funding > 30 million

8 & 8

8 hotspots and 8 research themes

75

More than 75 project partners

60 & 20

Almost 60 PhD students, more than 20 postdocs and more than 150 senior researchers

17.000

Climate TV and other films and videos have had more than 17,000 views. See www.youtube.com/ClimateNL

> 800

More than 800 scientific articles published, in cooperation with the Climate Changes Spatial Planning Programme. 300 publications based entirely on Knowledge for Climate research. Many scientific publications will appear only after the programme has ended; more than 100 publications are expected in 2015 alone.

30

30 national conferences, workshops and meetings organised, usually in cooperation with other parties (regional water authorities, consultants and local government).

1200

1200 people attended the international Deltas in Times of Climate Change conference in 2010, and more than 1200 attended the second international conference in 2014.

700

The Knowledge for Climate website (www.kennisvoorklimaat.nl) has more than 700 visitors a week.

2800 & 800

The programme has 2800 followers on Twitter and 800 LinkedIn members.

10.000

The Knowledge for Climate publications database had an average of 10,000 downloads a week in 2013.



2 Organisation, strategies and instruments

The Knowledge for Climate Programme was supposed to drive research forward and explore issues in-depth, with policymakers and researchers cooperating to make knowledge less abstract. Its underlying conditions and structure made it possible to work flexibly towards achieving the programme aims. Thanks to its organisational set-up, strategies and tools, the Knowledge for Climate Programme functioned as a knowledge broker and was free to determine how it would achieve its aims. Some strategies were developed at the programme's inception, while others were added as it evolved.

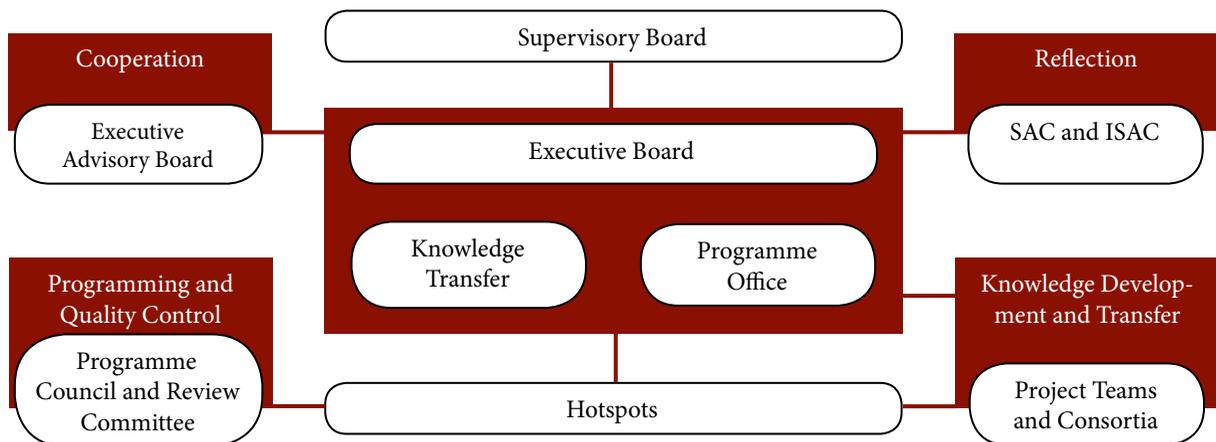
2.1 Organisational structure

The organisational heart of the Knowledge for Climate Programme consisted of four bodies: the Supervisory Board, the Executive Board, the Programme Office and the Knowledge Transfer unit. The Supervisory Board had the usual tasks of supervising and adopting policy. 2. The Supervisory Board had the responsibility to approve the annual reports, and annual plans. Two members of the Supervisory Board served as an “audit committee” in the preliminary discussions of financial issues prior

to the meetings between the Supervisory Board and the Executive Board. Furthermore, the Supervisory Board discussed and approved strategic decisions. The Executive Board bore overall responsibility for the programme and for achieving its aims. The Programme Office was charged with day-to-day programme execution, and with preparing and implementing board decisions. The Knowledge Transfer unit was responsible for knowledge uptake and knowledge-sharing between internal and external parties. The Programme Office and Knowledge Transfer unit worked as a single unit (see Figure 2.1).

In addition, a number of advisory bodies played an important role in programming and executing the research programme and in coordinating and cooperating with other programmes and initiatives. These were: a Programme Council, which advised on research programming; an International Scientific Advisory Council and a Societal Advisory Council, responsible for monitoring and evaluation; and an Executive Advisory Board, which advised on coordination with the national climate adaptation policy and the research programmes

Figure 2.1 Organisational structure



Box 2.1 Knowledge for Climate Strategies

Strategies

- 1 Developing evidence-based climate change adaptation strategies for economically and/or ecologically vulnerable regions, focused on long-term approaches and adapted as short-term policy measures
- 2 Linking theoretical knowledge generation to practical issues
- 3 In-depth knowledge generation (disciplinary, interdisciplinary, thematic)
- 4 Knowledge valorisation: ensuring that knowledge is applied in practice and encouraging the related economic activity
- 5 Adaptive programming
- 6 Working closely with other public-sector parties in the domain of climate change and adaptation.

of the main research institutions involved. The duties and responsibilities of the bodies and units given in [Figure 2.1](#) can be found in [Appendix 1](#).

2.2 Strategies (see also [Box 2.1](#))

1. Developing regional adaptation strategies

The ‘hotspot’ approach was chosen during the programme development stage. In other words, research would focus on eight regions considered economically and/or ecologically vulnerable. The aim was to develop regional adaptation strategies in cooperation with stakeholders. These strategies are meant to anticipate climate change and offer a particular mode of action, a range of different measures and policy intentions. [Chapter 3](#) looks at the hotspot approach in detail.

2. Linking theoretical knowledge generation to practical issues

One of the underlying principles in designing the research programme was to link theory and practice. In order to guarantee that the knowledge being generated is practical and relevant to society, the programme was demand-driven, for example by working with regional parties in the hotspots.

3. In-depth knowledge generation

One key strategy was to target cohesion between disciplines, between economic and policy sectors, and between general and area-specific issues by identifying a set of research themes. This is how the Knowledge for Climate Programme aimed to deepen scientific knowledge and avoid ‘fragmented’ knowledge generation. Climate-proof spatial planning requires an all-round approach to climate change adaptation.

4. Knowledge valorisation

Valorisation means making knowledge valuable to society and the economy. This involves having the public sector utilise that knowledge, developing regional adaptation strategies, and creating economic activity by applying innovative climate change adaptation strategies.

To what extent does climate change threaten Dutch agriculture? This question, posed by LTO-Noord – the northern branch of the Dutch Federation of Agricultural and Horticultural Organisations – was the starting point for research on climate change adaptation measures for farmers. The emphasis was on extreme weather events, which can cause considerable damage to agriculture. Peter Prins, LTO Noord: ‘The most important result is that farmers became aware that they themselves can take measures, for example drip irrigation and soil improvement. By knowing more about the extremes, farmers can apply these new ideas in their practice.’ The project, in which farming associations such as LTO collaborated with researchers, resulted in a follow-up in which model projects were carried out in Uganda and Cambodia, funded by Agriterra (organisation for international cooperation founded by civil society organisations in rural areas and the private agricultural sector).



5. Adaptive programming

An adaptive management strategy was used in the Knowledge for Climate Programme. Programming was in three phases (see Box 2.2). This made it possible to key into changing insights, new issues and trends.

Box 2.2 Programming in three phases

Research in the Knowledge for Climate Programme was planned over three phases. Each phase had its own programme line.

- 1 The first phase (2008-2013) addressed the most urgent knowledge demands in the eight regional hotspots. In addition, it also looked at more general, ‘supra-hotspot’ knowledge demands. The first phase covered 42 projects in all.
- 2 The second phase (2010-2014) was thematic in nature, focusing mainly on long-running, innovative and in-depth research along eight themes. The focus in these eight projects was on linking general and area-specific issues.
- 3 The third phase (2011-2014) was aimed at developing adaptation strategies for the hotspots and at innovation and/or at knowledge valorisation (‘value creation’). This phase covered 30 hotspot projects and 21 value creation projects.

6. Working with other public-sector parties on climate change and adaptation

The Knowledge for Climate Programme worked closely with a number of relevant parties also involved in researching and advising on climate change adaptation. They were the Climate Changes Spatial Planning Programme, the Netherlands Environmental Assessment Agency, the Foundation for Applied Water Research (STOWA, the regional water authorities’ research organisation), the Delta Programme, and the Netherlands Organisation for Scientific Research (NWO) (see Section 2.4).

2.3 Instruments for achieving key aims

The strategies described in Section 2.2, which guided programme execution, influenced the instruments chosen for the three research phases. Combined, the strategies and instruments constitute the approach used to achieve the aims of the research programme.

Demand articulation and co-creation

Climate-proof spatial planning requires an all-round approach to climate change adaptation that links short-term policy issues to long-term climate issues. Climate change adaptation strategies are more likely to be supported and implemented if the relevant parties in the

scientific community and the public and private sectors work together. That is why in the hotspots, a process of demand articulation was set up between the research institutions and the stakeholders. The purpose of that process was to ensure that the starting point for research was the demand for knowledge out in the field. The in-depth research carried out within the eight themes was also based on research questions arising from practice. Efforts were made to involve stakeholders in formulating the research questions, preferably as a project participant. Practitioners received regular updates on the project's progress and were asked to consider the practical relevance of the interim results.

How and to what extent does the failure of one network affects the way other networks operate? The Infrastructure and Networks consortium brought network managers and developers from the Rotterdam-Noord study area together with researchers in order to answer that question. The researchers used computational models and methods to calculate the local experts' practical questions. 'Knowledge generation went hand-in-hand with the network managers' practical experience,' says Jos Streng of the City of Rotterdam's Traffic and Transport Department. 'That resulted in a high level of commitment to the study. Although it remains difficult to strike the right balance between the short term and the long term, we managed to steer the middle course between research into phenomena of long-term relevance and measures that can also be useful today.'



Co-funding the research

To stimulate co-creation, the stakeholders had to fund part of the research. That was true both for the hotspot research projects (first and third phases) and for the research themes (second phase). Co-funding means that responsibility for executing the research and ensuring relevant research results lies with both parties. The research institutions are kept on their toes in this way: they must ensure that the research results are of practical use and that the research actually answers the questions posed.

Within the framework of the call for research proposals in the second phase, the hotspot parties and other stakeholders gave direction to the research by providing co-funding. Much of the funding for the research themes came from grant money allocated to the hotspots in the original research proposal. The hotspots themselves decided which research theme their grant money would be used towards. When grant money was applied towards a particular theme, the stakeholders involved also provided co-funding. This is how scientists and practitioners remained committed to one another throughout the entire research period.

Multidisciplinary knowledge generation

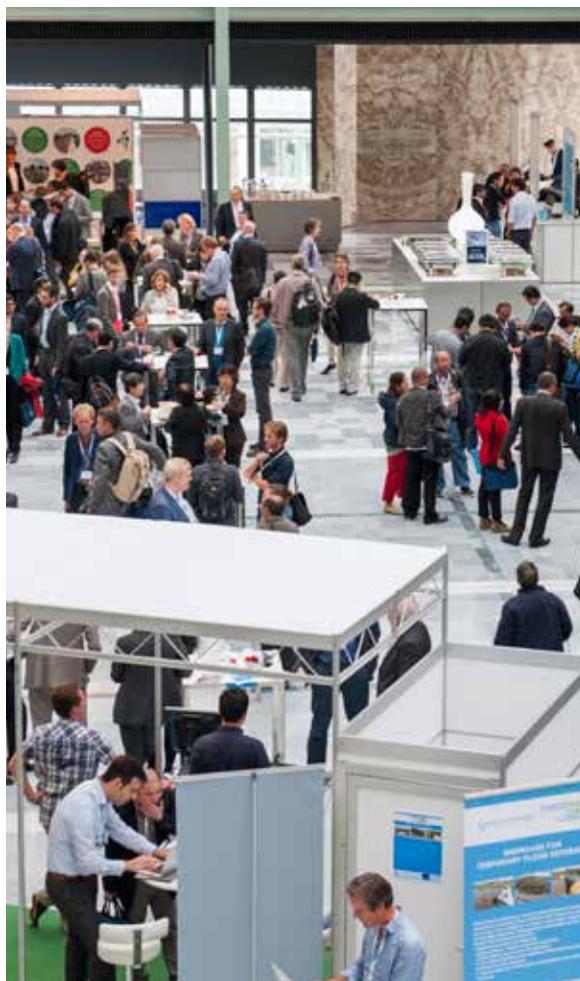
To promote multidisciplinary and cross-sector knowledge generation, the Knowledge for Climate projects were undertaken by consortia. In addition to universities and institutes of applied research, firms of consultants and businesses also took part in the research as experts.

The call for research proposals (second phase) was meant to ensure in-depth theoretical knowledge and prevent 'fragmented' knowledge generation. Consortia of research institutions were invited to submit proposals for one of the eight themes. To ensure that the themes were in fact studied in-depth and that the projects reflected international scientific discourse, multidisciplinary, cross-sector and international cooperation was important. The competitive nature of the open call ensured top-quality submissions from consortia of outstanding research institutions (see Appendix 4 for a list of all the project teams and consortia).

Scientific and societal review

The Knowledge for Climate organisation set up a quality assurance system in order to guarantee the quality of the research, monitor the programme lines and achieve the programme aims. The key assessment criteria were scientific merit, societal relevance, applicability and uptake of knowledge. The quality assurance system has played a pivotal role in strategic programming decisions and led to actual adjustments in the programme.

All project applications and the final project results were subject to an independent review. An effort was made to strike the right balance by asking both researchers and experts or policymakers in the field to review the project proposals. The Board of the Knowledge for Climate Programme based its decisions (whether or not to honour project applications or to approve final project results) on these external reviews. The review system was modified to reflect the research scope of the call in each of the three phases. Financial and research-related monitoring took place every six months during the project period.



Interim reviews of the overall programme were conducted at regular intervals, allowing the organisation to reflect on the path it had chosen, the results achieved so far, and the degree of knowledge uptake in the field (see Box 2.3). For example, research programming in the second phase was based in part on observations made while reviewing the first-phase proposals. The Executive Board felt that the first-phase projects were leading to a fragmented form of knowledge generation and lacked a certain depth. In consultation with the Supervisory Board and the Executive Advisory Board, it therefore decided to reallocate half of the grant money earmarked for the hotspots in the second phase for in-depth research on eight themes (see also Chapter 4). The research focused on issues and areas of application relevant to stakeholders in the hotspots, such as local government, regional water authorities and businesses.

Box 2.3 Monitoring and interim evaluations

In 2011, the Knowledge for Climate and Climate Changes Spatial Planning programmes organised a meeting between their joint International Scientific Advisory Council (ISAC) and the Societal Advisory Council (SAR). For the programme management of Knowledge for Climate, the findings of the two councils confirmed that the overall programme were on the right track. At the same time, the findings encouraged the management to continue working on and improving the programme, and to focus on how the issue of climate change can be adequately addressed in the long term¹.

The Knowledge for Climate Midterm Assessment took place in October 2012. It took the form of a written review and a meeting. Scheduled for halfway through the thematic research period of the second phase, the purpose was to consider whether the programme was on track to achieving its aims. Panels of more than forty international scientists, policymakers and expert practitioners reviewed the eight consortia falling under the second phase and the eight hotspots in the Netherlands, based on their midterm reports. A detailed report was included in the 2012 annual report. The Midterm Assessment revealed specific points of concern for each consortium and each hotspot. It offered an accurate overview of the programme's status and a look ahead to the final results in 2014. Appendix 4 of this report summarises the findings of the Midterm Assessment.

¹ Annual Report, 2011



Knowledge Transfer

Knowledge Transfer played an important role in achieving the main aims of the Knowledge for Climate Programme. It was not only within the context of the projects that researchers and practitioners shared their knowledge and experience with one another; active efforts were also made within the overall programme to communicate and share knowledge with others. The Knowledge Transfer unit was charged with passing on scientific knowledge to practitioners and with getting practitioners to share their knowledge with researchers. It did this by organising national and international symposiums and conferences, by preparing courses (for higher professional and postdoctoral training), by writing books and by producing films about climate change research. It also assisted the hotspots and research consortia with regard to knowledge uptake. For example, it organised several one-day project seminars for the hotspots and researchers. Also the Knowledge Transfer wrote flyers, booklets and digital newsletters with a wide circulation. The Knowledge for Climate website has played a particularly important role in knowledge-sharing and knowledge transfer (see Box 2.4). The starting point has always been to make all results publicly available. By organising workshops specifically intended to promote knowledge-sharing between the hotspots, the Knowledge Transfer unit made a major contribution to developing regional adaptation strategies. Appendix 5 describes the Knowledge Transfer unit's activities and publications.

Box 2.4 Digital access to knowledge

From the very start, the Knowledge for Climate research programme had both a Dutch-language and English-language website². The website explains the purpose of the programme, reviews the relevant research themes and hotspots, and shows the project results. News and calendar events related to the programme and the general field of climate change research were updated weekly, making the site dynamic and newsworthy. In time, social media was added into the mix, i.e. Twitter (2800 followers), LinkedIn (820 members) and Facebook (ClimateNL).

The site drew an average of 700 visitors a week, good for approximately 4000 page views per week. The number of publication downloads has increased rapidly in the past four years, from approximately 2000 to approximately 10,000 a week. There was a marked increase at the end of 2011. On the one hand, that was because the Knowledge for Climate Foundation had issued a major series of publications; on the other, it was because a growing number of websites were referencing publications in the Knowledge for Climate online database and because these publications were (and are) highly rated in Google Index. A digital newsletter was published every quarter with a circulation of more than 3000 e-mail addresses. The Knowledge for Climate website will remain online until at least 2020. The publications will be retrievable from the Wageningen University and Research Centre Library until at least 2024.

² www.kennisvoorklimaat.nl / www.knowledgeforclimate.org

2.4 Relationships with other national and international programmes

The Knowledge for Climate Programme has worked with national and international organisations at many different levels. In the hotspots and projects, it mainly cooperated with local and regional parties (regional water authorities, local and provincial authorities). On a national scale, the programme as a whole collaborated with the Netherlands Environmental Assessment Agency and the Delta Programme. It entered into relationships with other organisations and programmes in the Netherlands and internationally, giving rise to new projects and meetings and helping the programme management identify the research questions and promote knowledge uptake. The Knowledge for Climate Programme's annual reports report on these interactions. In this section, we briefly describe the most important alliances.

Climate Changes Spatial Planning Programme

To encourage its participants to draw on existing knowledge, the Knowledge for Climate Programme worked closely with the Climate Changes Spatial Planning Programme (launched in 2004) from the very start. For example, the two programmes developed a joint strategy for communication and knowledge uptake through the Knowledge Transfer unit. They also provided joint financial support for a number of projects. The Climate Changes Spatial Planning Programme came to an end in 2011.

Netherlands Environmental Assessment Agency (PBL) and Royal Netherlands Meteorological Society (KNMI)

The Knowledge for Climate Programme collaborated with the Netherlands Environmental Assessment Agency (PBL) on various projects. For example, it joined the PBL and the Climate Changes Spatial Planning Programme in preparing an advisory report for the national government on climate-proofing the Netherlands (2009-2011). Since late 2013, the Knowledge for Climate organisation has worked closely with PBL and the Royal Netherlands Meteorological Society (KNMI) at the request of the Ministry of Infrastructure and the Environment. on elements of the National Climate Change Adaptation Strategy, scheduled to be completed in 2016. The Knowledge for Climate Programme is coordinating a number of key subsidiary projects which involve the risks and opportunities of climate change for different sectors that have been under exposed in the Deltaprogramme. There also have been a study on public and private responsibili-

ties and innovations in climate adaptation. The Ministry of Infrastructure and the Environment has made an extra 0.4 million euros available to the Knowledge for Climate Programme for these projects. In 2014, the KNMI published a new series of climate scenarios. They are based in part on knowledge generated with the help of funding provided through the Knowledge for Climate Programme.

Regional water authorities

The Knowledge for Climate Programme and the Foundation for Applied Water Research (STOWA) worked with the regional water authorities at all levels on knowledge generation. STOWA is the Dutch regional water authorities' research organisation. It generates, acquires and disseminates knowledge that water management bodies need to meet their challenges. Wherever possible, issues that the regional water authorities had raised in STOWA's own Deltaproof research programme were phased into Knowledge for Climate research. Researchers involved in the second phase (in-depth research) helped write the online knowledge dossiers (the Deltaproof Delta Facts) about flood risk management and fresh water. The Delta Facts are decision support tools for the water management bodies. In addition, the Knowledge for Climate Programme organised a number of practice-based conferences in cooperation with STOWA, with researchers and policymakers collaborating on climate adaptation strategies. The Knowledge for Climate Programme has cooperated with 14 of the 24 regional water authorities in the Netherlands.



Netherlands Organisation for Scientific Research (NWO)

The Knowledge for Climate Programme worked with Netherlands Organisation for Scientific Research (NWO) on two open calls. The first, in 2009, involved collaboration with the NWO Sustainable Earth programme and concerned with the relationship between land use and climate change. The Knowledge for Climate Programme provided a third of the 1.5 million euro budget. This joint call produced five projects, each with two postdocs. One of the projects, INSPIRATOR, resulted in 2013 in the book *Kenniscocreatie: naar een productieve samenwerking tussen wetenschappers en beleidsmakers* [Knowledge co-creation: en route to productive cooperation between scientists and policymakers]³. A workshop held in January 2014 to mark the book's publication brought researchers and practitioners together to share lessons learned about knowledge co-creation.

The second call concerned an international alliance with ten other European research funding agencies focusing on the theme 'Societal Transformations in the Face of Climate Change' (*JPI Climate*; see page 22). The Knowledge for Climate Programme and NWO made a financial contribution to this international call.

In addition, the plans for two NWO calls were closely coordinated with the plans for the Knowledge for Climate Programme. These were the programmes Urban Deltas of the World (UDW) and Urban Regions in the Delta (URD).

Delta Programme

The Delta Programme was set up shortly after the Knowledge for Climate Programme was established. Its purpose was to develop policy on flood risk management and fresh water supply in the Netherlands, both now and in the future. It seemed logical and appropriate for the two programmes to work together. At the same time, it was clear from the start that their aims differed in a number of respects. The Delta Programme, for example, focuses on preparing policy, while Knowledge for Climate focuses on independent scientific research. The Delta Commissioner and the chairman of the Knowledge for Climate Executive Board nevertheless signed a declaration early on stating their intention to cooperate.

3 Hegger, D., De Boer, Y., Offermans, A., Merx, F., Dieperink, C., Kemp, R., Van Lente, H., Cörvers, R. (2013). *KennisCOcreatie: naar productieve samenwerking tussen wetenschappers en beleidsmakers*.

The cooperation between the two programmes has been very productive. One good example is the independent review that the Knowledge for Climate Programme organised in the interests of quality assurance within the Delta Programme (2013 and 2014). In addition, the Knowledge for Climate Programme and Wageningen University and Research Centre organised the third Delta Programme Knowledge Conference in 2013.



Delta Commissioner Wim Kuijken about cooperation between the two programmes:

'We worked hard to bring theory and practice together. We invested a lot of energy in turning theoretical knowledge into practical methods for the people working in the Delta subprogrammes. The Knowledge for Climate researchers conducted in-depth studies, collected information, made it available, and developed decision support tools and systems. They participated in the project teams and were involved in carrying out the practical pilot projects.'

Table 2.2 Interaction between the Delta Programme and the Knowledge for Climate Programme

Delta sub-programme	Flood Risk Management	Fresh water	New buildings and restructuring	Rijnmond-Drechtsteden Region	South-West Delta	Wadden Sea	Lake IJsselmeer	IJsselmeer	Coast
Knowledge for Climate									
Hotspot									
Haaglanden									
Mainport Schiphol									
Rotterdam Region									
South-West Delta									
Wadden Sea									
Major Rivers									
Shallow Waters and Peat Meadow Areas									
Dry Rural Areas									
Research theme									
Flood Risk Management									
Fresh Water Supply									
Fresh Water Supply									
Cities									
Infrastructure and Networks									
Climate Projections									
Governance of adaptation									
Decision Support Tools									

The Delta Programme made it possible for Knowledge for Climate researchers to align their studies with existing large-scale policymaking processes. In turn, the Knowledge for Climate Programme served as a welcome independent think tank, broker and research body for the Delta Programme, one in which societal and scientific climate change adaptation issues converged (Table 2.2).

International relationships

Besides cooperating with international partners in the projects, the Knowledge for Climate Programme also entered into international alliances. For example, it took part in two European Union initiatives. One was JPI Cli-

mate (Joint Programming Initiative Climate), where it played a significant role in developing this European-level research alliance. JPI is a partnership between fourteen European Union Member States whose purpose is to plan and fund joint research on climate change and climate change adaptation. Knowledge for Climate also provided input to the Governing Board and coordinated Dutch research input in the four working groups (climate projections, climate services, societal transformations and decision-support tools). JPI has since become a mature organisation that organises open calls. As reported above, the Knowledge for Climate Programme co-funded the first open call on Societal Transformations in the Face of Climate Change (in cooperation with NWO).

The second European-level project in which Knowledge for Climate participated on behalf of Dutch universities and research institutions was the EU-funded CIRCLE2 ERA-Net project. This project, which concluded in early 2014, focused on improving EU-level cooperation in funding research and encouraging policymakers to engage in dialogue with regard to the impact of climate change and climate change adaptation. In 2012, the Knowledge for Climate Programme surveyed 22 completed climate change adaptation projects across Europe within the context of CIRCLE-2. The projects were described in the *Adaptation Inspiration Book*⁴ (1500 copies printed), which was meant to inspire policymakers and researchers to tackle climate change adaptation in their own regions.

The knowledge gained through the Knowledge for Climate Programme helped large research institutions such as Deltares, Alterra, KNMI, TNO and the universities (Utrecht University, Wageningen University and Research Centre, VU University Amsterdam and Delft University of Technology) submit successful proposals under the EU's climate change adaptation research programmes (FP-7). This has given Dutch researchers a leading position in EU-funded research on climate change adaptation.

⁴ <http://www.circle-era.eu>, CIRCLE-2, *Adaptation inspiration book* (2013). 22 implemented cases of local climate change adaptation to inspire European citizens.





3 Hotspots: Developing regional adaptation strategies

The Knowledge for Climate hotspots are eight regions of major economic and/or ecological significance that are vulnerable to the consequences of climate change (see box 3.1). Together they represent the most important area categories in the Netherlands. In these hotspots, theory and practice are closely aligned, with the aim being to

identify problems arising from climate change and to develop adaptation strategies for each area. This chapter describes what this approach has produced and what role the hotspots played in the programme (see also Appendix 6). It also looks at the international component of the programme, i.e. the Delta Alliance.

Box 3.1 What is a hotspot?

A hotspot is a municipality or region that can be described as follows:

- An area in which major spatial planning investments have been envisaged that may increase vulnerability to climate change.
- An area in which the capacity to adapt is limited or can be improved considerably.
- An area in which the challenge of climate change adaptation impinges on various policy sectors and regional interests, and in which an integrated approach is required.
- An area in which the authorities basically support the idea of climate-proofing future spatial planning.
- An area in which the cooperating parties are prepared to develop a joint adaptation strategy as a mode of action for the future¹.

¹ Knowledge for Climate programme proposal, 2006.

In the hotspot Shallow Waters and Peat Meadow Areas, participants explored how to prevent water stress and subsidence in peat meadow areas and how to combat the growth of algae and botulism in lakes and ponds. Models show that if we make no changes to our management approach, almost all of the Netherlands' peat meadow areas will have disappeared by 2100. The hotspot team also invested in a website: www.veenweidegebieden-oras.nl. Project leader Jos Verhoeven: 'The site brings together all the research that we carried out in our hotspot. We generated a lot of knowledge in the hotspot. Most useful to us were knowledge workers in regional government who had good relationships with public administrators. I believe that we'll be able to save the peat meadows, in part because of our efforts to join theory and practice.'



3.1 Hotspot funding and set-up

The three 'big' hotspots – the Haaglanden Region, Mainport Schiphol and the Rotterdam Region – were each awarded a budget of 5.25 million euros from the Knowledge for Climate Programme owing to their immense economic significance and the major spatial challenges involved. Each of the other hotspots had a research budget of 1.1 million euros. The basic idea was to finance the research by means of co-funding, with 50% coming from the Knowledge for Climate budget and 50% in the form of matching funds.

Project team

Each hotspot coordinator – in most cases a representative of local or regional government – put together a hotspot team consisting of representatives from the regional water authorities, local government, provincial government, research institutions and other stakeholders. In the Mainport Schiphol hotspot, the private sector was the most important stakeholder.

Peter van den Brink, Mainport Schiphol hotspot coordinator:

'As a business, we are focused on concrete, practical results. The outcome is more precise meteorological information that will improve the safety of our aviation operations.'

Identifying the questions



The likelihood of developing practical climate change adaptation strategies is greater if the research is closely aligned with what practitioners need to know and if all the relevant parties cooperate closely. The demand for knowledge in the hotspots was therefore pivotal to the research plans drawn up within the Knowledge for Climate Programme.

At the start of the programme, the hotspot teams identified their most urgent knowledge requirements. The Knowledge for Climate organisation arranged debates and expert meetings to help the hotspot teams articulate their research questions. The teams also organised meetings with stakeholders at which they informed them about the programme and knowledge co-creation, put the issue of regional climate change adaptation on the agenda, and discussed specific questions about climate change and local or regional adaptation strategies. The research itself gave rise to new research questions. In each successive phase of the programme, the hotspots teams were involved in the research and able to indicate their knowledge requirements.

3.2 The role of the hotspots

Besides surveying and articulating research questions and raising matching funds, the hotspots teams played a number of specific roles during various phases of the programme.

- 1 They participated in the Knowledge for Climate Programme Council (see also Appendix 1). The Programme Council advised on the assessment of project ideas and helped formulate research questions as preparation for the research themes. Participating in the Programme Council allowed the hotspot teams to stay abreast of progress and get acquainted with one another while developing regional adaptation strategies.
- 2 They coordinated region-specific projects. Each hotspot team had a direct impact on the project research conducted within its hotspot; the teams themselves submitted project proposals to the Knowledge for Climate organisation.
- 3 They were stakeholders in the research themes. Because they provided funding, the hotspot teams were able to indicate which themes they considered interesting and relevant. The hotspot coordinators also participated in the steering committee that supervised the consortia's research. They also submitted case studies linking general research questions to area-specific questions.
- 4 They linked and adapted research results to produce suitable area-specific adaptation strategies.

Exploratory projects in the first programme phase

The first phase of the programme got under way in early 2009 with 33 hotspot projects in which the emphasis was on exploration and agenda-setting. Some were supra-hotspot projects because multiple hotspots had similar knowledge requirements. One example is the study 'Vraag en aanbod van zoetwater in de Zuidwestelijke Delta' [Fresh water supply and demand in the South-West Delta] (2009), with contributions by the Major Rivers, Haaglanden Region, Rotterdam Region and South-West Delta hotspots. The study explored the existing knowledge base on the salinity problem in the Netherlands' southwest delta. It revealed that even if Lake Volkerak-Zoommeer once again becomes a saltwater lake, there are enough ways to ensure a sufficient fresh water supply. The study turned out to be cutting-edge. A broad consortium investigated the supply of fresh water throughout the entire southwest delta and identified the limits of the current system's viability. These results paved the way for much of the follow-up research on fresh water supply in the Knowledge for Climate Programme.

Box 3.2 : Invent, develop and apply

The 2012 publication *Bedenk, Ontwikkel en Gebruik*² [Invent, Develop and Apply] contains interviews with researchers and end users about a number of hotspot projects. The book explains how research results gained in the hotspots have been applied in practice.

Riverfront on a dike

Researchers explored the option of climate-proofing the dikes protecting the village of Streefkerk³. Their research results were used to inform the design of a broad, multifunctional dike.

Working together to save the peat meadows

A study conducted within the Peat Meadow Areas hotspot focused on the effects of climate change on peat degradation⁴. Interactive workshops making use of a Touch Table – a large computer screen displaying layered maps – allowed stakeholders to work with the results of the study themselves. 'The consortium was valuable because it brought different disciplines together, as well as researchers and practitioners, with each group contributing its specific know-how,' says Johan Medenblik, senior policy officer for hydrology with the Province of Friesland, one of the project partners². Policymakers used the new data and interactive working method in their decision-making about the peat meadow areas of Friesland, ultimately leading to a strategic agenda for the peat meadows.

Lower flood risk outside dike protection zone?

The flood risk outside the dike protection zone and in the Port of Rotterdam is higher than inside that zone – but the impact of flooding is much smaller. The results of this Rotterdam Region project⁵ are being used in the Delta Programme's Rijnmond-Drechtsteden project, in the EU Floods Directive, and in teaching at Rotterdam University of Applied Sciences. 'This study has given our company and other stakeholders many innovative ideas in a relatively underexplored part of the flood risk problem,' says Joost Lansen, project manager at Royal HaskoningDHV, one of the project partners².

2 Pater, F. de & Pijnappels, M. (red). *Bedenk, ontwikkel en gebruik. Kennis voor Klimaat in de praktijk*. Utrecht, 2012.

3 Hotspot Grote Rivieren, Gebiedsspecifiek onderzoek naar nieuwe klimaatbestendige dijkverbeteringsalternatieven (2010)

4 Hotspot Ondiepe wateren en Veenweidegebieden, Ruimtelijke plannen voor het tegengaan van klimaateffecten in veenweiden en ondiepe meren (2010)

5 Hotspot Regio Rotterdam, Waterveiligheid buitendijks gebied (2010)

A year after these projects had ended, more than half of the results were being used by policymakers, eg. in the implementation of the Rotterdam Adaptation Strategy, in the design of the Haaglanden Region Adaptation Strategy, and as input for the Delta Programme (see Box 3.2).

In-depth research in the second programme phase

More basic research questions that arose in the hotspots were grouped under eight themes in the second phase of the programme. The hotspots themselves selected the themes in which they would participate. All hotspots took part in the Governance theme, for example (with the exception of Mainport Schiphol), whereas only the Rotterdam Region and Mainport Schiphol participated in the Infrastructure and Networks theme (see Table 3.2.). Chapter 4 will look more closely at the process of funding allocation and co-funding in the second phase.

The research themes linked theoretical and applied research. The hotspots and other co-funding parties submitted research proposals and suitable case studies for applied research. The research consortia successfully attracted new stakeholders in this stage as well, for example the cities of Amsterdam, Utrecht and Arnhem for the Urban Areas research theme, and electricity transmission operator TenneT for the Infrastructure and Networks research theme.

Bergpolder Zuid, a district of Rotterdam, is in need of redevelopment. The municipal authorities wanted to know whether climate adaptation measures would be possible and effective there. Researchers and practitioners explored the options together in 'climate ateliers'. In one atelier, the Climate-Proof Cities consortium exhibited a broad spectrum of different adaptation measures, from green roofs to better drainage systems. The atelier participants drew feasible measures in on a map and discussed the results. 'We combined a solid knowledge of the area with theoretical insights,' says Susanne Buijs, environment and sustainability adviser for the City of Rotterdam. 'The practitioners also became better acquainted with the thinking and language of scientists, so that we understood one another better.'

Table 3.2 Hotspot participation in the research themes

Themes	1 Flood Risk Management	2 Fresh Water Supply	3 Rural Areas	4 Cities	5 Infrastructure and Networks	6 Climate Projections	7 Governance of adaptation	8 Decision Support Tools
Hotspots								
Major Rivers								
Rotterdam Region								
Wadden Sea								
South-West Delta								
Mainport Schiphol								
Haaglanden Region								
Shallow Waters and Peat Meadow Areas								
Dry Rural Areas								



Lori Tavasszy, consortium leader of the Infrastructure and Networks research theme: 'During an area-specific study in the Rotterdam-Noord district, we became aware of how closely the various infrastructure networks are intertwined.' The process of awareness-raising was a slow one, Tavasszy observes. 'Network managers had a hard time hearing the wake-up call. We used practical examples to show them just how huge the cascade effect could be. And we suggested ways to minimise the risk of damage. By linking these measures to work that is already scheduled to take place, they can have a major impact for a relatively low price.'

En route to regional adaptation strategies in the third phase

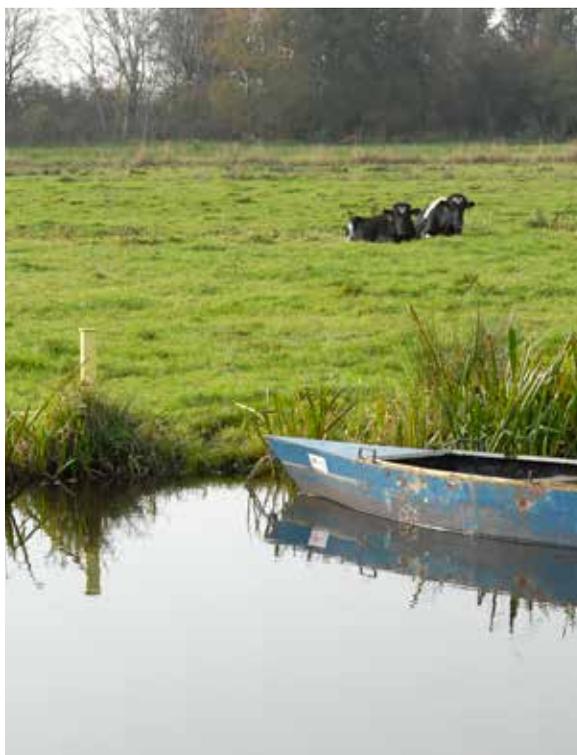
The third phase of the programme involved the hot-spots preparing to actually develop regional adaptation strategies. The final gaps in knowledge were filled in and the research results consolidated. The Knowledge for Climate Programme Office organised two workshops on developing regional adaptation strategies during this period, in part to allow the hotspot teams to learn from one another. The teams used the information gained during the workshops to draw up the initial outlines of their adaptation strategies. In 2012, each of the hotspot teams submitted a report for the programme's Midterm Assessment indicating how the results of their research projects would help them develop adaptation strategies.

The Midterm Assessment also indicated that the Knowledge for Climate Programme's relationship with the Delta Programme (and its regional sub-programmes) should be explored further. That was particularly important in the case of the South-West Delta, Wadden Sea, Major Rivers and Dry Rural Areas hotspots. A specific approach had already been developed for these regions within the Delta Programme, focusing on flood risk management and fresh water supply. The Knowledge for Climate Executive Board worked with the relevant Delta sub-programmes to find the best way for the final hotspot product (a regional adaptation strategy) to support the Delta Programme. The hotspot end products were valuable specifically because they took a longer-term (2050 – 2100), broader approach than the Delta Programme's focus on flood risk management and fresh water supply.



3.3 Results Regional adaptation strategies

Climate change does not only offer threats for the Netherlands – it also offers interesting opportunities for change and innovations. A regional adaptation strategy can contribute to conditions in which there is room for economic growth and quality of life. The hotspots have each developed (options) for regional adaptation strategies.⁶



Shallow Waters and Peat Meadow Areas

This hotspot produced a digital *Manual for Options for Regional Adaptation Strategies in Peat Meadow Areas* (2013, www.veenweidegebieden-oras.nl). Each peat meadow area requires a separate regional adaptation strategy that keys into its specific physical and socio-economic properties. The extent to which an area can accommodate climate adaptation measures and the types of measures selected depends mainly on what the future holds for the region. For example, are there plans to expand nature conservation or urban areas in the region? To make the right decisions, policymakers need a broadly supported future projection that describes how to neutralise risks – for example rapid soil subsidence and peat degradation – while simultaneously exploiting opportunities. Adaptation measures can be linked to long-term investments in agriculture and nature conservation.

Four options for regional adaptation strategies have been included in the report, with water as the guiding factor and various alternatives for agriculture and nature conservation.

[Manual for Options for Regional Adaptation Strategies in Peat Meadow Areas \[ORAS Veenweidegebieden\]:](#)

www.veenweidegebieden-oras.nl (2013) C. Kwakernaak (WUR), J.T.A. Verhoeven (UU), F. de Jong (WUR).⁷

Launched on 20 November 2013 at a symposium on peat meadow areas.



Rotterdam Region

Important decisions must be taken in this region to safeguard the city and the port in the longer term. The issues involved go beyond inland or coastal flood risk management to include heavier peak rainfall and heat stress, drought, salinization and soil subsidence. The Rotterdam Region's adaptation strategy consists of elements for a climate adaptation policy that will climate-proof Rotterdam and surrounding municipalities. The strategy takes similarities and differences between them into account. Not all of the effects of climate

change will be felt in every municipality, for example salinization. Some measures can best be tackled at local level. One example would be the construction of public squares that serve as water buffers in times of heavy rainfall. Flood risk management requires a regional approach.

The regional adaptation strategy shows how urban climate-proofing can be linked to existing urban restructuring plans and aims. The regional adaptation strategy is based on the City of Rotterdam's own adaptation strategy (Rotterdam Adaptation Strategy), which was also unveiled in 2013. Much of the knowledge that the hotspot generated for the city can also be applied at regional level. The City of Rotterdam is aiming to make itself climate-proof by 2025. Spatial planning in the city must allow for climate change and the uncertainties that it entails. The basic starting point is to introduce small-scale measures – green roofs, removal of hard paving in gardens, more plants and shrubs along city streets – throughout the city. Adaptation measures will then be 'mainstreamed' with the city's urban development plans and with regular management and maintenance programmes. One good example involves the climate-proofing of urban areas that lie outside the dike protection zone, a plan that is currently being carried out in the Feijenoord district. This project is especially valuable because the hotspot team is cooperating with local residents, housing corporations, regional water authorities and businesses.

[Building Blocks for Adaptation Strategies in the Rotterdam Region \[Bouwstenen voor Adaptatiestrategieën in de Regio Rotterdam\]](#) (2013) L. Nijhuis, City of Rotterdam.⁸

Presented to the Executive Councillors of the Rotterdam urban region on 28 November 2013.

[Rotterdam Adaptation Strategy \[Rotterdamse Adaptatiestrategie\]](#) (2013) City of Rotterdam's Sustainability Programme Office.⁹ Adopted by the Municipal Executive and launched on 28 October 2013.

⁶ www.kennisvoorklimaat.nl/onderzoeksprogramma/optiesregionaleadaptatiestrategieën

⁷ www.veenweidegebieden-oras.nl

⁸ <http://edepot.wur.nl/326799>

⁹ <http://edepot.wur.nl/333711>



Dry Rural Areas

The approach taken by the Dry Rural Areas hotspot team is explained in the report 'Bouwstenen voor duurzame klimaatadaptatie in hoog Nederland' [Basic Elements for Sustainable Climate Change Adaptation in the Higher Parts of the Netherlands]. While the approach was being developed, the hotspot team coordinated closely with stakeholders in the region, including participants involved in two regional projects linked to the Delta Programme, i.e. the Delta Plan for High-Lying Sandy Soils (Deltaplan Hoge Zandgronden, DHZ) and Fresh Water Supply in the Eastern Netherlands (Zoetwatervoorziening Oost Nederland, ZON). These projects concern fresh water supply in high-lying sandy regions and focus specifically on agriculture. Various provincial authorities, regional water authorities, agricultural/horticultural organisations and NGOs are involved in the two projects. The hotspot approach to adaptation is especially valuable because it takes a broader view of climate change adaptation than fresh water supply alone, and because it has a longer time horizon (up to 2050), fostering a broader assessment of future spatial planning in high-lying sandy regions. Expectations are that dry rural areas situated on sandy soil will be exposed to periods of water stress more often than in the past. It is important to know this before investing in agriculture, nature conservation and water management. Such regions can be made less vulnerable to drought and flooding by means of land consolidation, with swaps between nature conservation areas and farmland.

The report also looks at such topics as flooding and heat stress in cities. It indicates how cities, regions and provinces can put climate change adaptation on their agendas by focusing on spatial development, and suggests various modes of action concerning groundwater management, spatial planning and regional policymaking, cooperative alliances in agrarian nature and water management, and the role of knowledge and innovation.

[Basic Elements for Sustainable Climate Change Adaptation in the Higher Parts of the Netherlands \[Bouwstenen voor duurzame klimaatadaptatie in hoog Nederland\]](#) (2014) H. Bleumink, Overland.¹⁰

- Presented to regional administrators within the East Rhine Regional Administrative Consultation Body [Regionaal Bestuurlijk Overleg Rijn-Oost] on 10 October 2014.
- Presented to the Steering Committee for the Delta Plan for elevated Sandy Soils [Stuurgroep Deltaplan Hoge Zandgronden] on 30 October 2014.



Haaglanden Region

The Haaglanden Urban District is the public authority responsible for the Regional Adaptation Strategy (RAS) in the Haaglanden Region hotspot. The nine local authorities, two regional water authorities and provincial authorities collaborated closely on drafting a joint strategic agenda, supported by the Knowledge for Climate Programme Office and with the cooperation of Royal HaskoningDHV. The title is 'Focusing on the future. The Haaglanden Regional Climate Change Adaptation Strategy' [Met het oog op de toekomst. Regionale klimaat Adaptatie Strategie Haaglanden]. It describes the challenges and opportunities for the three area categories that epitomise the region, i.e. Glass, City and Grass. The general solutions described in the RAS assume that the strategy will be linked to existing challenges and are aligned with the region's core values:

- *A robust, innovative greenhouse horticulture sector.* The challenge facing the heavily built-up greenhouse horticulture sector is twofold: to create enough space for water storage to prevent flooding and to guarantee a sustainable supply of fresh water. A smart approach to 'supply management' is needed to link these two challenges to one another, for example by using irrigation water reservoirs and subsurface storage of irrigation water dynamically.
- *Liveable cities.* Urban areas will increasingly be dealing with heat stress issues. Ongoing urban infill and more extreme precipitation will also aggravate flooding problems. It is possible to create room for water buffering and a healthy and attractive living environment by capitalising on spatial planning and management and maintenance programmes.
- *Accessible green areas and coastal zones.* The peat meadow area of the Haaglanden Region is subsiding rapidly. It is vital to consider climate change scenarios and the related effects in government decisions concerning water-level control. There are opportunities for farmers, who have long been adapting to poorer growing conditions. Increasingly, they are focusing on agri-environmental (green and blue) services and leisure and care facilities. There are further opportunities for leisure and tourism as more city-dwellers seek relief from urban heat in green rural areas and on the seashore.

Focusing on the Future. The Haaglanden Regional Climate Change Adaptation Strategy [Met het oog op de toekomst. De Regionale Klimaatadaptatie Strategie Haaglanden] (2014).¹¹ This was adopted by the Executive Board of the Haaglanden urban district on 10 September 2014 and sent to local authorities, the Province, and the Regional water authority.

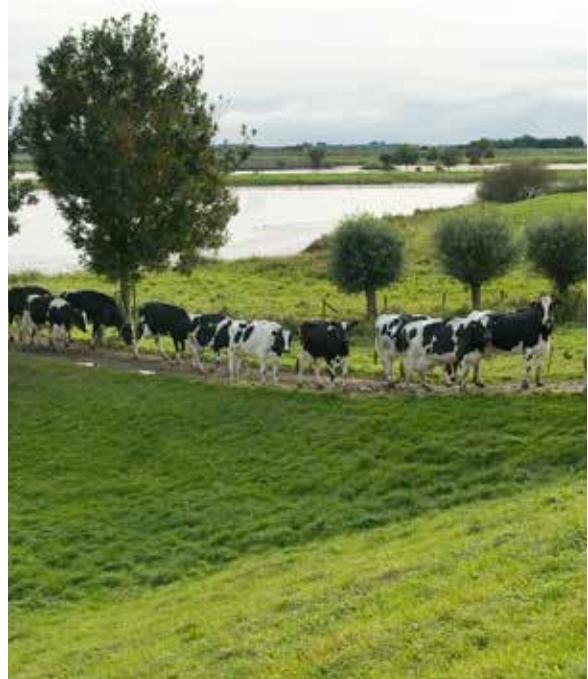
Major Rivers

The Major Rivers hotspot team worked constructively with the Delta Programme's Rivers sub-programme, not only in projects but also in the overall programme. Co-creation gave rise to various projects, for example a robustness analysis of the river Meuse and a study of the cross-border aspects of climate change in the Major Rivers region. The hotspot team deliberately chose to supplement the Delta Programme's preferred strategy

with an end product that offers a broader view and longer-term strategic agenda. This 'inspiration document' draws attention to spatial quality, cross-border aspects, soil subsidence and morphological processes, the limits to drainage capacity, the cost of maintaining structures, and the changing role of the public. In doing so, the Knowledge for Climate Programme has given current and future professionals involved in managing the major rivers important insights that are neglected or not adequately addressed in current policy and that will inform discussions about the future of the Major Rivers region. This knowledge is of enormous importance for long-term investments in flood risk management and urban development in that region.

[Inspiration Document on Climate Change Adaptation for the Major Rivers \[Inspiratiedocument Klimaatadaptatie Grote Rivieren\]](#) (2014) Marnix de Vriend, Aequae Consult.¹²

[Regional Adaptation Strategy Hotspot Major Rivers \[Regionale adaptatiestrategie Hotspot Grote Rivieren\]](#) (2015) Harold van Waveren (RWS) Presentation to be organised in collaboration with the Delta Programme's Rivers sub-programme.



¹⁰ <http://edepot.wur.nl/333712>

¹¹ <http://edepot.wur.nl/333710>

¹² <http://edepot.wur.nl/333585>



South-West Delta

The South-West Delta is seeking an economically viable future. The key to that future is to invest in agriculture, certain types of fisheries, and the leisure industry. Climate change and sea level rise are important parameters that may influence the return on investment in these sectors. The South-West Delta wants to exploit the opportunities associated with climate change by focusing on a strategy of economic development. The regional adaptation strategy that it has developed in cooperation with the Knowledge for Climate organisation provides an important frame of reference.

The strategy focuses specifically on urban development, estuarine dynamics and the land in the dike protection zone. Working as a unified whole within the urban delta, industry, towns and cities, and farmers are doing what they can to close the fresh water cycle and to treat natural resources and energy as efficiently as possible. While there are arguments in favour of increasing estuarine dynamics in streams, this must happen within the limits imposed by past spatial planning measures (in particular the Delta Works). 'Self-sufficiency' is the key concept for the land lying within the dike protection zone. The strategic agenda paints a picture of a resilient delta, but with the awareness that such resilience is largely artificial and must be 'tended' like a garden. The challenge is to think in terms of systems, in other words by seeing the interconnectedness of things. However, actions must be flexible

and small in scale. 'Living with water' means letting go of the idea that water has to be contained at any cost. The public is self-sufficient, even enterprising, in this context, and the role of government is much more facilitative.

Adapting to Climate Change in the South-West Delta. A long-term strategy (2050-2100) [Adaptatie aan klimaatverandering in de Zuidwestelijke Delta. Een langetermijnvisie (2050-2100)] (2014) W. ten Brinke, Blueland Consultancy.¹³

To be presented in partnership with the Delta Programme's South-West Delta sub-programme and the Province of Zeeland.



Wadden Sea

Can the Wadden Sea Region continue to expand as sea levels rise? If so, then climate change need not impede investment in the coastal areas and the islands. The strategic adaptation agenda developed for this region shows that there are various options for coping with climate change and sea level rise.

The Wadden Sea hotspot team decided to pursue a long-term strategic agenda for the Wadden Sea, with natural solutions being promoted as climate change adaptation measures. A crucial factor in this approach was the team's collaboration with the Delta Programme, the Programme towards a Rich Wadden Sea, the Wadden Academy and the regional water authorities. This resulted in optional regional adaptation strategies that take sediment as



their basis and that focus on the long-term preservation of the Wadden Sea ecosystem and all related ecological and economic features. The key question of this exploration was: can the Wadden Sea's sedimentary system be preserved by applying a 'soft' adaptation strategy (based on sediment replenishment), given the long-term effects of rapid sea level rise? This study looks in particular at how to identify and select viable measures that fit into a soft adaptation strategy. Research carried out under the Knowledge for Climate Programme concerning natural solutions to the flood risk management problem provided a firm basis for this study; the relevant insights also found their way to the Delta Programme and the regional regional water authorities.

"Natural solutions to cope with accelerated sea level rise in the Wadden Sea region. Towards an integrated long term adaptation strategy framework" (2014) G. Baarse, BB&C.¹⁴

Draft version presented during the working conference on the same subject. The strategic agenda was amended in the light of discussions at the conference.

Mainport Schiphol

Detailed insights into the weather and climate change are extremely important for investments in the Netherlands' national airport, Schiphol. Flood risk management at Schiphol Airport is another key criterion in investment

decision-making, especially for foreign companies. The studies carried out in this hotspot show that a better understanding of crosswinds can improve the operational capacity of the runways. Flood risk research shows that small interventions can upgrade Schiphol Airport to one of the safest polders of the Netherlands in terms of flooding.

The highest flood safety standards apply for the area made up of the Haarlemmermeer Region and the airport. As improbable as it might be, if flooding were to occur its economic impact and public disruption would be dramatic. The Mainport Schiphol strategy recommends applying a form of adaptive management in future decision-making. It is highly important to keep a close eye on climate change and the consequences for the mainport in order to anticipate them. It is also important to have reliable and up-to-date information on the local weather conditions.

Mainport Schiphol Hotspot. Developing a Regional Adaptation Strategy [Hotspot Mainport Schiphol. Visieontwikkeling Regionale Adaptatiestrategie] (2014) G. Baarse, BB&C.¹⁵

This was presented to Peter van den Brink (Schiphol Group) and Executive Councillor Adam Elzakalai (Municipality of Haarlemmermeer) during a symposium held on 20 October 2014.

13 <http://edepot.wur.nl/333714>

14 <http://edepot.wur.nl/333715>

15 <http://edepot.wur.nl/333718>

Delta Alliance as an international knowledge-driven network

Although delta regions are among the most economically prosperous and ecologically diverse in the world, they are vulnerable to the effects of climate change. The Dutch Delta would benefit from a practical and results-driven adaptation strategy. The Knowledge for Climate Programme delivered the data needed to chart the possible consequences of climate change and to design integrated, long-term adaptation strategies. The programme organisation wants to share this knowledge with other delta and coastal regions worldwide that will also be facing the effects of climate change. Owing to the temporary nature of the programme and its relatively small budget, the organisation decided to set up a network of vulnerable delta regions. The Delta Alliance knowledge network was established in 2010.

The Delta Alliance supports research and the dissemination of research results, the aim being to help public and private parties in key deltas around the world respond to specific challenges, including climate change. River delta regions in twelve countries are now members of the alliance: Indonesia, Vietnam, Bangladesh, China, Argentina, Brazil, Egypt, Mozambique, Myanmar, Spain, the Netherlands, and the States of California and Louisiana in the United States (see figure 3.1).

An interim evaluation of the Delta Alliance was conducted in October 2013. Since then, greater emphasis has been placed on the alliance as a knowledge network focusing more on applied research and less on theoretical research. The products being developed in the Dutch Delta can enhance international cooperation. For example, there is now a Dutch Delta Approach toolbox¹⁶ and a comparable vulnerability assessment for fourteen delta regions (see Table 3.3).

A separate foundation has been set up for the Delta Alliance with an International Governing Board. The Dutch Ministry of Infrastructure and Environment, through its Partners for Water Programme, continues to fund the Delta Alliance from September 2014 onwards.

16 www.delta-alliance.org/toolbox





Figure 3.1

Member deltas 1 California Bay and Delta (USA) 2 Mississippi (USA) 3 Pantanal (Brazil) 4 Parana (Argentina) 5 Ebro (Spain) 6 Rhin-Meuse-Scheldt (The Netherlands) 7 Nile (Egypt) 8 Zambezi (Mozambique) 9 Ganges-Brahmaputra-Meghna (Bangladesh) 10 Ayeyarwady (Myanmar) 11 Mekong (Vietnam) 12 Ciliwung and Mahakam (Indonesia) 13 Yangtze (China)

Potential member deltas 14 Senegal + Saloum (Senegal) 15 Volta (Ghana) 16 Ouémé (Benin) 17 Danube (Romania) 18 Tana (Kenya) 19 Chao Phraya (Thailand) 20 Yellow River (China) 21 Lanyang (Taiwan)

Table 3.3 Vulnerability and resilience of fourteen deltas¹⁷

Current situation	Land and water use (occupation layer)	Infrastructure (network layer)	Natural Resources (base layer)	Governance	Resilience & Sustainability		
					Indicator		
					Current	Moderate Scenario	Extreme scenario
Nile delta	--	0	-	0	-	-	--
Tana	-	-	0	-	-	-	--
Incomati delta	0	-	-	-	-	-	--
Zambezi	+	-	+	-	0	0	-
Ganges-Brahmaputra-Meghna delta	--	--	--	0	--	-	--
Yangtze delta	-	+	-	0	0	0	--
Ciliwung delta	--	--	--	-	--	--	-
Ayeyarwady	-	--	--	-	-	0	-
Mekong delta	0	0	-	0	0	+	0
Rhine-Meuse delta	+	++	0	+	+	0	-
Danube delta	+	+	+	0	+	0	0
California Bay-Delta	0	-	-	0	-	0	-
Mississippi River Delta	0	0	-	0	-	0	-
Parana	+	0	-	0	+	0	-

17 Bucx, T., W. van Driel, H. de Boer, S. Graas, V.T. Langenberg, M. Marchand and C. Van de Guchte. 2014: *Comparative assessment of the vulnerability and resilience of deltas – extended version with 14 deltas - synthesis report*. Delta Alliance report number 7.

Delta Alliance International, Delft-Wageningen, The Netherlands (Tabel 8 p. 41)



4 Research themes

4.1 Background to research themes

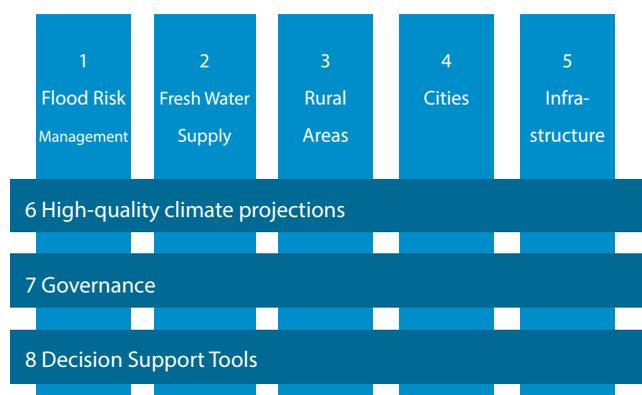
The Knowledge for Climate Programme began programming its ‘second phase’ in late 2009. This second phase would focus more on cutting-edge climate adaptation research. To promote cohesion in research programming, the research institutions involved identified eight research themes. In addition, the hotspot teams were asked to draw up a list of their most important research questions, which were then compared to the themes. This procedure led to a long list of almost two hundred questions and themes. The hotspot representatives and researchers then worked together to reduce the list to eight relevant research themes. These themes provided the basic principles for drawing up the national and regional adaptation strategies.

Themes 6, 7 and 8 cut across research themes 1 to 5 and link the more theoretical climate issues, each from its own unique perspective.

An initial budget was allocated to each of the themes, consisting of three parts:

- a the second phase funding earmarked for the hot-spots;
- b general funding from the Knowledge for Climate Programme;
- c third-party matching funds (co-funding).

Figure 4.1 The eight research themes in the second phase



The hotspots decided which themes they wished to join and how they would distribute their available budget (a) over these themes. The general funding (b) and co-funding (c) depended on the participation of the hotspots; the more they themselves invested, the more money became available. One key advantage was that this guaranteed region-specific research questions.

An open call was issued in late May 2009 inviting universities, institutes of applied research and consultancy firms to set up consortia and submit pre-proposals for one or more of the eight research themes¹. At least 5 percent of the research budget was to be spent on input by foreign research institutions (see Box 4.1).

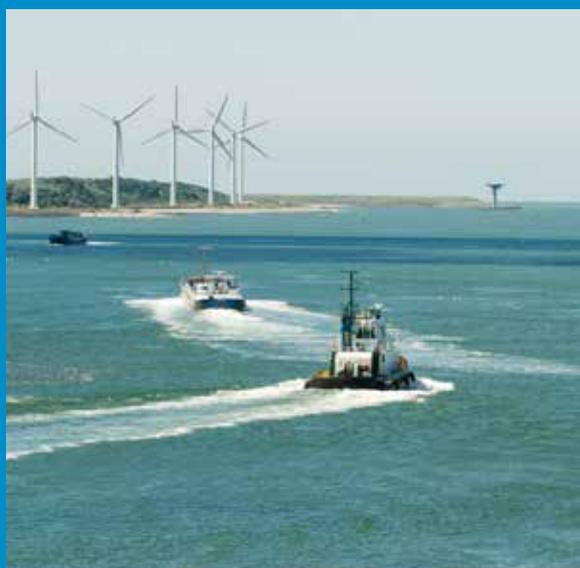
A Dutch review committee made up of experts from the scientific community and civic organisations selected one proposal out of the fourteen submissions for each theme. The consortia were asked to turn the overall proposals into a 'full proposal' and to coordinate their ideas with the hotspots. Based on the results, the hotspots finalised their co-funding for the research themes. This approach meant that the hotspots made different choices, leading to shifts in the budgets. Table 4.1 shows a sharp decline in the research budgets allocated to the consortia for research themes 1 and 3, whereas the budgets allocated to the consortia for themes 4 and 8 increased.

The full proposals were then assessed, with panels of internationally renowned scientists reviewing their scientific merit and policy experts (senior government officials) evaluating their social relevance and practical applicability. In the end, the eight proposals were approved and the consortia were able to commence the research and begin raising the necessary co-funding.

Co-funding also ensured that the stakeholders became more closely involved in carrying out the research. The researchers were forced to focus at least part of their research activities on the questions raised by the co-funding institutions. At the same time, the consortia had more money to put on their research ideas into practice. Co-funding also had advantages for the authorities, businesses and NGOs. A relatively small contribution allowed them to participate in and benefit from the results of major research projects.

Appendix 2 shows that more than 18 million euros in co-funding is expected to be generated in the second phase.

[1 Adaptation to climate change. Invitation to submit pre-proposals \(2009\).](#)



Box 4.1 Open call requirements

- Innovative and multidisciplinary research
- Connection between general and area-specific research questions
- Knowledge dissemination strategy
- Research of scientific merit that is also socially relevant and of practical use
- Each consortium to have at least three Dutch research institutions and an international partner
- No more than 40 per cent of available funding allocated to one consortium partner

Assessment criteria

- Scientific merit, social relevance and quality of the consortium

Table 4.1 Provisional budget, final allocation of funding and relevant co-funding requirement

Theme	Provisional funds based on hotspot participation (K€)			Finalised project budget based on hotspot funding (K€)				Minimum Co-funding required
	Hotspot	General	Total	Final allocation of funding				
				Hotspot	General	Total		
1	1.900	950	2.850	1.375	675	2.050	1.600	
2	1.850	925	2.775	1.665	835	2.500	1.950	
3	1.650	825	2.475	900	800	1.700	1.300	
4	1.750	875	2.625	2.935	1.250	4.185	3.142,5	
5	1.100	550	1.650	1.320	600	1.920	1.485	
6	625	2.312,5	2.937,5	700	2.350	3.050	1.500	
7	1.500	1.250	2.750	1.710	1.190	2.900	1.954,6	
8	225	1.612,5	1.837,5	700	1.900	2.600	1.350	
Total	10.600	9.300	19.900	11.305	9.600	20.905	14.282,1	



4.2 Knowledge co-creation in practice

The main aim of the Knowledge for Climate Programme was to generate knowledge about climate adaptation that is not only scientifically innovative but also of practical use. The second phase of the programme involved the roll-out of a number of measures and activities geared towards achieving that aim and encouraging knowledge co-creation. Steering committees were founded, science-practice workshops were organised, and case studies were undertaken. The consortia researchers also took steps to make their research more practical in nature.

Steering committees

A steering committee was set up for each consortium to supervise the research and make adjustments when necessary. Their specific task was to safeguard and reinforce the direction and consistency of the research and to encourage the consortium to adapt the research results to practical policymaking. Each of the steering committees had representatives from the national government, the relevant hotspots and other co-funding bodies. Each committee was chaired by a Dutch professor who was an acknowledged authority in the relevant research field. The steering committees were obliged to meet at least twice a year. Their tasks, responsibilities and composition are described in [Appendix 7](#).

Monitoring and evaluation

A progress meeting was held twice a year with all consortia. In addition to the consortium leader, a communications officer and a financial officer also attended this meeting. They were responsible for the consortium's knowledge dissemination strategy and the finances.

A Midterm Assessment was organised for the entire Knowledge for Climate Programme in late 2012. All consortia were asked to report on the progress of their research and preliminary results during a review meeting in Amsterdam. Two foreign researchers offered critical reflections on each consortium. In addition, two other experts were asked to reflect on the social relevance and impact of the research. The Midterm Assessment led many of the consortia to tighten up their procedures and focus on developing practice-driven products, for example a practical course on urban climate change adaptation and a book on action strategies for governing adaptation (see also Appendix 4).

Case studies

The consortia conducted a large number of case studies that improved our understanding of the practice of climate change adaptation in Dutch regions and cities. For example, there were studies on the effects of heat inside and outside buildings in the City of Arnhem, the City of Rotterdam's green roofs policy, construction outside the dike protection zone in the the Rotterdam district of Heijplaat, and underground water storage in the Haaglanden Region and the South-West Delta. These case studies were directly relevant to policymaking practices in part because the researchers communicated closely with the relevant policy officers about the results.

PhD candidates in the field

More than fifty PhD candidates were involved in the research themes. Many of them carried out some of their research on site, for example testing and field trials. They also contributed to the case studies by collaborating with regional water management bodies, businesses or municipal officials, for example. They also organised case study meetings at regular intervals to present interim results and answer questions.

PhD students on site

Underground rainwater storage

In the Fresh Water Supply theme, Koen Zuurbier conducted pilots at a number of greenhouse horticulture firms in the Haaglanden Region that involved storing excess rainwater in subsurface brackish and saline aquifers. The fresh water can be pumped to the surface and used for irrigation purposes when water shortages arise. Koen has kept an easy-to-read blog² about the project for stakeholders and other interested parties.

² <http://www.kwrwater.nl/page.aspx?id=7975>



Touch Table interface

Tessa Eikelboom of the Decision Support Tools theme worked on the Touch Table, an interface that can be used during area-development processes. The Touch Table's interactive maps allow stakeholders to test out their spatial adaptation measures. The maps show the consequences of these measures for the designated area. The tool has been used in the Province of Friesland to develop water management plans and a strategic agenda for peat meadows.



Natural buffers against waves

Jantsje van Loon-Steensma explored innovative dike concepts under the Flood Risk Management theme. Salt marshes and osier beds are natural buffers that protect dikes and river embankments against heavy waves. If we expand our salt marshes and osier beds, we will have less need of very high dikes and scour protection, thereby cutting costs. This will also foster the evolution of larger natural zones between land and sea, which can be used for saline agriculture, fisheries, nature conservation, leisure and tourism.



Green roofs

Heleen Mees conducted a comparative study on encouraging green roofs in the city. She compared the policies and practices of a number of cities, including Basel, Chicago, Rotterdam and Stuttgart. 'Starting out with non-coercive measures, for example a subsidy for green roof construction, and effective communication draws in the innovators. After a trial period, it isn't a problem to scale up implementation by introducing mandatory requirements.' Mees says that the authorities tend to step on the brakes as soon as the word 'coercion' is mentioned. 'Dutch policymakers want nothing more than to cut down on the rules. Commercial parties like housing corporations and property managers are less worried about coercion than you might expect. After all, mandatory rules make everything clear and apply to everyone across the board.'



Analysis of the Knowledge for Climate PhDs

Tjerk Wardenaar of the Rathenau Institute compared the Knowledge for Climate PhD candidates with research assistants working for the Netherlands Organisation for Scientific Research (NWO). The former group did more than just conduct scientific research. 'Even so, the quality of their academic publications matched that of the "traditional" research assistants. They published in relevant academic journals. The Knowledge for Climate Programme also gave them the chance to participate in group processes and to get deeply involved in communicating with non-scientists.' They helped author policy documents, organised practical workshops and gave lectures geared to non-scientists. Their work was more interdisciplinary and transdisciplinary than that of 'normal' research assistants.



Workshops and dialogue meetings

Various workshops,³ working conferences, and dialogue meetings were organised in the past few years to encourage researchers and practitioners to share what they know.

- The 'Eureka – Wat nu: van kennen naar kunnen' [Eureka! What's Next? From Knowing to Action] conference was held in Amersfoort in October 2013. The Foundation for Applied Water Research (STOWA) and the Knowledge for Climate Programme organised the event. Participants considered how to apply theoretical approaches to keeping the Netherlands safe, habitable and economically prosperous during climate change in actual case studies. They looked at which parties would be needed and what a particular approach would mean in terms of maintenance and management. Approximately 100 researchers and policymakers (municipal, provincial, regional water authorities) attended the conference.
- The conference 'Handelingsperspectieven voor de governance van klimaatadaptatie' [Modes of Action for Governance of Climate Change Adaptation] took place in Rotterdam on 13 March 2014. A series of round-table discussions, debates and workshops led to new modes of action for climate adaptation in cities and rural areas, both at national and international level. Examples included the interaction between the state and regional authorities in the area of climate adaptation and a self-organising approach to urban water management.
- Many closed 'dialogue meetings' have been organised down through the years to foster close interaction between researchers and expert practitioners. For example, the interim results of the Baakse Beek case study were presented at several different meetings, with stakeholders being invited to comment. The researchers used their input to take the research a step further. This made it possible to visualise the effects of climate change in the Baakse Beek region and to develop adaptation options in cooperation with the stakeholders, which included regional users and managers (Theme Rural Areas).

³ <http://kennisvoorklimaat.klimaatonderzoeknederland.nl/agenda/archief-kvk-bijeenkomsten>

- The Royal Netherlands Meteorological Institute (KNMI), one of the consortium partners in the Climate Projections theme, organised a series of stakeholder meetings in early 2014 about its new climate scenarios (known as the KNMI'14), which adapt results from the IPCC's 2013 climate change report to the Dutch situation. These meetings helped the KNMI understand user wishes and the questions that preoccupy stakeholders. The consortium used its own newsletters to address the questions raised.

Practical publications, newsletters and Climate TV

Besides organising meetings, the Knowledge for Climate organisation (including the consortia and individual researchers) fostered knowledge uptake by practitioners by issuing newsletters, developing the programme website and publishing articles in professional journals (e.g. H2O, Landschap and Rooilijn). It also produced press releases and made use of LinkedIn, Twitter, Facebook and YouTube. YouTube served as a distribution channel for seven short films on important themes. Knowledge for Climate researchers and PhD candidates served as the film's narrators and interviewers. They were filmed on location to show how climate change data has led to the development of water buffers, green roofs and other adaptation measures and to research on networks and infrastructure in the Netherlands. The films were well received and have been viewed more than 17,000 times.

They have been used in blogs and shared on various websites, news sites and social media platforms. They were also screened at meetings and included in a database of teaching materials for primary and secondary education (Groene Kennisnet database). The films are still being viewed about 200 times a week. In July 2014, one of the films, For a better urban climate, competed in the Connect4Climate documentary contest and was screened in Times Square, New York City.

Each consortium described the most socially relevant research results in a concluding publication. These books outline the practical results achieved by the consortia. They also offer readers a user-friendly guide through all the consortia's other products and publications. The books were published in September 2014 and distributed during the international Deltas in Times of Climate Change II conference.



Watch KfC TV on http://www.kennisvoorklimaat.nl/templates/dispatcher.asp?page_id=25223296
The societal books can be found on <http://www.knowledgeforclimate.nl>

Table 4.2 Number and types of publications by consortia and other Knowledge for Climate projects*

	Consortia by research theme									Total other projects	Total KfC
	Theme 1	Theme 2	Theme 3	Theme 4	Theme 5	Theme 6	Theme 7	Theme 8	Total		
Scientific articles	63	35	38	75	32	36	81	41	441	65	466
Popular science articles	0	11	19	10	0	8	13	1	62	16	78
Books	5	0	0	6	2	0	21	2	36	40	76
Booklets	2	4	2	3	3	5	2	2	23	28	51
Media	1	2	8	10	0	19	3	3	46	98	144
Reports	21	24	20	44	18	15	51	28	221	178	399
PhD theses	1	0	0	1	2	0	2	1	7**	0	7**
Project newsletters	7	6	6	19	8	4	8	7	65	16	81
KfC newsletters										17	17
Special issues	1	2	1	1	1	1	3	1	11	1	12

* Status February 2015. More publications will be released (with more than 100 expected)

** At the end of 2015, 56 PhD theses are expected



4.3 Consortia's main research results

This section describes some of the consortia's main research results.

Publications

Table 4.2 shows that the eight consortia produced a long list of publications. All of these were made available on the Knowledge for Climate website. The consortia also contributed to various special issues. For example, in mid-2014 *Regional Environmental Change* brought out a special issue on the Climate Changes Spatial Planning Programme and the Knowledge for Climate Programme⁴. Each consortium also produced a special issue as a research end product (see Table 4.3). The consortia made important contributions to research and knowledge generation. Besides publishing reports and articles, they have also helped change the way we think about certain climate-related themes. These are breakthroughs of considerable relevance to society.

4 Veraart, J., K. van Nieuwaal, P.P.J. Driessen & P. Kabat (2014). From climate research to climate compatible development: experiences and progress in the Netherlands: Editorial, *Regional Environmental Change*, vol. 14(3), pp. 851-863. DOI 10.1007/s10113-013-0567-7

Table 4.3 Consortia's special issues as end products

<http://knowledgeforclimate.nl/publications/specialissueccpkfc>

Consortium	Special issues
T1 Flood Risk Management	Mitigation and Adaptation Strategies to Global Change (8 papers submitted)
T2 Fresh Water Supply	Water Resources Management (12 papers submitted)
T3 Rural Areas	Landscape Ecology (12 papers submitted)
T4 Cities	Building and Environment (17 papers submitted)
T5 Infrastructure and Networks	European Journal of Transport and Infrastructure Research (16 papers submitted)
T6 Climate Projections	Environmental Research Letters (8 papers submitted)
T7 Governance	Journal of Water and Climate Change (6 papers submitted)
T8 Decision Support Tools	Mitigation and Adaptation Strategies for Global Change (6 papers submitted)



International collaboration

The eight research consortia in the second phase collaborated with international research institutions, in part via individual contacts between Dutch and foreign consortium partners (see Table 4.4). Some consortia had foreign members who were fully committed to the research. That was the case for the University of Edinburgh, which participated in the Rural Areas consortium (Theme 3). Researchers at Edinburgh played an important role in developing Agent Based Modelling (ABM), a method applied within the consortium itself. Some consortia promoted knowledge-sharing by assigning researchers to a foreign partner on a temporary basis. For example, the Infrastructure and Networks consortium worked with a PhD candidate from the Massachusetts Institute of Technology (MIT) on a serious game about dealing with uncertainties in decision-making processes.

The consortium parties are involved in other programmes and projects beyond Knowledge for Climate. They also participate in and regularly head other international projects that focus on similar themes as the Knowledge for Climate research. These relationships have been invaluable because they promote a 'natural' form of knowledge-sharing between projects and programmes. Examples of European climate change adaptation projects in which consortium parties have participated are ECCONET, ITERATE, MEDIATION, RESPONSES, STARFLOOD, TURAS (FP-7) and Future Cities (INTERREG)⁵.

⁵ <http://knowledgeforclimate.climate-research-netherlands.nl/programme/cooperation>

Table 4.4 Composition of research consortia

Number	T1	T2	T3	T4	T5	T6	T7	T8	Totaal
PhD students	7 (6,5)*	7 (6,5)*	3	9	4	9	9	9	56
Postdocs	1	2	8	3	3	3	2	1	23
Other researchers	17	22	28	68	35	37	18	24	**
Dutch consortium partners	6	10	6	10	5	9	5	8	**
Foreign partners	2	6	1	3	8	3	3	7	**
No. of stakeholders providing matching funds	6	15	7	13	4	3	5	2	**

* One PhD student did her research in two different themes.

** Not unique parties, and therefore excluded from total.

Notable breakthroughs, by research theme

Theme 1 Flood Risk Management

Key question: Are there other ways of managing flood risk in the Netherlands besides building taller dikes?

Answer: Broad dikes offer a higher level of flood safety than tall dikes. Although they will flood, flooding can be controlled; they will not collapse without warning and are more sympathetic to their environment.

Researchers and practitioners in the consortium collaborated on climate-proofing the Netherlands against flooding. The Netherlands is an international trendsetter because it is not only concerned with managing current flood risk but also explicitly considers future risk trends by analysing scenarios and assessing measures from the perspective of sustainability (i.e. considering not only their current effectiveness but also their future performance and side-effects). The consortium has taken pains to adopt this long-range approach by incorporating such factors as robustness, spatial quality, and nature conservation into its research. Its interdisciplinary approach is also considered to be state-of-the-art. This involved a problem analysis that considered not only the climate and water but also demographic and economic trends; an exploration of solutions not only from the technical-scientific perspective (beta) but also with a feel for social relationships and as a 'governance problem'; and

a basic desire to work with stakeholders on developing effective plans and to approach the design of technical solutions as a cultural activity as well (alpha).

Unbreachable dikes

The Netherlands Environmental Assessment Agency (PBL) views the 'unbreachable dike' as the most cost-effective way to reduce the number of flood victims. A broad dike has space for buildings, recreation or nature conservation. As the Knowledge for Climate Programme draws to a close in 2014, this robust form of flood defence is being tested at about twenty different locations in the Netherlands. The boulevard at the seaside resort of Scheveningen (near The Hague), is one such location. Another is the Prins Hendrik Polder on the Frisian island of Texel, and the banks of the river Lek near the village of Streefkerk. STOWA, Deltares, VU University Amsterdam/Institute for Environmental Studies (IVM) and PBL are all studying the unbreachable dike. 'The Dutch are gradually changing the way they think about flood risk; there is more acceptance nowadays that we have to live with a certain level of risk.' Frans Klijn, consortium leader, Climate-Proof Flood Risk Management.

Recovery after a flood

The Flood Risk Management consortium explored how



well and how rapidly an area can recover after a flood. PhD candidate Marjolein Mens studied which measures would do most to improve resilience in the IJssel river valley. Mens: 'It's not just about how often things go wrong, but also about how they go wrong. If gradual, controlled flooding takes place, there's more time to take action.' 'Safety is a relative concept. It makes good sense to see what we can do to live with the residual risk, because that will always be there.' Jan Lourens, Rijn & IJssel Regional water authority.

Key publications

- Aerts, J.C.J.H., W.J.W. Botzen, K. Emanuel, N. Lin, H. de Moel, E.O. Michel-Kerjan (2014). Evaluating Flood Resilience Strategies for Coastal Megacities. *Science* 344 (2 May 2014): 473-475. doi 10.1126/science.1248222.
- Klijn, F. & T. Schweckendiek (eds). (2013). Comprehensive flood risk management. Research for policy and practice. Proceedings of the 2nd European Conference on Flood Risk Management, FLOODrisk2012, Rotterdam, the Netherlands, 19-23 November. CRC Press, Taylor & Francis Group, London, UK. ISBN 978-0-415-62144-1. 436 pp.
- Nillesen, A.L. Osiel G., D., Stithou, M., Pescaroli, G., (2014) Improving the allocation of flood-risk interventions from a spatial quality perspective. *Journal of Landscape Architecture* 9/1:20-31. doi:10.1080/18626033.2014.89882336.
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- Klijn, F., J. Knoop, W. Ligtvoet & M.J.P. Mens (2012). In search of robust flood risk management alternatives for the Netherlands. DOI:10.5194/nhess-12-1469-2012 *Nat. Hazards Earth Syst. Sci.* 12, 1469–1479.

Scientific end product

Special issue “*Adapting Flood Risk Management in a Changing Global Environment*”, in *Mitigation and Adaptation Strategies to Global Change* (in review).

Societal end product

Book “*Water safety. Climate and floods*”. [Waterveiligheid. Klimaat en overstromingen.]

Theme 2 Fresh Water Supply

Key question: Fresh water shortages are becoming more common in the Netherlands. Current solutions will eventually become too expensive and are therefore not sustainable. Besides storing fresh water in large concrete reservoirs, how can we ensure a sufficient supply for different purposes at different times?

Answer: It is possible to store fresh water underground in different ways, reducing the extent to which consumers must rely on supplies from elsewhere to meet their needs.

Within the theme Climate-proof Fresh Water Supply and Water Quality, researchers collaborated with practitioners to ensure a sustainable supply of fresh water. The consortium also succeeded in disseminating its research results in a broader social context. One example is the way in which small-scale solutions, such as underground water storage, are now taken much more seriously, including in the outcomes of the Delta Programme. The United States, Australia and other countries have expressed great interest in the tests carried out in the Netherlands with underground water storage. After the end of the Knowledge for Climate Programme, the consortium partners will continue to develop and apply the concept of infiltration and extraction in partnership with other countries, for example near Barcelona on the coast of Spain. Another interesting project in Theme 2 was a study of the mechanisms in samphire that make it so highly tolerant to salt. The consortium has laid the basis for potential breeding and modification of other food crops. From the societal perspective, this is interesting for areas with salinating soils. That is why other countries are becoming more interested in the results of research on saline-tolerant crops, for example in the Yellow River delta in China.



Maps of potential can help identify local fresh water supply solutions

The Fresh Water Options Optimizer project mapped out potential water-efficiency methods. The maps show the extent to which fresh water supply can be increased and the risk of damage decreased in a region. They answer such questions as 'Which methods will work where?' The project also explored whether these techniques can improve water efficiency in agriculture.

Fresh water solutions for greenhouse horticulture

Han Weber, executive councillor for the Province of Zuid-Holland: 'Greenhouse horticulture firms were quick to catch on to the Knowledge for Climate Programme. It was an excellent example of how enterprise, government and science can work together. The sector is now taking responsibility for applying potential methods on a wider scale in the Nootdorp and GO-FRESH follow-up projects.'

Fresh water in saline areas

Research on innovative subsurface fresh water buffering may have economic benefits for farmers working the saline soil of the south-west delta. Researchers have tested a level-dependent drainage system near the village of Serooskerke in the Province of Zeeland. Researcher Pieter Pauw: 'Despite our calculations, we had not imagined that we could store so much extra water to see farmers through in times of scarcity.' One added advantage of the buffering system is that it consumes very little energy. Farmers are also not obliged to sacrifice precious farmland to water reservoirs. 'It's important for the system to remain affordable for farmers,' says Pauw, 'and to contribute to the economic prosperity of farming areas.'



Key publications

- Tolk L., (2013). Fresh water clarified, Measures for fresh water self-sufficiency in sight. [Zoetwater verhelderd, Maatregelen voor zoetwater zelfvoorzienendheid in beeld], KfC report number 90/2013.
- Ad Jeuken, Eelco van Beek (eds) (2012). Balancing supply and demand of fresh water under increasing drought and salinisation in the Netherlands, Midterm Assessment 2012, Theme 2 Climate Proof Fresh Water Supply, KfC report number 58/2012.
- J.H. Kwakkel, M.J.P. Mens, A. de Jong, J.A. Wardekker, W.A.H. Thissen, J.P. van der Sluijs (2011). Uncertainty Terminology.
- Special Issue (Rozema et al. editor) 'Sustainable cultivation and exploitation of halophyte crops in a salinizing world' Environmental and Experimental Botany (August 2013) V92 Pages 1-196.
- Special Issue (Jeuken et al. Editors, draft) 'Climate proof fresh water supply in coastal areas and deltas' Water Resources Management (in review).

Scientific end product

Special issue "Climate proof fresh water supply in coastal areas and deltas" in Water Resources Management (in review).

Societal end product

Book "Fresh water supply and water quality. Climate and Fresh water". [Zoetwatervoorziening en waterkwaliteit. Klimaat en zoet water.]

Theme 3 Rural Areas

Key question: Are there better ways to climate-proof nature and farming than the methods used today?

Answer: When farmers and eco-managers work together, both benefit more than when nature conservation areas are imposed from the top down. New technologies such as the Touch Table interface and RULEX models promote collaboration and help each side understand the other's interests.

In this theme, it is important to view water management, agriculture, and nature conservation as spatially interrelated when developing adaptation strategies. The agent-based model, RULEX, developed by the Climate Adaptation for Rural arEas (CARE) consortium provides land use patterns and farm types that can serve as the basis for stakeholders – for example policymakers and nature conservation organisations – to take decisions. Within this theme, researchers looked at how nature responds to climate change. Climate models make it possible to simulate how nature functions in various climatological situations, for example how the migration patterns of flora and fauna change. There was also collaboration with farmers, who are of course important players when it comes to planning in rural areas. Amongst other things, the consortium demonstrated how important hydrological parameters – for example the water table, seepage intensities, and (something of direct importance to plant growth) the shortage of water and oxygen in the rooting zone – will change in two extreme climate scenarios (G and W+). In the case of elevated sandy soils, where there are large reserves of fresh groundwater, the consortium investigated the most important cause of losses in the water balance, namely actual evapotranspiration. This has led to a completely new understanding of evapotranspiration in arid vegetation and a new system for measuring actual evapotranspiration.



Metering system as commercial product

We know very little about actual evapotranspiration in high-lying areas with sandy soil (push-moraines, dunes, cover-sand landscapes). A metering system was therefore developed for such dry rural areas. The system is so promising that it is being developed commercially. This research project has also led to the startling discovery that mosses evapotranspire at the same low rate as bare sandy soil. Mosses can effectively increase the supply of fresh water while also improving the eco-diversity of an area.

Adaptation Options Handbook helps climate-proof rural areas

The Rural Areas Consortium (CARE) developed an Adaptation Options Handbook for farmers, water management bodies and eco-managers. It describes thirteen measures to combat the consequences of climate change, for example heat, flooding and drought.

Creating new conservation areas

Martha Bakker of Wageningen University and Research Centre developed a series of maps identifying farmland that could be used for nature conservation, giving flora and fauna a place to adjust to climate change. 'The provincial authorities can use the maps to plan an eco-friendly network at locations where it has the best chance of succeeding.' Process manager Arno Gosselink of the Rijn & IJssel Regional water authority is delighted with the model. 'Farmers have been involved in every change made in the Baakse Beek research area, whether it was the construction of a water buffer, adjustments to the road infrastructure, or the development of new conservation areas – it makes no difference. Whenever changes are introduced in an area, the availability of land becomes an issue. The easiest approach is to ride along on the wave of changes that are already taking place.'

Key publications

- Witte, J.P.M., R.P. Bartholomeus, P.M. van Bodegom, R. van Ek, Y. Fujita, G.M.C.M. Janssen, T.J. Spek & J. Runhaar. A probabilistic eco-hydrological model to predict the effects of climate change on natural vegetation at a regional scale. In press with Landscape Ecology.



- Van der Knaap, Y.A.M., M. de Graaf, M., R. van Ek, R., J.P.M. Witte, M.F.P. Bierkens & P.M. van Bodegom. Potential impacts of groundwater conservation measures on catchment-wide vegetation patterns in a future climate. *Landscape Ecology* (in review).
- Van Teeffelen, A.J.A., C.C. Vos, R. Jochem, H. Baveco, H. Meeuwssen en J.P. Hilbers. The effectiveness of green infrastructure as a climate adaptation strategy for great crested newt in intensively used landscapes. In press with *Landscape Ecology*.
- Bakker, M.M., S.J. Alam, J. van Dijk, M.D.A. Rounsevell, T. Spek and A. van den Brink. The feasibility of implementing an ecological network in The Netherlands under conditions of global change. In press with *Landscape Ecology*.
- Bakker, M.M., S.J. Alam, J. van Dijk, M.D.A. Rounsevell. Land-use change as the result of rural land exchange: an agent-based simulation model. In press with *Landscape Ecology*.
- Van Dijk, J., R.E Van der Vliet, H. De Jong, M.J. Zeylmans van Emmichoven, H.A. Van Hardeveld, S.C. Dekker, M.J. Wassen. Modeling direct and indirect climate change impacts on the breeding habitat quality of four meadow bird species. *Landscape Ecology* (in review).
- Kros, J., M.M. Bakker, P. Reidsma, A. Kanellopoulos, S. Jamal Alam and W. de Vries. Impacts of agricultural changes in response to climate and socio economic change on nitrogen deposition in nature reserves. *Landscape Ecology* (in review).

Scientific end product

Special issue “*Model explorations of ecological network performance under conditions of global change*” in *Landscape Ecology* (in review).

Societal end product

Book “*Rural areas. Climate and nature and agriculture*”.
[Rurale gebieden. Klimaat en natuur en landbouw.]

Theme 4 Climate-Proof Cities

Key question: How can we climate-proof cities in the medium and longer term?

Answer: The vulnerability of the Dutch cities shows a wide spatial variety. Climate proofing cities involves the accumulation of many relatively small and local measures. Traditional green roofs are little effective for influencing indoor and outdoor climate and for the storage of extreme rainfall. The cooling effect of surface water in the city is ambiguous.

The research theme Climate-Proof Cities (CPC) aims to make cities more resilient to the impact of climate change by improving their adaptive capacity. CPC consequently developed strategies for dealing with urban heat and with flooding due to heavy precipitation. The study considered various levels of scale: buildings, streets, neighbourhoods, and the region. The research carried out by the consortium has generated a vast number of new insights. It became clear, for example, that in summer heat does not hang over a city like a big dome, but that one side of a street can be much cooler than the other. The extent to which that is the case depends on the location, height, facing and colour of the buildings, and the presence of vegetation and water. The presence of water in a city does not always have a cooling effect. In fact, still water retains heat and can lead to higher nighttime temperatures than in an area where there is no water. Green roofs also appear to do little to reduce heat in outside areas, and they are little effective for water retention and for insulating buildings. CPC contributed to the development of 3Di, a three-dimensional modelling platform that visualises the spatial effects of adaptation measures intended to deal with extreme precipitation in a particular urban area.





Urban heat islands

Professor Bert Holtslag at Wageningen UR worked on weather and climate in cities. “Cities, even relatively small villages, could be warmer than the country side. This can lead to heat stress and less human comfort, especially in areas with high building density and a small surface covered with green vegetation. Open water doesn’t provide enough cooling. In a warmer world measures will be necessary to safeguard the quality of life in the city.”

Vulnerability maps support urban planning decisions

Researcher Franklin van de Hoeven worked on vulnerability maps, which combine data on vulnerable populations, buildings and temperature. ‘The maps help local authorities decide where to start combating heat stress.’ The municipal authorities of Amsterdam had vulnerability maps produced for their city.

Ellen Monchen, Amsterdam Spatial Planning Department: ‘The vulnerability maps opened our eyes to the fact that heat can lead to real problems, even in a city like Amsterdam, with all its canals.’

Key publications

- R.A.W. Albers; P.R. Bosch; B. Blocken; A.A.J.F. van den Dobbelsteen; L.W.A. van Hove; T.J.M. Spit; F. van de Ven; T. van Hooff, V. Rovers. Overview of challenges and achievements in the Climate Adaptation of Cities and in the Climate Proof Cities program. *Building and Environment* 83, 2015. DOI: 10.1016/j.buildenv.2014.09.006.
- Rovers, V., Bosch, P., Albers, R. (eds.) (2014). Final report Climate Proof Cities 2010-2014 (in Dutch). Utrecht. KfC report nr 129/2014.
- L.W.A. van Hove, C.M.J. Jacobs, B.G. Heusinkveld, J.A. Elbers, B.L. van Driel, A.A.M. Holtslag. 2014. Temporal and spatial variability of urban heat island and thermal comfort within the Rotterdam agglomeration. *Building and Environment* 83, 2015. DOI: 10.1016/j.buildenv.2014.08.029.
- T. van Hooff, B. Blocken, J.L.M. Hensen, H.J.P. Timmermans. 2014. On the predicted effectiveness of climate adaptation measures for residential buildings. *Building and Environment* 83, 2015. DOI: 10.1016/j.buildenv.2014.08.027.
- Thomas Hartmann, Tejo Spit, 2014. Capacity Building for the Integration of Climate Adaptation into Urban Planning Processes: The Dutch Experience. *American Journal of Climate Change*, 2014, 3. 0.4236/ajcc.2014.33023.

Scientific end product

Special issue “*Climate adaptation in cities*” in *Building and Environment* (83).

Societal end product

Book “*Climate Proof City. Climate and the city*”. [Klimaatbestendige stad. Klimaat en de stad.]



Theme 5 Infrastructure and Networks

Key question: How do we make our infrastructures and networks more robust in the face of climate change?

Answer: Our physical infrastructures are highly interdependent. Area-specific studies chart which organisation is responsible for what. Public and private parties must share responsibility more than they currently do.

The consortium for Theme 5 – Infrastructure Networks Climate Adaptation and Hotspots (INCAH) – investigated the effects of climate change on Dutch transport, energy, and drinking water infrastructures. The consortium also attempted to find solutions and develop a strategy for adapting those infrastructures in the light of climate change. Little was known about this subject, either nationally or internationally, and the existing studies had little in common. Theme 5 changed this by studying the vulnerability of infrastructures and networks from different angles – for example technical and economic – and combining the outcomes. Adaptive management of infrastructures requires a large number of stakeholders – policymakers and researchers – with varying types of information, values, and interests to be involved in the process. This means, however, that efforts must be made to connect disciplines and to ensure collaboration between researchers and policymakers. A useful strategy for structuring the dialogue between stakeholders and researchers was to model infrastructure as a socio-technical system.

Studying together

A simulated flood in the Rotterdam-Noord district allowed area experts and researchers to study interdependencies between networks. Researcher Bert Sman of Deltares: ‘The Dutch have so much confidence in their dikes that they have virtually ignored what the impact would be if a flood were to happen anyway. We don’t know anything about the successive effects that various parties would have to tackle. It wasn’t always clear who was responsible for flood risk management. In this study, the research models revealed why and when certain networks fail. Because the participants gained a better understanding of one another’s networks, their vulnerability to extreme weather, and their mutual dependencies, they were able to work together.’

- L.A. Bollinger, C.W.J. Bogmans, E.J.L. Chappin, G.P.J. Dijkema, J.N. Huibregtse, N. Maas, T. Schenk, M. Snelder, P. van Thienen. S. de Wit, B. Wols, L.A. Tavasszy (2013), *Climate Adaptation of Infrastructure Networks: Lessons from the Energy, Transport and Water sector*, Regional Environmental Change (2013). <http://link.springer.com/article/10.1007/s10113-013-0428-4>.
- Bollinger, L.A., Dijkema, G.P.J. and Nikolic, I. Resilience of Electricity Infrastructures to Climate Change. *Adaptation Futures 2012*, Tucson, USA, 30 May 2012.
- Chappin, E. J. L. & van der Lei, T. (2012), Modeling the adaptation of infrastructures to prevent the effects of climate change – an overview of existing literature, in ‘Third International Engineering Systems Symposium – Design and Governance in Engineering Systems – Roots, Trunk, Blossoms’, Delft, 18-20 June 2012.
- G.P.J. Dijkema, L.A. Bollinger, M. Snelder, C.W.J. Bogmans, E.J.L. Chappin, I. Nikolic *Infrastructure Networks, Climate Adaptation and Hotspots - Researching the Interconnections, Exploring Adaptation, Planet Under Pressure 2012*, London.
- J.N. Huibregtse, O. Morales Napoles & M.S. de Wit, Flooding of tunnels: quantifying climate change effects on infrastructure, 11th International Conference on Structural Safety & Reliability, June 16-20, 2013.
- Maas N. (2012) Modeling as knowledge brokerage Instruments, in ‘Third International Engineering Systems Symposium – Design and Governance in Engineering Systems – Roots, Trunk, Blossoms’, Delft, 18-20 June 2012.

Scientific end product

Special issue “*Climate Change Adaptation for Transport Infrastructures*” in *European Journal for Transport and Infrastructure Research* (in review).

Societal end product

Book “*Infrastructure and networks. Climate and vital infrastructures*”. [Infrastructuur en netwerken. Klimaat en vitale infrastructuur.]

Theme 6 Climate Projections

Key question: How can the KNMI's climate and weather data and models be altered to make them useful to regional and local public and private parties (local authorities and regional water authorities, farmers and infrastructure management bodies)?

Answer: Cooperation with commercial parties has produced climate scenarios and information that users can base everyday practices on.

Theme 6 – High-Quality Climate Projections for Adaptation in the Netherlands – is closely associated with the KNMI's 'KNMI next' project, the purpose of which is to produce new climate scenarios for the Netherlands based on the global climate simulations for the IPCC Assessment Report 5, which was published in 2013. The new climate scenarios – referred to as 'KNMI14' – play a central role in Dutch government policy on climate change adaptation. A groundbreaking aspect of this theme was the development of high-resolution modelling. With this, it is possible to make more realistic simulations of future meteorological events and to give more detailed information about spatial and temporal patterns. Development of the KNMI's HARMONIE meteorological modelling platform was unexpectedly rapid in the course of this project. This contributed to greatly improving the meteorological information for weather applications, including for the Mainport Schiphol hotspot.

High resolution

High-resolution modelling is cutting edge. It enables the making of realistic simulations of extreme meteorological events that could occur in a future climate. It gives the stakeholders insight into the impacts and, with this, in action strategies. It details the spatial and temporal patterns of climate projections. Thanks to a method that integrates climate models, we can also calculate the risk of certain extreme weather types coinciding.

KNMI'14 scenarios

The aim of the KNMI'14 project was to help users take the consequences of climate change into account despite the uncertainties inherent in the climate change scenarios. Policymaker Erik de Haan comments that the Province of Zuid-Holland is now more acutely aware of climate change. 'It's no longer something that happens in other places. The scenarios back up changes that people have already observed, like extreme rainfall and more hot days given

the time of year. Public awareness plays a very important role in fostering support for our regional climate change adaptation policy.'

Key publications

- Bessembinder, J.J.E. , A.M.R. Bakker, B.J.J.M. van den Hurk and B. Overbeek (2014): Improving data and information exchange in the chain of climate research, impact research, to policy making, Environ. Res. Lett., submitted.
- Schaap, B.F., P. Reidsma, J. Verhagen, J. Wolf and M.K. van Ittersum (2014): Participatory design of farm level adaptation to climate risks in an arable region in the Netherlands, European Journal of Agronomy, Vol. 48, July 2013, p 30-42.
- Kew, S.F., F.M. Selten, G. Lenderink and W. Hazeleger (2013): The simultaneous occurrence of surge and discharge extremes for the Rhine Delta, Nat. Hazards Earth Syst. Sci., 13, 2017-2029.
- Attema, J.J., J.M. Loriaux, and G. Lenderink (2014): Extreme precipitation response to climate perturbations in an atmospheric mesoscale model, Environ. Res. Lett, 9(1), 014003, doi:10.1088/1748-9326/9/1/014003.
- Van Pelt, S., J. J. Beersma, T.A. Buishand, B.J.J.M. van den Hurk and J. Schellekens (2014): Uncertainty in the future change of extreme precipitation over the Rhine basin: the role of internal variability, Climate Dynamics, DOI 10.1007/s00382-014-2312-4.

Scientific end product

Special issue "Focus on Climate and Climate Impact Projections for Adaptation Strategies" in Environmental Research Letters (in review).

Societal end product

Book "Climate projections. Future Climate". [Klimaatprojecties. Toekomstig klimaat.]

"KNMI'14 climate scenarios for the Netherlands; guidelines for professionals in climate adaptation". [KNMI'14-klimaatscenario's voor Nederland; Leidraad voor professionals in klimaatadaptatie.]



Theme 7 Governance

Key question: What forms of governance used in various adaptation strategies are the most effective, legitimate and resilient?

Answer: Unless we get public and private parties working together, it will be impossible to get climate change adaptation measures successfully off the ground. It is important to have a streamlined organisation, a set of normative principles and dedicated decision support tools.

Adaptation to climate change is not just a technical matter but also a complex challenge for public administrators, policymakers, civil society organisations, and businesses. All of these find themselves confronted with urgent questions regarding governance. How should we organise cooperation between sectors and tiers of government? What role should self-organising groups of citizens or businesses play in implementing adaptation measures? How can we allow for long-term considerations in short-term decision-making? How can regional networks continue to play a significant role after the Delta Decisions have been taken? In order to clarify the research results, the consortium identified various action strategies, a set of practical guidelines for policymakers compiled in a booklet. That practical guide is the result of a unique partnership of policymakers, public administrators, and researchers. Pairs of policymakers and researchers jointly identified action strategies for eight urgent governance issues.

Adaptation is about people

Ellen van Mulligen, senior adviser for RWS (the Netherlands' public works agency), has learned a great deal from the governance study prompted by the increase in the water level in Lake IJsselmeer. 'Climate change adaptation is a process that involves people. The technicians tend to forget that and get fixated on the data.' The partnerships that arose in the IJsselmeer region have been formalised, for example in implementation projects. That has become clear in the draft Delta Decision setting out plans for the IJsselmeer Region, which refers to a 'new form of water governance'. The new partnership will be coordinated by a new IJsselmeer Region Governance Platform.

Key publications

- Termeer, C., Dewulf, A., Van Rijswijk, H., Van Buuren, A., Huitema, D., Meijerink, S., Rayner, T. & Wiering, M. (2011). The regional governance of

climate adaptation: a framework for developing legitimate, effective, and resilient governance arrangements. *Climate Law*, vol. 2: 159-179.

- Buuren, A. van, Driessen, P., Teisman, G. & Rijswijk, M. van (2013). Toward legitimate governance strategies for climate adaptation in the Netherlands: combining insights from a legal, planning, and network perspective. *Regional Environmental Change*, 13(2): 1-15.
- Mees, H. L., Dijk, J., van Soest, D., Driessen, P. P., van Rijswijk, M. H., & Runhaar, H. (2014). A method for the deliberate and deliberative selection of policy instrument mixes for climate change adaptation. *Ecology and Society*, 19(2), 58.
- Eisenack, K., Moser, S. Hoffmann, E., Klein R.T.J. Oberlack, C. Pechan, A. Rotter, M. and C.J.A.M. Termeer (2014) Explaining and overcoming barriers to climate change adaptation, *Nature Climate Change*, in press.
- Buuren, A. van, J. Eshuis and M. van Vliet (eds). (2014) *Action Research for Climate Change Adaptation - Developing and Applying Knowledge for Governance*. Routledge, Routledge Advances in Climate Change Research series.

Scientific end product

Special issue "The governance of climate adaptation: a European comparative perspective" in *Journal of Water and Climate Change* (in review).

Societal end product

Book "Governance of climate adaptation". [Governance. Klimaat en bestuur.]



Theme 8 Decision Support Tools

Key question: How do we make the uncertainties of climate change manageable?

Answer: Tools such as 3Di and various types of maps can convert climate change into a language that practitioners understand while making the uncertainties clear. This provides a framework for putting properly substantiated adaptation measures into practice.

The Decision Support Tools theme assisted policymakers with adaptation and dealing with uncertainties. The tools developed in this theme were meant to clarify the effects of climate change and to develop effective adaptation strategies. The consortium also developed evaluation tools with which to optimise adaptation options and to select the best possible solution. The dynamic 3Di flood modelling platform clarifies the effects of climate change, showing water streaming – virtually – through a city's streets. The three-dimensional presentation is based on cutting-edge technology. It is specifically aimed at laypeople who need to be able to use the tools, for example planners who wish to test the effectiveness of spatial planning measures. 3Di Water Management represents a genuine breakthrough; never before has so much data been assembled, calculated from the perspective of water management technology, and presented in the form of high-resolution images. The consortium also achieved a major breakthrough in analysing the secondary effects of flooding. The study shows that the 1953 flooding disaster and the Delta Works that were constructed subsequently have influenced the population distribution of the Netherlands. The results reveal how natural disasters and geographical differentiation in the level of protection have an effect on the economy.

Climate Adaptation Atlas

The Knowledge for Climate Programme has worked with the provinces on a Climate Adaptation Atlas. The collection of maps that make up the atlas is helping policymakers put climate change on their agendas. Researcher Hasse Goosen of Wageningen University and Research Centre: 'Climate change is a complex phenomenon that impacts many different sectors and the way we use space. It is also beset with uncertainties. With so many different climate change scenarios and models and with climate change having a spectrum-wide impact, the amount of

information is overwhelming and almost too complex to comprehend. The interactive Climate Adaptation Atlas provides user-friendly access to this information overload.'

3Di

Thanks to the ingenious 3Di flood modelling platform, we can look into the future and see what parts of a city will flood after heavy rainfall or a dike breach.

Key publications

- Brouns, K., Eikelboom, T., Jansen, P.C., Janssen, R., Van den Akker, J.J.H. and Verhoeven, J.T.A. (2014). Spatial analysis of soil subsidence in peat meadow areas in Friesland in relation to land and water management, climate change and adaptation. *Journal for environment management and planning*, xx-xx (IN PRESS).
- Kehl, C. and Haan, G. de (2013). Interactive simulation and visualisation of realistic flooding scenarios. S. Zlatanova et al. (eds.) *Intelligent systems for crisis management*, Lecture Notes in Geoinformation and Cartography, p. 79-93.
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Scientific end product

Special issue "Decision-making on adaptation to climate change: approaches for well-balanced decisions" in *Mitigation and Adaptation Strategies to Global Change* (in review).

Societal end product

Book "Decision support tools. Tools and climate policy". [Beleidsondersteunende instrumenten. Instrumenten en klimaatbeleid.]



5 Value creation

The results and examples discussed in previous chapters show what the Knowledge for Climate Programme has achieved since its start. The programme has not only yielded research results or specific project outcomes. Its broader value lies largely in its societal impact and in the economic value that it has created. To determine the extent to which the investment in knowledge generation has been effective, we now look at the Knowledge for Climate Programme's yield from the perspective of value creation.

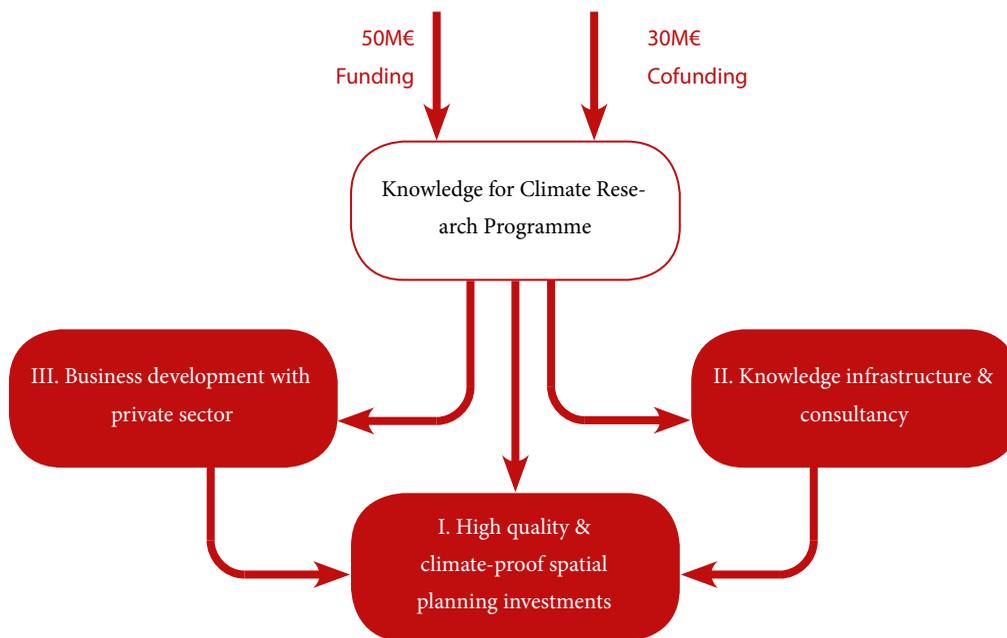
The Knowledge for Climate organisation conducted its first internal review of value creation at the same time as its Midterm Assessment (2012). The main question of the review was:

'What economic or social value has been created from the knowledge generated in the Knowledge for Climate Programme and applied in the field, and what can we do in the remaining two years to increase that value?'

A value creation model was developed to help answer these questions. The model differentiates between three domains that are related to the three main aims of the programme (Figure 5.1 and Section 1.2).

When the value creation model was applied during the Midterm Assessment, it became clear that there was room for improvement in the third domain, i.e. 'Business development with private sector'. Extra efforts have been made in this domain in the final two years of the programme (see Section 5.3).

Figure 5.1 The value creation model



Now that it is drawing to a close, it is clear that the Knowledge for Climate Programme's innovative approach, based on knowledge co-creation, has generated social impact and created economic value in the three domains:

- I the knowledge generated in the programme provided the basis for climate-proof investments that will prevent long-term costs; the value of those investments in other domains, for example the quality of the living environment, will produce short-term benefits;
- II the new knowledge infrastructure created by the programme has yielded a strong knowledge base that will equip the Netherlands for a changing climate (social value) and give Dutch research institutions and consulting and engineering firms a strong competitive position in the international market (economic value);
- III the programme has led to the development and marketing of commercial products and services and provided a basis for further business development by private parties in the area of climate change adaptation.

The following sections look more closely at value creation by domain and describe the additional value-creation activities carried out in the past two years.

5.1 Domain I. Contribution to climate-robust spatial planning investments

The Knowledge for Climate Programme has made clear that climate change adaptation does not necessarily imply huge investments in large-scale engineering works. In fact, it can spur robust interventions that are more valuable because they can be linked to other aims in a region. Researchers and practitioners have together generated knowledge about effective spatial planning investments. In some situations, it may be necessary to completely overhaul plans and building concepts. In most cases, however, it will be sufficient to link adaptation measures to other plans and investments. The consortia have developed a number of innovative climate-proof concepts that can be integrated into existing spatial planning programmes (see the textbox 'New dike concepts' on the next page). Knowledge for Climate has shown that by making small adjustments now, we can avoid costly damage or adaptation measures later.

New dike concepts

The broad dike in the village of Streefkerk is a good example of an adaptation measure that is paying for itself by improving the living environment. The cost of building a broad dike is approximately 25 per cent higher than building a standard dike. However, the integrated plans for Streefkerk go beyond merely building a dike; they include a marina, new homes located on the dike, and a village conservation area with a view of the river. The local authority was able to sell the land for a good price while making the village attractive to middle-class families who would have otherwise moved elsewhere.



Local climate at Schiphol Airport

The study carried out for Schiphol Airport in the first programme phase and the related Climate Projections research (Theme 6) made it possible to trace the spatial and temporal patterns of meteorological events in much greater detail. Because air traffic is greatly affected by sudden weather events, for example extreme precipitation, high winds and poor visibility, such information is extremely important to Schiphol Airport and Air Traffic Control The Netherlands. Using the high-resolution HARMONIE modelling platform, meteorologists can produce local weather forecasts that are of crucial importance to the airport's daily operations.

Regional adaptation strategies

The regional adaptation strategies provided a framework for climate-proof investments in the hotspots. They offer guidelines for policymaking or practical application.

Section 3.3's description of the various regional adaptation strategies shows that they offer the hotspots various modes of action for the future. These strategies are valuable for the hotspot regions because they include cost-effective, climate-robust solutions and because they were created by means of a particular process. For example, the adaptation strategies for the Rotterdam and Haaglanden urban hotspots are valuable mainly because they were developed jointly by the relevant parties (local authorities,

regional water authorities and provincial authorities) and have their support. Sometimes strategies can also be valuable for a city's image. The Rotterdam Adaptation Strategy plays an important role in positioning Rotterdam as a sustainable, climate-robust world port city¹.

Knowledge generation in the Delta Programme

The Knowledge for Climate Programme played a key role in the Delta Programme's knowledge-generation process. This means it also made a contribution to climate-proof spatial planning at national level and the associated investments. Section 2.4 describes how the two programmes cooperated. The Knowledge for Climate Programme – and in particular its researchers and the research institutes involved – developed close ties with the Delta Programme's various sub-programmes. Many of the research projects carried out by the KNMI, Deltares, TNO and other institutes turned out to be of crucial significance for the Delta Programme.

Delta Commissioner Wim Kuijken: 'A lot of effort went into making research results useful for the people involved in the Delta Programme's sub-programmes.' Products that turn new theoretical knowledge into practical applications offer good examples of the way the Delta and Knowledge for Climate programmes complemented each other, says Kuijken. 'These include the climate projections for the delta scenarios, the Climate Effect Atlas for climate-proof spatial planning, the coastal design tool or the studies focusing on multifunctional dikes and on building outside dike protection zones.'

Extra impetus through 'value-creation projects'

The breakthroughs achieved in the Knowledge for Climate Programme do not automatically find their way into applications. That is why the organisation is making an extra effort in the final stage of the programme to encourage and accelerate knowledge uptake in the field. Seven value-creation projects were set up in late 2012 to spur the consortia to take their research results a step closer to practical application. See the list of projects in Appendix 3 and the textbox 'Value-creation project: What can we learn from Hurricane Sandy?'

¹ <http://www.rotterdamclimateinitiative.nl/en/100percent-climate-proof>

Value-creation project: What can we learn from Hurricane Sandy? Organised within the context of the value-creation project 'What can we learn from Hurricane Sandy?', the 'Worst Case Scenario!' seminar held in June 2013 built on knowledge gleaned in Theme 5, Infrastructure and Networks. Researchers joined the owners and managers of various infrastructure networks in examining how well prepared the Netherlands is for an extreme storm like Hurricane Sandy. Representatives of network management bodies, area management bodies, regional safety authorities and emergency services explored the interdependencies between networks and their possible implications. It became clear that the parties are heavily dependent on one another and that they had better learn to speak one another's language more fluently if they hope to manage their vulnerability.



5.2 Domain II. Knowledge infrastructure & consultancy

The Knowledge for Climate Programme focused on reinforcing the knowledge infrastructure and the quality of climate-adaptation consultancy. The programme organisation spent the past few years building a community of more than 1200 researchers, policymakers and professionals, who were active in more than 100 joint projects in the hotspots, the consortia and elsewhere. The Knowledge Transfer unit played a crucial role in building this network (see Section 2.3).

One of the accomplishments of the Knowledge for Climate Programme is that it brought together parties that normally do not cooperate, even though they need to do so to arrive at effective solutions. This was one of the conclusions of the 2012 Midterm Assessment (see Appendix 4). For example, the authorities became involved in research, and the researchers were asked to join in the policymaking process. In addition, 'dedicated' research institutes such as the KNMI, Alterra, TNO and Deltares cooperated more closely on problem-based research than ever before. The programme has given rise to many new alliances between research, policy and practice, and the Dutch knowledge infrastructure is now much better equipped to face the challenges of the changing climate. Not only has this created a sound knowledge base, but the improved knowledge infrastructure has also created

value for the individual parties involved in the Knowledge for Climate Programme. The following sections will describe the value generated for each party.

Universities and research institutions

The Knowledge for Climate Programme provided universities with funding to explore new fields of research. The programme also opened up new research domains for institutes of applied research, as well as new themes with which to identify themselves (see the textbox 'Climate-Proof City'). Knowledge for Climate research often led to new themes being placed on the research agenda and to the 'climate dimension' being included in research projects more often than in the past. For example, infrastructure and network vulnerability to climate change had been unexplored territory before, even in other countries. Knowledge for Climate research has put this subject on the Dutch and international agenda.

Transdisciplinary approach leads to new research domains: Climate-Proof City

The Climate-Proof Cities consortium (CPC, Theme 4) explored climate-proof urban planning from the perspective of multiple disciplines. Various universities faculties (for example at Delft and Eindhoven universities of technology) took up the issue of urban climate change adaptation, and research institutions created new clusters of specific expertise. Before the start of the Knowledge for Climate Programme, Dutch research institutions (with the exception of the Meteorology and Air Quality group at Wageningen University and Research Centre) were not positioned in the field of urban climate change adaptation. The CPC's research has boosted the Netherlands international standing in research on urban heat islands (UHI) and urban water management, urban building physics and CFD modelling, and urban planning and landscape architecture. The parties participating in the CPC now rank as one of the front runners in university teaching and research on urban climate change adaptation, both in the Netherlands and abroad.



Cooperation between research institutes, universities and stakeholders in the field is providing fertile soil for new applied research. Scientific data has also enriched existing research, for example in the applied modelling platform developed by the KNMI and Deltares. By collaborating with stakeholders in the hotspots and beyond, research institutions are better able to respond to society's needs and policy issues. Increasingly, they are incorporating the co-creation method into their own approach, leading to vast improvements in their interaction with knowledge users.

The knowledge generated within the Knowledge for Climate Programme is also serving as input in higher education. One good example is the interdepartmental subject 'Climate Change', part of the Honours Programme² at VU University Amsterdam, which is taught by instructors from different faculties, almost all of which were involved in the Knowledge for Climate Programme. Another example is a course on developing local climate change adaptation strategies developed by the Open Universiteit of the Netherlands in cooperation with the Climate-Proof Cities consortium (Theme 4). This open access course (which will become available in late 2014) is intended for civil servants working for local government, regional water authorities, provincial government and national ministries, as well as other professionals involved in drafting and implementing climate-change adaptation policy.



Both universities and institutes of applied research enjoyed additional advantages from their involvement in the Knowledge for Climate Programme in terms of other research programmes and activities. For example, they were awarded major NWO and EU projects, supplied data for the Delta Programme, contributed to IPCC publications and took part in JPI Climate (see Section 2.4). Internationally, the research conducted within the Knowledge for Climate Programme is generating a great deal of interest, especially concerning the role that theoretical research can play in developing and implementing climate change adaptation strategies. Researchers working in different disciplines are making more efforts to seek one another out, resulting in innovative and promising research proposals. As a result, the Knowledge for Climate partners are well positioned to compete against other parties in international calls for research projects.

PhD candidates and postdocs

The Knowledge for Climate Programme trained numerous young researchers, including 60 PhD candidates and more than 30 postdocs, making a major contribution to the long-term knowledge infrastructure of the Netherlands. These young professionals are invaluable because they have mastered both the theoretical knowledge of climate change adaptation and the skills that they acquired in transdisciplinary research (see also Section 4.2).

To derive even greater benefits from these students and their research, the Rathenau Institute, the Knowledge for Climate organisation and SENSE Research School organised a workshop in early 2014 focusing on the valorisation of PhD research in the climate sciences.³ The workshop challenged PhD candidates to apply valorisation processes to get even more out of their research and to boost the societal relevance of their research results. By developing a valorisation strategy, they learned skills that will make them more competitive in their later careers in science or business.

² <http://www.vu.nl/nl/opleidingen/bacheloropleidingen/vu-honours-programme/courses/interdepartmental-courses/climate-change/index.asp>

³ <http://kennisvoorklimaat.klimaatonderzoeknederland.nl/workshopvalorisationPhDresearch>

Consulting and engineering firms

Various consulting and engineering firms were involved in Knowledge for Climate projects. They included such international firms as Arcadis, Royal HaskoningDHV and Grontmij, but also smaller firms such as Acacia Water, HKV Lijn in water, Nelen & Schuurmans and De Urbanisten. These firms made a major contribution to the research projects in which they were involved. At the same time, their participation in the Knowledge for Climate Programme gave them access to research results and to the expertise of the researchers with whom they were collaborating. The new networks that they created as a result mean that they can source crucial parties more easily and have a direct channel to them.

Erik Schellekens of Arcadis: 'Commercial firms are benefitting from the Netherlands' position as a trendsetter in climate change research. "We" have access to the latest knowledge and the best approach. Participation in Knowledge for Climate is regarded as strategically important in that respect. The programme has given its participants a good reputation and credibility in the field of climate change adaptation research and consultancy, and the participating firms frequently cite research carried out under the Knowledge for Climate Programme to win international assignments.'



Consulting firms play an important role by bridging the gap between research and practice, ensuring the uptake of state-of-the-art knowledge. These firms are very good at identifying market demands, giving rise to new research questions that research institutions can then tackle. This demand-driven approach is partly responsible for the growing demand for climate change adaptation measures in the commercial market, with consultants taking on an increasing number of commercial assignments. By contributing to Knowledge for Climate research and practical implementation, large and small consulting firms now lead the way in numerous facets of climate change adaptation and have built a solid position in both the Dutch and foreign markets (see Box 5.1).

Box 5.1 Cooperating with consultants; international economic opportunities

One of the products of a new partnership that has emerged from the Knowledge for Climate Programme is the book *Climate adaptation and flood risk in coastal cities*. Two of the authors were Prof. Jeroen Aerts (VU University Amsterdam) and Piet Dircke (Arcadis and Rotterdam University of Applied Sciences). The book describes climate change adaptation to rising sea levels and flood risk scenarios for large coastal cities such as Rotterdam, New York and Jakarta. Besides participating in the Knowledge for Climate Programme, Arcadis has been involved in many large-scale water management and climate change adaptation projects, including major assignments in New Orleans and New York. Consultants at Royal HaskoningDHV have gained expertise and developed networks that they used later in Jakarta and other large international projects. Grontmij's work for Ho Chi Minh City in Vietnam draws heavily on expertise that the firm acquired in the Knowledge for Climate Programme.

Government institutions

The Knowledge for Climate Programme was invaluable for government institutions because its research programming and approach supported their cooperation with regional partners (e.g. local authorities, regional water authorities and local private parties). In addition, after cooperating with research institutions and consulting firms, these parties now know where to source expertise in future.

The Rotterdam Region's Midterm Report states this very plainly: 'Many parties are involved in climate change adaptation in this region, and each one has its own interests to promote and its own competencies. Government complexity and fragmentation thwart an effective strategy on climate change and sustainability. The Knowledge for Climate Programme created a context in which parties could join forces and arrive at co-creation, an ambition cherished by many and thus a good reason to participate.'

Another reason that government parties take part in programmes such as Knowledge for Climate is the 'multiplier effect'. By concentrating budgets and efforts, they can arrive at research results that are worth much more than the relatively small investment they make. This not only produces an immense return on investment in terms of knowledge and expertise, but also helps generate support among co-funding bodies.

5.3 Domain III. Business development with private sector

The journey from theory to practice depends to a large extent on getting the business community involved.

Innovation and the ability to turn research results into new products and services – value creation or valorisation – has therefore been the focus of attention in the final phase of the programme.

Winner of the 2013 Climate Adaptation Business Challenge:

Saline-tolerant Potato

The 2013 Business Challenge 2013 was won by Arjen de Vos, co-owner of TS Agri Station Tested on Texel. His business plan for saline-tolerant potato cultivation won him seed capital of €25,000 to market a very special potato. 'This is a variety that will grow in saline soil and can be irrigated with brackish water. The effects of climate change - seepage pressure and more drought – are raising saline levels in farmland, and not just in the Netherlands but worldwide. This potato shows that we don't actually need fresh water in farming. Brackish water is just as good!' says Arjen de Vos.



The research plans drawn up for the third programme phase in 2011 took steps in this direction by developing specific valorisation projects in the hotspots. From 2012 onwards, valorisation and business development also became programme-wide concerns, along two lines. The first focused on turning theoretical knowledge into innovative and commercial applications and encouraging new business ideas for climate change adaptation (see the [Climate Adaptation Business Challenge](#)). The second focused on facilitating the short- and long-term development of the climate change adaptation business market by setting up independent foundations that would continue even after the conclusion of the Knowledge for Climate Programme (see [Long-term market development](#)).

Climate Adaptation Business Challenge: from idea to new business

Our knowledge of climate change adaptation has grown considerably, and the market demand for adaptation measures is increasing. Even so, relatively little new business activity has developed in that connection. As an extra incentive to produce new ideas and develop new business, the Knowledge for Climate organisation twice organised the Climate Adaptation Business Challenge⁴. In each case, the most innovative and promising climate adaptation business ideas were selected in various competition rounds. Thanks to financial support and business coaching, the ideas moved a step closer to becoming commercial products and services (see the [Climate Adaptation Business Challenge](#)).

⁴ www.climatebusinesschallenge.nl

Box 5.2 Climate-KIC

Climate-KIC is one of three Knowledge and Innovation Communities (KICs) created in 2010 by the European Institute of Innovation and Technology (EIT). The EIT is an European Union body whose mission is to create sustainable growth and increased competitiveness in the EU. Climate-KIC integrates activities and results from education, entrepreneurship and innovation resulting in connected, creative transformation of knowledge and ideas into economically viable products or services that help to address climate change issues, both in the area of mitigation and adaptation.

Climate-KIC has developed into the largest public-private innovation partnership in Europe, and probably worldwide, with partners from companies such as Bayer, GDF Suez and Schiphol Airport, the best European academic and research institutions and the public sector. Climate-KIC has received a budget of 75 Mio euro in 2014 from EIT to achieve its objectives, which is likely to grow to a level of 100 Mio euros in the coming years. Deltares, TNO, UU and Wageningen UR, all playing a major role in the Knowledge for Climate Programme, have been involved in Climate-KIC from its early beginning.

The Knowledge for Climate Programme organised the Business Challenge in cooperation with Climate-KIC⁵, the European innovation programme that supports valorisation in the area of climate change mitigation and adaptation (see Box 5.2). Climate-KIC gave participants access to professional business coaching and an international network for climate start-ups. The winners also qualified for the Climate-KIC Acceleration Programme, a demanding training programme that fast-tracks product or service commercialisation for start-up companies.

The first Climate Adaptation Business Challenge (2013) attracted 25 submissions from the Netherlands. The second Challenge, held in 2014, was an international competition with more than eighty business ideas being submitted from 28 different countries. Besides delivering new ideas, business plans and potential start-ups, the Business Challenge encouraged businesses to think about climate change adaptation from a different perspective. The innovative products and services showed that opportunities abound for businesses that take a fresh approach to tackling the effects of climate change. By organising various related events, for example the MatchMaking Event⁶ and Starting up Climate Business⁷, and making use of social media, the Knowledge for Climate organisation was able to draw the attention of new groups (students, start-ups and businesses) to the topic of climate change adaptation.

Market development in the longer term: smoothing the path

The conditions for business development are not always ideal in the short or even the longer term. Sometimes we have to smooth the path, for example by raising awareness, ensuring standardisation, or bringing about a paradigm shift in climate change adaptation. The Knowledge for Climate Programme has done its share by setting up a number of foundations. The process of developing commercially viable products and services is lengthy and will extend beyond the closing date of the Knowledge for Climate Programme. That is why the Knowledge for Climate organisation has decided to set up a number of organisations for the longer term that straddle the divide between the public interest and the potential business development (in the public interest).

5.4 Follow-up foundations

Delta Alliance International

Delta Alliance International⁸ is a foundation set up to create an international network whose mission is to improve the resilience of the world's vulnerable deltas. The Foundation initiates joint research and international knowledge-sharing. Section 3.3 describes the foundation and how it came about.

Following the conclusion of the Knowledge for Climate Programme, funds provided by the Ministry of Infrastructure and the Environment will allow the Foundation to continue its work until the end of 2015. As it has the potential to deliver important input towards achieving the Netherlands' aims in the international water sector, and in particular in deltas, the Foundation may well continue beyond 2015. Rising interest in the theme of water and its association with food security and energy supply is increasing the demand for practical knowledge. Delta Alliance International must play a crucial role in concentrating this knowledge, making it available and sharing it with public and private parties around the world. In doing so, it can facilitate the export of Dutch expertise, in which institutes for applied research and consulting firms play a key role.



5 www.climate-kic.org

6 <http://knowledgeforclimate.climate-research-netherlands.nl/businesschallenge2013/Matchmaking21May>

7 <http://knowledgeforclimate.climate-research-netherlands.nl/businesschallenge2013/finalevent15november>

8 www.delta-alliance.org

Climate Adaptation Services (CAS)

Climate Adaptation Services (CAS)⁹ is an independent foundation that makes information on climate change adaptation available and ensures it is up to date. The foundation's purpose is to make spatial data on the effects of climate change available. It does this by concentrating climate-relevant data produced by KNMI, Deltares, Alterra, TNO and other organisations so that it is easily accessible for public and private-sector users. The foundation is also developing an up-to-date compendium of promising adaptation options, including cost-benefit analysis.

It meets a critical need of parties involved in local and regional spatial planning issues, for example local and provincial authorities, regional water authorities, businesses and the public. The Ministry of Infrastructure and the Environment views CAS as an organisation that provides these parties with up-to-date information on the current and future effects of climate change. One of its basic tasks is to maintain, promote, expand and provide access to the Spatial Adaptation Knowledge Portal (www.ruimtelijkeadaptatie.nl/en) and its associated tools (see Box 5.3).

Box 5.3 Spatial Adaptation Knowledge Portal

The Delta Decision on Spatial Adaptation [Deltabeslissing Ruimtelijke Adaptatie] calls on lower-level governments to work with commercial parties and city-dwellers on creating a climate-proof, water-robust city. CAS, the Knowledge for Climate organisation and the Delta Programme's New Construction and Restructuring sub-programme (financed by the Ministry of Infrastructure and the Environment) have developed a digital Knowledge Portal giving access to climate-related knowledge (www.ruimtelijkeadaptatie.nl/en). The portal makes information and tools available that can assist in climate-proof and water-robust spatial planning or redevelopment. Until recently this information was scattered among multiple sources. It is important to user groups to have a single, easy-to-access source. The website offers visitors a Guide to Spatial Adaptation, a practical tool for dealing with climate change adaptation, for example when managing public space, choosing sites for new buildings or infrastructure, issuing permits or making investment decisions.



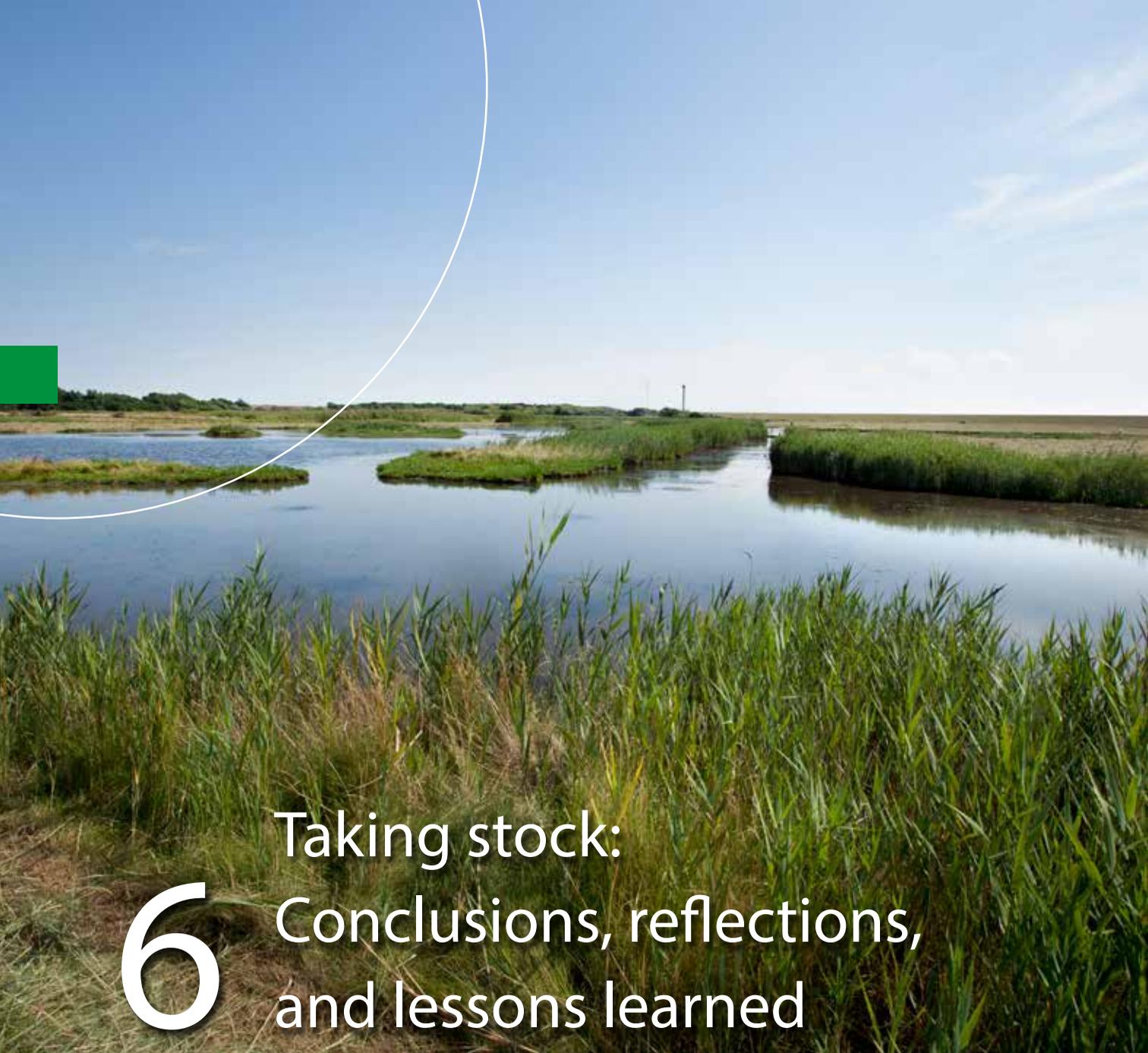
Waterbuffer Foundation

The Waterbuffer Foundation¹⁰ was set up to promote the local buffering of fresh water in periods of extreme rainfall for use in periods of drought. This innovative technology can vastly improve regional and local fresh water self-sufficiency and make water use more efficient, thereby creating opportunities for businesses looking for a return on their investment. The Foundation wants to place subsurface water buffering on the political and administrative agenda as well as share and provide access to knowledge. Its partners include regional water authorities, which also contribute to the funding. Key activities are setting up and supporting pilot projects, showcasing successful practical applications and making expertise available for applications in the Netherlands and abroad.

⁹ www.climateadaptationservices.com

¹⁰ www.waterbuffer.net





6 Taking stock: Conclusions, reflections, and lessons learned

6.1 Introduction

The Knowledge for Climate research programme was set up to explore the consequences of climate change for the Netherlands and how they should be managed. Over the past seven years, the programme has identified and filled in gaps in the existent knowledge. It has also made uncertainties manageable and developed options for dealing sensibly with the necessary adaptation to climate change. This has been done with an investment of 50 million euros. Participating national, regional and local authorities, businesses, and research institutes added another 30 million euros to that initial budget. This resulted in a large number of projects focusing on vulnerable areas and based on pioneering research and

innovation. Between 2008 and 2014, the Knowledge for Climate Programme played an important role as a knowledge broker.

This final chapter clarifies the extent to which the aims of the programme were ultimately achieved. What went well, what went less well, and why was that? This chapter also looks at how the Knowledge for Climate Programme functions within Dutch and international research and policy-making in the field of climate change adaptation. Finally, it considers the main lessons learned, which may be relevant to further research in that field in the Netherlands.

6.2 Reflection on the aims of the programme

As explained in [Chapter 1](#) of this report, the Knowledge for Climate Programme had three aims at its start in 2008:

- 1 to develop knowledge on climate-proofing spatial planning investments;
- 2 to reinforce the knowledge infrastructure for climate change adaptation;
- 3 to develop business opportunities in cooperation with the private sector.

Climate-proofing spatial planning investments

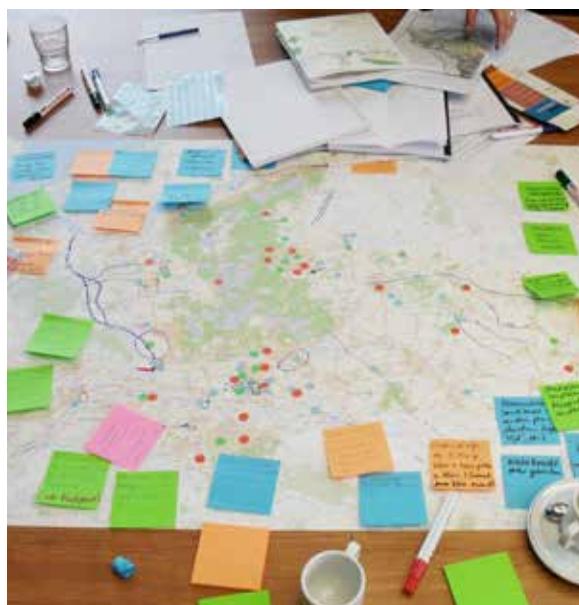
One important goal of the Knowledge for Climate Programme was to explore the phenomenon of climate change and to make it manageable, and to do the same for the adaptation options that local authorities and businesses have to work with. Climate change was an abstract threat that needed to be turned into a real challenge with local and regional solutions. The hotspot approach demonstrated how road management authorities, farmers, urban planners, eco-managers and water management bodies can deal with the consequences of climate change. They were presented with specific adaptation options for use in actual practice.

The programme did not aim to influence regional and local authorities directly. It provided the knowledge needed to improve decision-making regarding long-term spatial planning investments. The programme provided the tools – for example the Climate Adaptation Atlas – so that local and regional authorities can get to work on adaptation. One result is that strategic planning agendas have been drawn up at provincial level from the perspective of climate change adaptation. A number of local governments also incorporated the knowledge generated in the programme into their spatial planning strategies. As explained at length in [Chapter 3](#), adaptation strategies were developed for a number of vulnerable areas ('hotspots'). When drawing up research questions and implementing research, and also when transforming the results of research into practical applications, there was a great deal of interaction, at all stages, between the researchers and practitioners. The Knowledge for Climate Programme encouraged and facilitated such interaction by means of workshops, seminars, conferences, and debates. There were also close alliances with the

regional water authorities (STOWA), the provinces, the Delta Programme, and the Netherlands Environmental Assessment Agency (PBL).

As the previous chapters have made clear, these processes of knowledge co-creation were generally productive. However, a number of critical comments need to be made.

First, bringing together researchers and stakeholders and allocating research funds does not automatically lead to a shared course of action, resulting in a robust strategy for adaptation. A lot depends on the quality of the participating professionals, the level of administrative support, the right 'brokers', and windows of opportunity (i.e. opportunities to combine adaptation aims with other objectives). The amount of time required for these processes and the transaction costs involved must not be underestimated. Interaction also frequently led to difficulty in building consensus and to irritation. There is not in fact any blueprint for these processes aimed at local, regional, or sector adaptation strategies. Obviously, these processes need to focus on identifying vulnerabilities and risks, on developing scenarios for the future and adaptation options, and on mainstreaming adaptation measures with normal policy initiatives. But just how best to organise or design these processes often differs depending on the context. Lessons can be learned not only from best practices but also from 'worst' practices. A knowledge broker – also referred to in the scientific literature as a 'boundary worker' – can play a highly effective role in these processes.



Second, it appears that the pursuit of socially relevant knowledge generation is not always compatible with the pursuit of scientific innovation. Authorities and companies often interpret societal relevance in terms of 'direct applicability to a strictly defined problem', 'maximum certainty about the nature of the outcomes', and 'relevance to the problems of today and tomorrow'. Scientific innovation, however, tends to occur at a distance from politics, when it allows for a longer time horizon and when there is scope for including uncertainties in the research. Over the years, it has always been a particular challenge to find the right balance between scientific innovation and societal relevance. For this dilemma no suitable solution is found. Our experience is that intensive communication between researchers and stakeholders can contribute to mutual understanding and that is an important basis for fruitful cooperation.

The third critical comment is that in processes of knowledge co-creation, both parties – researchers and also practitioners – must be made subject to 'admission requirements'. For example, the Knowledge for Climate Programme imposed strict requirements as to how researchers and consortia were to focus on research questions posed in the field, and how they were to involve stakeholders in carrying out the research and in knowledge dissemination. To a lesser extent, requirements were imposed on the other side, i.e. the hotspots. The hotspots had already been selected prior to the start of the programme, and they had also already been allocated a research budget. No conditions were set for the way in which the hotspots were to cooperate with researchers and research consortia. In some cases, that led to rather unproductive interaction, difficult negotiations about co-funding, and even to a lack of interest in the programme. In retrospect, it would have been better to hold a competition for hotspots as well. It would then have been possible to make firm arrangements with the winners about their involvement, specific activities, and co-funding within processes of knowledge dissemination and knowledge valorisation.

Reinforcing the knowledge infrastructure

The Knowledge for Climate Programme made a major contribution to reinforcing the knowledge infrastructure in the field of climate change adaptation. At the start of the programme, there was a call for more application-driven research, in response to questions posed in

the field. Nevertheless, the programme also focused to a great extent on generating fundamental knowledge. It was precisely this that made it possible to construct a knowledge infrastructure that may ultimately prove valuable for substantiating climate-proof spatial planning investments.

Investment in interdisciplinary fundamental research produced a number of positive effects. Climate science previously leaned towards the natural sciences in the Netherlands (but also internationally). The boost provided by the Knowledge for Climate Programme has moved social science research firmly into the climate research landscape, through such disciplines as public administration, economics, law, spatial planning, and environmental sciences. The theme of governance, for example, has become a significant component of research on climate change adaptation. The Netherlands is in the vanguard in this respect. Based on this theme, a number of debates were organised which proved very enlightening in the field of water management, previously been dominated by technical know-how. The governance aspects turned out to be extremely important in tackling this issue.

In this way, the Knowledge for Climate Programme expanded the agenda on climate change adaptation. The programme highlighted some relatively new adaptation themes, in part from an interdisciplinary perspective combining the natural sciences and social sciences. Initially, for example, there was little interest in the Netherlands for such aspects as health, macro-economic issues or infrastructure. Even a topic such as the climate-proof city attracted little attention when the programme started. Now, however, that topic is one of the main themes within adaptation policy. Similarly, at the start of the programme there was hardly any interest in the vulnerability of the infrastructure to climate change. Identifying that vulnerability and developing adaptation options have ushered that theme into the limelight.

Focusing on themes outside the traditional domain of water management brought new parties on board that had not previously been involved in climate change research. Efforts were made to combine the natural sciences and the social sciences. Research groups at the universities of technology in Delft, Twente and Eindhoven collaborated, but so did social scientists from, for example,

the universities of Rotterdam, Amsterdam, Utrecht, and Wageningen. The Knowledge for Climate Programme focused on less obvious consortia and parties. The added value of the programme lies in new partnerships and the scope it offered for carrying out new kinds of climate research. This led to new insights, as has repeatedly been made clear in the previous chapters.

In the second phase of the programme, 56 PhD students and more than 30 postdocs began tackling fundamental research questions, thereby laying the basis for application-driven research and knowledge uptake. A large number of senior researchers also concerned themselves with projects for the programme. Sixty-eight researchers were involved in the theme of Climate-Proof Cities alone. This made it possible to produce a reservoir of knowledge and to focus at the same time on targeted research. The underlying idea was to have a group of experts within the programme who were linked to practical policymakers through the multidisciplinary consortia. *The aim here was to train research assistants who would be different to 'ordinary' research assistants. They would be trained in 'science-policy interactions', i.e. cooperation with policymakers in research based on questions raised in actual practice.*

Of course this commitment to fundamental research within a programme primarily intended to help make spatial planning investments climate-proof also involves risks. Government and business representatives generally

view the research carried out by PhD candidates with a certain amount of suspicion. The fact that research often takes a long time and focuses primarily on producing articles and dissertations means that its results are not automatically of practical use. The decision to deploy 60 PhD candidates within the programme initially led to a great deal of criticism and put pressure on the negotiations with regional players regarding research co-funding. A number of parties pulled out, and the programme was in danger of being known solely for fundamental scientific research. After a great deal of discussion and communication, it was possible to turn that idea around.

The combination of applied and theoretical research meant that the programme could regularly act as a 'gadfly'. At times it was necessary to swim against the stream and investigate adaptation options that did not fit in with the prevailing policy-making philosophy. This was not always appreciated. Nevertheless, it turned out that a strategy of this kind can ultimately have positive effects. At the end of the programme, the thinking about climate change adaptation had clearly changed, for example in the area of flood risk management. The research carried out within this theme has helped bring about a significant shift in the way we think about the dike construction and reinforcement. We no longer think in terms of absolute safety – which is impossible anyway – but in terms of risk management, with broader dikes and smarter spatial planning offering better protection against disasters.





Development of business opportunities with the private sector

In the course of the Knowledge for Climate Programme, it was possible to ensure effective cooperation with the public authorities – provinces, regional water authorities, and municipalities – that are responsible for investing in spatial planning in the Netherlands. There was also close cooperation with consulting firms and consultants. On the other hand, there was far less cooperation with businesses with landholdings, contractors, and other enterprises responsible for constructing buildings and infrastructure. This was largely because these parties showed little interest in climate change between 2008 and 2014. The issue of climate change adaptation is a new one for many private parties, and they are relatively unaware of the opportunities that it provides for developing new business activities.

Nevertheless, the Knowledge for Climate Programme also created value for the private sector. **First, it clarified the way in which long-term costs can be avoided through climate-proof investment, not only by public authorities but also by businesses.** In the case of Schiphol Airport, for example, the research results concerning crosswinds

can help optimise investment in the system of runways and in the airport's operations. **Second, the improved knowledge infrastructure for climate change adaptation also offers businesses major benefits because it makes consulting and engineering firms more competitive, both nationally and internationally.** The Netherlands is aiming to turn its expertise in water control and water management into an export product, and the Knowledge for Climate Programme has made a major contribution to making that possible. Third, the first step has been taken towards marketing products and services emerging from research, thus creating new business. As pointed out in **Chapter 5**, this has been a modest development so far, but it is nevertheless very promising. A programme such as Climate-KIC will provide further impetus in the years ahead.

6.3 Knowledge for Climate in a national and international context

In the past, the Dutch government founded research institutions in specific sectors to address the issues facing the country; examples include TNO, Deltares, KNMI, RIVM, Alterra, and ECN. The Netherlands Organisation for Scientific Research (NWO) also plays an important role as the organisation that plans and funds fundamental scientific research. The NWO distributes research budgets by inviting universities and research groups to compete for funding. Although the NWO is increasingly focusing on issues of societal importance and on multi-disciplinary research, funding is allocated primarily by discipline.

The institutes concerned were set up a long time ago, based on the issues and priorities at that time. They are deeply embedded within the ministerial structure, with each ministry or directorate-general being responsible for, and supporting, its own research institute. Changes sometimes do occur – especially when the various ministries are restructured or when major austerity measures are implemented – but the divisions between sectors have nevertheless remained firmly in place.

But the issues facing Dutch society cannot always be categorised within particular sectors or disciplines. Innovation in the past and coming decades is far more likely to take place at the interface between sectors and disciplines. Moreover, the traditional division between fundamental and applied research and between research

organisations and consulting firms is becoming increasingly less practical when innovation, and understanding and solving societal issues are concerned.

The Knowledge for Climate Programme decided to adopt a different approach. A separate foundation was set up, tasked with generating the knowledge and solutions needed to make the Netherlands climate-proof. The foundation was allocated 50 million euros for research, but on condition that the stakeholder organisations – public authorities, the business community, and research institutions – would contribute at least 23 million euros in matching funds (co-funding). This allowed the foundation to plan research autonomously and independently, in cooperation with the stakeholders. The foundation's mandate was to solve an important problem that was facing society, namely the fact that municipalities, provinces, regional water authorities, the business community, and research institutions did not really know how to convert relatively abstract theoretical knowledge on climate change into practical knowledge and solutions.

This 'institute' – the Knowledge for Climate Foundation [Stichting Kennis voor Klimaat] – also appears to meet a wider need for an independent knowledge broker. Not only has it built up knowledge about the nature of the issue and the solutions, but it has also learned about creating effective research networks. Which research groups in the Netherlands – but also elsewhere – have the most up-to-date knowledge at their disposal, and which institutes and consulting firms should cooperate on which aspects of this extremely complex issue? How can the knowledge infrastructure that the Netherlands has constructed regarding climate change adaptation be utilised most effectively? How can knowledge from various different disciplines be combined to produce multidisciplinary solutions? Above all else, this means combining knowledge about climate change, infrastructure development, urban development, water management, and nature conservation and landscape management.

There was also another way in which the role of 'independent knowledge broker' turned out to meet a need. For two years in succession, the Delta Programme asked the Knowledge for Climate organisation to carry out an independent review. The organisation brought together researchers from a variety of disciplines to assess the arguments underpinning the preferred strategies and Delta Decisions drawn up by the sub-programmes.

These reviews played an important role in validating the 2015 Delta Programme. In addition, the Ministry of Infrastructure and the Environment and the Netherlands Environmental Assessment Agency (PBL) asked the Knowledge for Climate organisation to help develop a knowledge-driven national strategy for climate change adaptation, to be presented to Parliament in mid-2016. Co-ordinated by the programme organisation, various research groups carried out studies of the climate-related risks and opportunities in the field of energy, ICT, transport, agriculture, fisheries, health, nature conservation, innovation and governance, doing so according to a strict framework so as to optimise the usefulness of these studies for policy-making.

The role of 'independent knowledge broker' also proved to be valuable in the international context. **For example, the Knowledge for Climate Programme played a significant part in developing the European JPI Climate platform,** a partnership of national research funding organisations focusing on climate research. The Knowledge for Climate organisation helped set up this platform and co-ordinated and financed the Netherlands' input into the programme contents. It played a similar role in the precursor programme, CIRCLE2. The Knowledge for Climate Programme also assisted Dutch research groups in establishing contacts with important foreign counterparts – one of the conditions for funding the consortia in the second phase – in order to develop international networks. This greatly increased the international reputation of Dutch climate research.

An independent knowledge broker is needed to analyse and assess investments intended to climate-proof the Netherlands – and ensure that it remains so – and to encourage relevant research. The drawback of permanent structures is that they tend to become rigid and to focus increasingly on their own continuity. Temporary structures can provide a boost each time they are set up, but their dynamic and continuity depends very much on the political mood. The Knowledge for Climate Foundation has demonstrated that a temporary 'institute' with a clear mandate can be extremely effective. Such an organisation must, however, have top-notch experts at its disposal and be allowed to operate with a large measure of autonomy. It must also have the firm commitment of authoritative figures.

6.4 Lessons learned

The end of the Knowledge for Climate Programme also brings to an end its role as ‘independent research planner and knowledge broker’ in the field of climate change adaptation. Any subsequent follow-up initiatives can learn from the experience gained in this programme. The lessons learned can be summarised under six headings:

1. Make use of research programming and funding as a policy tool
2. Set up an independent institute to act as a knowledge broker
3. Ensure careful but also flexible research programming
4. Create partnerships that go beyond the boundaries of disciplines and sectors
5. Apply a strict and careful system of quality assurance from both the scientific and societal perspectives
6. Invest in processes of knowledge dissemination and knowledge valorisation
7. Secure and valorise the knowledge obtained through the programme after it ends

1. Make use of research programming and funding as a policy tool

Research is not just a means of enlarging or improving the knowledge base for policy-making. Research programming and funding is itself also a policy tool. Providing funding for research can generate new initiatives in certain policy portfolios, for example by placing certain adaptation options on the agenda that have hitherto been neglected, creating a new dynamism by combining existing insights, introducing tools that make assessment and decision-making clearer and more transparent, etc. Ultimately, research can help increase the effectiveness, efficiency, and legitimacy of policy, including in the long term.

2. Set up an independent institute to act as a knowledge broker

The role of knowledge broker can only be undertaken effectively and legitimately if the broker has complete independence and authority. The Executive Board of the Knowledge for Climate Foundation discovered on a number of occasions how important it is to be able to take decisions freely, and without any duty to consult other parties, regarding research programming and accepting or rejecting research proposals. Independence is also necessary if the knowledge broker is to initiate



necessary innovations in the research agenda and to encourage necessary interaction between researchers and policymakers. It may be vital to abandon existing routines, something that is impossible if those in charge of a research programme are affiliated with organisations where such routines are customary. In order to guarantee this independence, there must be a Supervisory Board that will support and legitimise the decisions taken by the Executive Board.

3. Ensure careful but also flexible research programming

We have already emphasised that research must be planned carefully, with the participation of important representatives from science, policy-making, and the business community. The resulting discussions, confrontations, and debates require careful guidance, focusing on developing a shared, responsible course of action. Cooperation with stakeholders in articulating and working up research questions also requires flexible programming. Certainly when a programme extends over many years, it is important to adopt a cautious and flexible strategy, one that can be adjusted at any point to take account of changing insights and needs.

4. Create partnerships that go beyond the boundaries of disciplines and sectors

Research programming took an unusual form in the Knowledge for Climate Programme. The research plans were not based on research questions proposed by particular sectors or scientific disciplines; rather, they were based on the demand for solutions for a problem facing society. The questions that emerged were then put before sector-specific research institutions, university

research groups and businesses, which submitted relevant project proposals in competition with one another. This forced research groups to collaborate that do not normally do so. This multidisciplinary and multisector form of collaboration generated a large number of new theoretical insights and at the same time a great deal of practical knowledge that can be applied in the field. The atmosphere was not always harmonious, however. There were frequent arguments, mutual incomprehension, and serious differences of opinion. In most cases, however, confrontation ultimately produced synergy. Much of the knowledge generated in this way was put to use by the stakeholder organisations and public authorities within a few years, or will be utilised within the foreseeable future. This approach means that even after the end of the Knowledge for Climate Programme, complementary research groups can be expected to work together more effectively than they did previously.

5. Apply a strict and careful system of quality assurance from both the scientific and societal perspectives

The quality assurance system is an important element in ensuring the reliability and authority of a research programme. The research agenda, the individual research proposals and the research results must be subjected to critical assessment by third parties. This is normal in the research world, but it is not yet standard practice in the case of public authorities or the business community. In programmes aimed at knowledge co-creation, systematic review from both the scientific and societal perspectives is considered standard procedure. In the Knowledge for Climate Programme, this two-pronged system of accountability made a major contribution to the quality of the research, the applicability of the research results, and the effective use of research funding. It is important to ensure that the reviewers are entirely independent, especially in the societal domain. Experience has shown that choosing reviewers carefully can boost the quality of research projects significantly and help turn their results into practical applications.

6. Invest in processes of knowledge dissemination and knowledge valorisation

Sharing and disseminating knowledge and encouraging value creation are important activities that demand specific expertise and prudent strategies. After all, they involve creating complicated relationships between public authorities, the scientific community, and policymakers,

between institutes and between disciplines, including internationally. It is crucial to mobilise individuals and organisations at every level, from small-scale workshops right up to international conferences. But creating networks (simply bringing people from different worlds together), finding windows of opportunity, provoking debates, and utilising social media (a website, LinkedIn, Twitter) can also be highly effective. Encouraging knowledge dissemination and knowledge valorisation once again requires independence and organisational capacity.

7. Secure and valorise the knowledge obtained through the programme after it ends

The Knowledge for Climate programme has served as a knowledge broker in the past few years by developing research projects in response to practitioners' questions and by adapting the results of that research to practical policymaking. That role will disappear once the programme has ended, posing a potential risk. It is precisely at the end of the programme that we are seeing many research results of potential use to national and regional governments, businesses and civil society. We therefore recommend that temporary research programmes also provide for follow-up. That way, the knowledge generated in such programmes will be secured and remain accessible to potential users. Ongoing investment in knowledge valorisation is also important. The Knowledge for Climate programme has solved this problem by establishing Climate Adaptation Services (CAS, see Section 5.4), a foundation that valorises, updates and makes climate adaptation knowledge available.





Review & response



Review

Introduction

In the last year of the research programme Knowledge for Climate (2008 – 2014) a Final Evaluation was organized to assess the programme and its key-results. This report includes the main findings of the Final Evaluation that was conducted by a scientific and a societal review panel.

Objective

The Final Evaluation of Knowledge for Climate was organised to assess the effectiveness and efficiency of the approach and results of the programme. Not only in order to justify the public resources spent but particularly to identify lessons for the future. Evaluation of the Knowledge for Climate programme supplies major input for follow-up research and policy development on climate adaptation in the Netherlands and on international level. How successful is the unique approach of the Knowledge for Climate programme based on co-creation and what are the “lessons learned”?

Approach

The Final Evaluation of Knowledge for Climate was conducted by a scientific and a societal review panel, both consisting of four reviewers. The scientific reviewers were requested to focus on the Scientific quality, the societal reviewers were requested to focus on the Societal impact. In addition, both panels were asked to reflect on the Value creation and Programme organization of Knowledge for Climate. The review was conducted from a ‘helicopter view’.

The evaluation process involved a written review of the Knowledge for Climate self-assessment report by the individual reviewers and an Evaluation Panel Meeting on 21 November 2014 in Amsterdam. During this one-day meeting, the review panels interviewed several representatives of the Knowledge for Climate community, including researchers, stakeholders and funders.

Findings

Based on the individual reviews, interviews and panel discussions, the conclusions of the Final Evaluation of both panels are formulated (separately) in this report.

Main findings scientific review panel

- Prof. Jos Engelen (Chair)- Chairman of the Netherlands Organisation for Scientific Research (NWO)
- Prof. Simin Davoudi - Professor of Environment Policy & Planning at the School of Architecture, Planning & Landscape and Associate Director of the Institute for Sustainability, Newcastle University
- Prof. Wolfgang Cramer - Research Director (CNRS) at the Mediterranean Institute for Biodiversity and Ecology (IMBE), Aix-en-Provence, France
- Prof. Jim Hall - Director Environmental Change Institute, Professor of Climate and Environmental Risks at University of Oxford

Remarkable results

The well-structured yet open approach to the definition of specific research questions in this broad framework is impressive. Knowledge for Climate has clearly been successful in bringing some of the most competent research teams together, allowing them to address key concerns of adaptation in the Netherlands. The programme has led to the production of a large body of knowledge about climate change adaptation and has firmly put Dutch researchers at the centre of international debate in the field. More importantly, the program has strengthened the value and contribution of social sciences in climate research and has given it a high visibility. The leaders of the programme have created an open and innovative management structure, and this has allowed them to meet many of their goals. These goals are identifiable with respect to the traditional indicators of scientific output (papers & PhDs) as well as the technical knowledge that could be applied for better adaptation of the Netherlands to climate change.

One of the greatest achievements of Knowledge for Climate is its success in combining different scientific disciplines, different research methodologies and in its success in bridging the gap between researchers, policy makers, private sector partners and other stakeholders. Knowledge for Climate shows that the different worlds of science, policy, industry and civil society can be linked to each other. Achieving this integration is by no means simple and requires a fair amount of time, resources and key qualities of partners such as mutual trust and understanding. Knowledge for Climate and its regional hotspots, general research topics and the wide variety of stakeholders are early examples and innovative tem-

plates for future “regional knowledge ecosystems”, currently promoted at national and European level as one of the promising models for successful collaboration

The materials sent to conduct this review have been comprehensive and put together very well. The self-evaluation report honestly sets out the tensions between generating outstanding scientific results and conducting stakeholder-relevant research. The value of the achievements of this programme should not be underestimated. Nevertheless the review panel wants to offer some critical remarks for consideration. In the self evaluation report there could have been more emphasis on concrete examples of scientific, societal and business breakthroughs. The ‘key publications’ section of the “in-depth research” report is helpful, but it would have been useful to know what are considered to be the six (or some other small number) most important scientific achievements from each theme. The production of a special issue in each theme is admirable and a good way of increasing visibility. But all major publications, including the Special Issues should be made publicly accessible (“open access”) which is only the case for one of them at the moment.

PhDs

The program supported an impressive number of PhD-students and post-docs whose training and education was of high quality, although not exclusively focused on scientific excellence. Alongside their individual scientific responsibilities, the young researchers were asked to engage in partnerships with people and institutions not only outside their own research fields but also outside the science community. It is clear that this multi-, inter- and transdisciplinary approach and the continuous dialogue between scientists and their counterparts in society, industry and public administration has created a new type of scientists willing and able to provide their academic skills for the broad benefit of society. Current plans to diversify academic curricula can take stock of this experience.

Writing policy-relevant documents can be time consuming. It is very important that the PhDs have the right guidance from their supervisors in order not to jeopardize the academic work. There is evidence that the Knowledge for Climate PhDs are being successful in finding jobs after their dissertation. They have built a big network due to the fact that they worked with different

stakeholders. Surprisingly, the PhDs within the Knowledge for Climate programme did not really know each other. Programme management should have put more effort in building a real and active PhD-community. This could have generated benefits and cooperation. The PhDs themselves explained that it was already a big task to cooperate and know everyone within their own theme, which appeared to them as being very big with many stakeholders, projects and work packages.

Knowledge transfer

As its name indicates, societal engagement and knowledge transfer has been an important aspect of the Knowledge for Climate programme. Considerable effort and resources have been invested in knowledge transfer. This level of commitment is to be applauded. But the mere dissemination of results is not enough. While it is not possible that the scientists be held responsible for the application of knowledge, it is still very important to support this as much as possible. The self-evaluation is candid about some of the challenges that this has posed and the mixed level of commitment on the part of stakeholders. Much has been learnt as is clearly stated in the self-evaluation report. In future programmes it is recommended to have someone specialised in co-creation (a knowledge broker or translator) at the programme level to support the consortia. It is important to have some specific targets for knowledge transfer at the start of the programme, around which the co-creation can be designed.

The self-evaluation report appropriately highlights the importance of the consultancy industry for knowledge transfer. The profit margins in consultancy are not always high, but it is a high added value industry that creates many 'knowledge economy' jobs. The Dutch consultancy industry is respected worldwide and has established considerable comparative advantage in climate risk assessment and adaptation planning. The work of the Knowledge for Climate programme has contributed to those business opportunities and advantages.

Internationalisation

The review panel thought that still more could have been achieved in terms of international scientific impact if more resources had been invested in global assessment and case studies outside the Netherlands. The Netherlands are in a very particular environmental and societal

setting, with hardly any major comparable region elsewhere in the world. Knowledge for Climate researchers should aim to build upon their achievements by articulating the main insights for the international research and practitioner community.

Legacy

The urgency for adaptation has not decreased since the start of the programme: it has increased. It became apparent during the visit with stakeholders of Knowledge for Climate, that the adequate sense of urgency had not been communicated very effectively to the government. Likewise, the actual needs for significant change in adaptation strategies, using the findings from Knowledge for Climate, could have been articulated much more strongly in the self-evaluation report.

There should have been more attention in an earlier stage on financing projects and consortia that would survive after the lifespan of Knowledge for Climate. It is desirable that the momentum created by the programme is maintained and enriched. Like any other infrastructure, knowledge infrastructure needs maintenance. How can the collaborations be structurally preserved? How can we maintain the momentum? The Panel recommends that the programme leaders proactively explore possibilities for the future. One way to move forward is to organise a brainstorming session among the programme leaders and the main researchers and stakeholder to identify practical and feasible options (in terms of available resources) for keeping the network and producing new ideas for future research.



Main findings societal review panel

- Drs. Luc Kohsiek (Chair) - Dyke Warden for the Hollands Noorderkwartier Water Authority. Chairman of the Foundation of Applied Water Research (STOWA)
- Drs. Pieter Jongstra - Former managing partner Ernst & Young
- Alexandra van Huffelen - CEO GVB Amsterdam (public transport company). Former alderman for Sustainability, City centre and Public space for the city of Rotterdam
- Katheleen Poels - Director Business Unit Rivers, Deltas & Coasts at Royal HaskoningDHV

Broader knowledge base and practical solutions

A giant step has been made by Knowledge for Climate (KfC) in the field of climate adaptation research and practice. KfC contributed to a broader and deeper knowledge base and created a well-defined knowledge infrastructure. The programme has given lots of insight in the effects of climate change in the Netherlands and the potential solutions to deal with this. Many innovative ideas, concrete solutions and action plans were produced. The regional adaptation strategies and the work for the Deltaprogramme are good examples of how the programme contributed to climate robust spatial investments by the government. The projects did not only provide local solutions, but also resulted in opportunities internationally for companies and knowledge institutes.

Research was carried out on a wide range of climate related topics. From the perspective of the knowledge users, most have been achieved in the fields of heat (e.g. urban heat island effect, heat stress) and water (e.g. urban flooding, underground water storage). The focus was largely on technical aspects of climate adaptation. Topics that were less explored and need to be addressed in the future are:

- Integration of adaptation in regional economic development
- Finance and governance for the implementation of adaptation measures
- Effects of long periods of drought, e.g. on groundwater levels in urban areas

Based on the interviews with the hotspot teams and other KfC stakeholders it can be concluded that a lot has been achieved with respect to societal relevant research. There are many examples of KfC results that are very



useful for the stakeholders involved. Clearly, many of these topics would not have been tackled by the stakeholders if KfC did not create the opportunity, including funding, to start the projects together with the knowledge institutes.

It is difficult to assess to what extent the goals of the programme are achieved, for example with respect to useful results for practice, due to a lack of specific or quantitative goal setting. A recommendation for future programmes is to identify key performance indicators (KPIs) at the start of the process, related to the objectives of the programme. Not primarily to be judged at the end at the programme but also as guideline for progress during the programme. Another recommendation is to highlight some examples of specific achievements, also in the final report.

Some results are still to come, for example the final theses of the PhD students of the programme. It is important that after finalization of KfC these results will find their way to the relevant stakeholders.

Bridging science and practice

An important achievement of the KfC programme is bridging science and practice. The programme had a crucial role in linking IPCC and other scientific research on climate change with projects on the ground. People from science and practice did a lot of 'learning on the job' by working together in multidisciplinary and multi-stakeholder teams and through the exchange of knowledge from both sides. The programme functioned like a 'dating bureau' where practitioners and researchers could find each other through the projects. This resulted in many new contacts that often remain after completion of projects. KfC acted as a community builder and it is important to keep this community alive.

The co-creation approach of the KfC programme was a good first step in involving stakeholders. However, there are still challenges in dealing with the tension between scientific quality standards and results for practical use in these types of projects. Also in terms of timing: a PhD study lasts four years while practitioners are looking for results on short term. Not all KfC research resulted in practical and useful results for the stakeholders. Particularly in the 2e tranche of the programme, where the co-creation approach appeared to be most challenging. The focus was more on the scientific impact of the thematic research and it was harder for the stakeholders to be involved and get practical results. More attention is needed to understand each others language and needs. The common interests of scientists and practitioners should be investigated better before starting co-creation processes in future programmes and projects.

The involvement of ‘real policy makers’ or politicians in the co-creation process of climate adaptation is still very limited. As a result, the implications of the developed knowledge for policies is limited to certain themes and few local governments. A recommendation for the future is to improve the involvement of policymakers and politicians, for example by better alignment of adaptation with non-climate issues on the political agenda and with regional economic development.

Contribution to the Deltaprogramme

KfC contributed significantly to the knowledge base for national policy development in the Deltaprogramme. Even though KfC was already running when the research questions in the Deltaprogramme were formulated, there has been a successful ‘marriage’ between the programmes. Over the years, the programmes succeeded to align with and benefit from each other, both in the hotspots and in the Delta-subprogrammes. A lot of KfC knowledge has been used for the development of the Delta decisions that have just been adopted by the Cabinet for the next 5 years. There is a great demand in having the KfC results on a regional level for implementation of the Delta decisions.

The review of the Delta-subprogrammes facilitated by KfC has been of great value. The syntheses documents that were produced as a result of the review and recommended by KfC, do not only contribute to scientifically reviewed policy making, but they are also very effective for the Deltaprogramme knowledge dissemination.

Awareness, knowledge use and dissemination

KfC has made an important step towards a common approach and understanding of the analyses of climate effects and how to deal with it, for science, (local) governments and the private sector.



Due to KfC, the awareness and the sense of urgency for climate adaptation in the Netherlands has increased significantly. However, this is just the start.

The KfC programme initiated various knowledge dissemination activities and tools, including a great website and many knowledge sharing events. The huge event 'Deltas in times of climate change' in Rotterdam is a great example of how KfC really enriched the "ecosystem" of climate adaptation research at national and international level. What will happen after KfC? Concerns are that results will be lost and new programmes and projects will build too little on the knowledge that is available.

A big challenge now is to effectively disseminate the applied knowledge outside the inner circle of KfC to all levels of governmental organizations, the private sector and to the citizens. How can it be ensured that climate adaptation is included in the decision making process, as an integral part of tradeoffs that are being made in spatial developments. Therefore, actions for dissemination of the applied knowledge should be continued and intensified.

In most of the hotspots the KfC results are (starting to be) used, but these hotspots and other KfC partners do not cover the whole of the Netherlands. Knowledge has not been disseminated to non-involved parts of the country yet. A lot of work has to be done to reach these regions and municipalities, and to make knowledge applicable for other local situations. The Climate Adaptation Services (CAS) foundation has great potential in this, which already worked with various municipalities on vulnerability maps and other tools. CAS makes the climate information applicable on local level and supports stakeholders to start the adaptation process together.

Finance

Accountability is very important in these types of programmes and it is clear that KfC felt that high level of control was necessary. The financial cycle of KfC in terms of annual planning, reporting and auditing of the programme looks very solid, and is a clear demonstration of good governance. However, it is too early to draw conclusions about the final financial results. There are

still some open ends with respect to the finalization of the programme, at the end of 2014 with a run off in 2015. The last annual financial report will be audited together with the complete evaluation of the programme by the accountant. If this audit still leaves some open ends, a final financial review is recommended once the whole programme is completed.

The definition of co-finance, in terms of type of funders (public/private) or sources of funding, is not very clear. It is recommended to give a clear explanation in the final report.

Legacy and follow up

Bringing the KfC programme to an end does not mean breaking down the ambitions. The urgency for climate adaptation has only increased during the time of the programme. It is important to continue the work that has been started and to accelerate the implementation of adaptation. No continuation would be destruction of capital. Concerns are that the national government does not seem to be aware of this. It is crucial to keep communication with politicians about the urgency of climate adaptation during and after the programme.

The research programme 'Water en Klimaat' will continue with (scientific) research on the topics of climate adaptation. However, this programme does not cover the dissemination and use of knowledge in practice that is crucial in the next stages of adaptation. It is important to ensure that the knowledge questions that arise from practice in that process will be collected and picked up by research.

The foundations that were initiated by KfC play an important role in the dissemination and use of knowledge after the programme: Delta Alliance, Waterbuffer and Climate Adaptation Services (CAS). The assignments of the foundations are not very clear with respect to which part of the KfC legacy they focus on. It is recommended that, especially concerning the CAS foundation, the mandates are being enlarged. The position of these foundations could be reinforced by involving more partners, including the private sector.



Response

Dear members of the scientific and societal review panels,

Having received and studied the Findings Report, we would like to thank you all for the huge effort that you put into thoroughly assessing the Knowledge for Climate Programme last November. We are gratified by the positive remarks about our programme and the valuable recommendations that have emerged from this review.

This letter is our response to the main issues raised in the Findings Report. We will explain how we will incorporate some of your comments into the final version of our self-assessment report, and will indicate what further ac-

tion we will implement in order to promote the development and dissemination of knowledge in the near future.

1. Scope of the programme

The Knowledge for Climate Research Programme has emerged from the increasing public and political awareness that societies need to adapt to climate change and that fundamental changes must take place at various scales and in various sectors of society in order to cope with this multi-faceted problem. Responses to climate change are not only a matter of infrastructural adjustments, such as constructing dykes, or technical innovations, such as new ways of storing fresh water. They also include fundamental changes in our way of living, urban and

regional planning, mobility patterns, land and water use, and nature conservation – to name just a few. As such, climate challenges are also societal challenges. We are happy to read that both review panels acknowledge the achievements of the Knowledge for Climate Programme in this respect, more specifically that the programme has strengthened the value and contribution of the social sciences, besides the natural sciences. Intensive cooperation between the natural and social sciences is of the utmost importance in understanding and dealing with the challenges of climate change. Building on our experience, we will continue to encourage governments and businesses at all levels of society to promote both fundamental and applied research in this field. We agree with your recommendation that in future programmes other research topics should also be explored, such as the integration of adaptation into regional economic development and the role of finance and governance in implementation processes.

2. Multi-, inter- and transdisciplinary approach

From the start of the programme, an ambitious multi-, inter- and transdisciplinary approach was introduced, including an intensive and continuous dialogue between scientists and stakeholders (i.e. representatives of governments, businesses, and NGOs). We are aware that this approach posed a huge challenge to the PhD candidates involved. They not only had to carry out the traditional academic work (theoretical and empirical research, writing academic papers) but most of them also had to engage in societal debates and were involved in complex processes of knowledge co-creation. In this way, we have actually created a new type of scientist “willing and able to provide their academic skills for the broad benefit of society”. Unfortunately, there is always a reverse side to such an achievement. As you critically remarked, the interaction and mutual cooperation between PhD candidates has not developed as desired. The main reason was so as not to overburden these young professionals. Nevertheless, some fruitful cooperation between the PhD candidates emerged within the research consortia.

The co-creation approach has been very effective in involving stakeholders. We concur with your observation that there are still challenges in dealing with the tension between scientific quality standards and results for practical use, and that intensive communication between both scientific and policy communities should be one of

the cornerstones of this approach. The main lessons from these processes of knowledge co-creation – highlighted in chapter 6 of the self-assessment report – will be actively communicated by the Board to relevant national and regional knowledge networks. Your recommendation to appoint knowledge brokers in future research programmes is also endorsed.

3. International orientation

It became clear from the Findings Report that more could have been achieved in terms of international scientific impact if more resources had been invested in global assessments and case studies outside the Netherlands. We certainly agree with this opinion, but at the same time we would like to emphasise that – based on one of the Dutch government’s main requirements – the scope of the programme was restricted to the Netherlands and especially to vulnerable regions. Nonetheless, a substantial amount of research within the “second phase” of the programme either involved international comparisons or contributed to international academic debate (including the production and publication of eleven special issues of leading academic journals). Moreover, the research consortia were encouraged to cooperate with foreign research groups. But in our view, more attention should be paid to international research cooperation in follow-up research programmes.

4. Scientific, societal, and business breakthroughs

One important recommendation of both review panels is that the final report should highlight specific achievements more effectively, for instance by placing more emphasis on concrete examples of scientific, societal, and business breakthroughs. We acknowledge that the draft self-assessment report has an emphasis on process-related issues rather than substance-related issues. Although the latter information is to be found in annexes and in the scientific progress report, your comments have convinced us to add more information to the body text about notable research results, key publications, and the impact on society.

Some results are still to come, for example the final dissertations of many of the PhD candidates in the programme. After finalisation, these results will be made available to the scientific and policy communities via the KfC database. As far as possible, the Board will also disseminate these results to relevant stakeholders.



5. Open access to publications

Knowledge for Climate uses public funds to promote fundamental and applied research. It is our view that the results generated by this investment should also be made publicly available. We have therefore invested a substantial amount of money in an easily accessible website, including a database of publications. In 2013, our publication database had an average of 10,000 downloads each week. This shows that our approach actually works. Nevertheless, your remarks about open access are justified. We have therefore decided to allocate additional funds for keeping the publication database accessible in the coming years. We have also allocated a substantial budget for providing open access to a specific set of overarching articles published in journals that do not normally permit open access.

6. Knowledge transfer

Knowledge transfer and dissemination played an important role in achieving the main aims of the KfC programme. The self-assessment report presents a detailed overview of the activities and results during the past seven years. In our view, these results are very promising and clearly show the benefits of our approach. We do admit, however, that in future programmes additional approaches can also be adopted, for example involving policy-makers and politicians in processes of knowledge co-creation, communicating the sense of urgency for developing adaptation strategies, and up-scaling good adaptation practices to other cities and regions.

7. Legacy

Both review panels expressed their concern that after the end of the KfC programme results will be lost and new programmes and projects will not build sufficiently on the knowledge that is available. We understand these concerns, but at the same time we are hopeful that NWO (the Netherlands Organisation for Scientific Research), the Dutch Ministry of Infrastructure and the Environment, and the leaders of future research programmes will continue the work started by KfC and will accelerate the development and implementation of adaptation strategies. The urgency of adaptation has increased since the start of the KfC programme. The Dutch government intends publishing a national adaptation strategy in 2016, based partly on the results of the KfC programme. Moreover, NWO is creating new internationally oriented research programmes, which will also build on the experience of knowledge co-creation developed by KfC. Last but not least, a national follow-up research programme was recently established – “Water & Climate”, partly funded by the Delta Programme – that aims to build on the work of KfC.

As far as possible, the Board of KfC will do its utmost to encourage governments to take appropriate action, to influence the sense of urgency, and to continue disseminating the results of our programme (for instance by organising workshops, roadshows, and presentations by researchers for regional and local authorities). Attention will also be paid to follow-up research programmes and to encouraging cooperation and networking between knowledge institutions and stakeholders. KfC has also created a follow-up foundation: Climate Adaptation Services (CAS). This aims to make information from

the KfC programme on climate adaptation available for regional and local authorities and ensures that the information is kept up to date. With funding from KfC and national government, CAS will take responsibility for the legacy of KfC.

8. *Accountability*

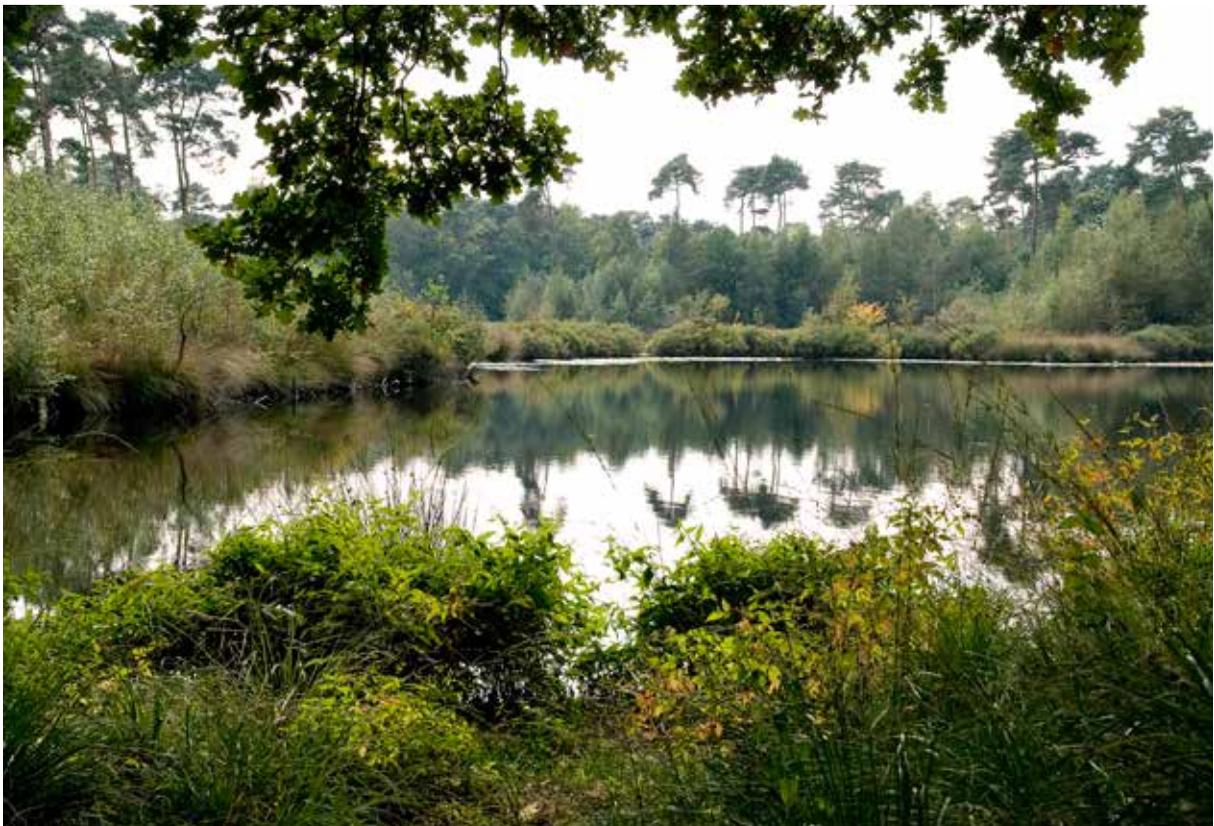
Accountability is indeed a highly important issue in research programmes of this kind. The purpose of the self-assessment report is to account for the way in which the Board has utilised the public funds entrusted to it. Those funds (a budget of 50 million euros) were made available by national government and by regional and local authorities, businesses, and knowledge institutions (more than 30 million euros in co-funding). We are pleased to read in the Findings Report that KfC's financial cycle in terms of annual planning, reporting, and auditing looks solid and clearly demonstrates the emphasis on good governance. However, the final financial reports for 2014 and 2015 were not yet included in the self-assessment report.

Your recommendation for future programmes to identify key performance indicators (KPIs) at the start of the process related to the objectives of the programme has been taken to heart, and will be communicated to the leaders responsible for follow-up research programmes.

9. *Concluding remarks*

Climate change is an intriguing issue, one that triggers both curiosity and ingenuity. This is what we have seen and exploited in our programme. We believe that the insights that have been revealed and the commitments that have developed in the course of our programme have created a long-term basis for understanding and dealing with climate change. However, climate change is about the future and will by definition involve surprises. We therefore call on all readers to remain alert and to continue exploring climate change and how we can deal with it. Knowledge co-creation is one of the best ways to approach the future challenges and that is what this programme has demonstrated.

Prof. Pier Vellinga
Prof. Peter Driessen
Ir. Kees van Deelen
Executive Board KfC





Appendix

1 Organisation of Knowledge for Climate Programme

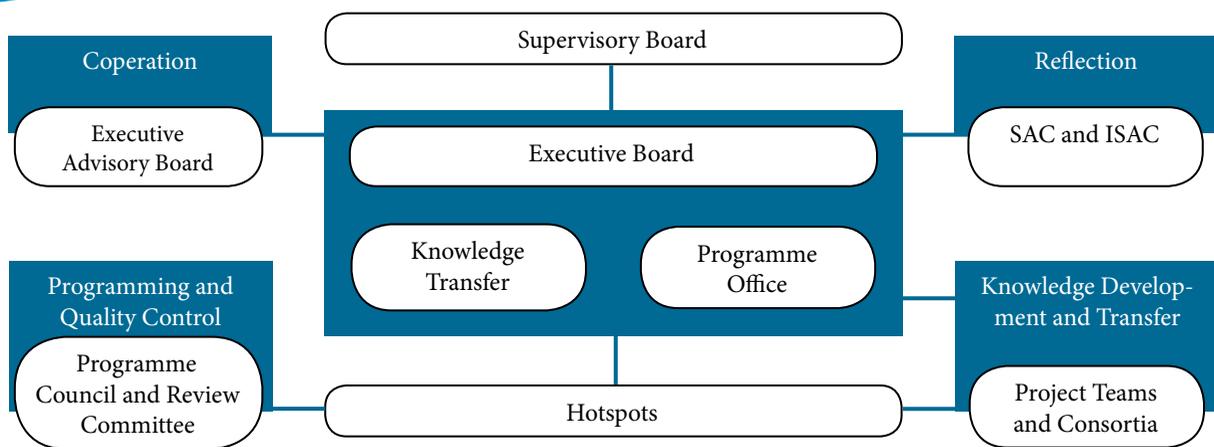


Figure 1.1 The figure above shows the structure of the Knowledge for Climate Programme. The various bodies and the role of each in the programme are described below¹.

The task of the [Supervisory Board](#) was to supervise the policy of the Executive Board, the use made of the funds, and the general course of affairs. It was also an important sounding board and adviser for the Executive Board of the programme.

The [Executive Board](#) bore overall responsibility for the programme and for achieving its aims. It also played a governance role with regard to research programming and to monitoring the consistency and quality of the research. The Executive Board was also responsible for what went on within the organisation and for financial matters.

The Knowledge for Climate [Programme Office](#) was responsible for implementing the programme activities. For that purpose, it had four units at its disposal, for

secretarial matters, financial affairs, project supervision and management, and internal and external communication. The Programme Office had an especially important task in the preparation and implementation of board decisions.

Effective communication and the sharing of knowledge between researchers – but above all between researchers and practitioners – was crucial to achieving the aims of the Knowledge for Climate Programme. The [Knowledge Transfer](#) component of the programme was responsible for this. The Knowledge Transfer unit supported the hot-

¹ The Knowledge for Climate Programme's annual reports describe the main topics discussed by the supervisory and advisory bodies.

spot teams and the project supervisors in encouraging knowledge uptake via activities, including organising symposiums and debates and publishing books/booklets intended for practitioners.

In addition, a number of advisory bodies played an important role in programming the research programme and in coordinating and cooperating with other programmes and initiatives. The [Programme Council](#) played an important advisory role in programming the Knowledge for Climate Programme and in preparing the various evaluations of the programme.

The Programme Council comprised researchers and stakeholders. On the knowledge supply side, each of the six parties that initiated the Knowledge for Climate Programme delegated a representative. On the demand side, the coordinators of the eight hotspots and of the international hotspot (Delta Alliance) were represented. The coordinating ministry was also represented. The Programme Council also included the Executive Board and representatives of the Knowledge Transfer unit and the Programme Office.

The [Executive Advisory Board](#) included representatives (director-generals) of the two ministries involved (Infrastructure and the Environment and Economic Affairs). The managements of the six research institutions that were the 'founding fathers' of the programme were also represented. The Delta Commissioner was also a member of the Executive Advisory Board. The main role of the Executive Advisory Board was to ensure effective policy coordination between the research institutions, the Knowledge for Climate Programme, and the policy and research agendas of the ministries.

The Knowledge for Climate and Climate Changes Spatial Planning programmes decided to appoint a joint [Societal Advisory Council](#) (SAR) and an [International Scientific Advisory Council](#) (ISAC). That decision was taken because these two programmes complemented one another in addressing climate change adaptation and in their trans disciplinary approach. Both councils were appointed to carry out periodic monitoring of the programmes. The first round of monitoring for the Knowledge for Climate

programme was carried out by the two councils in 2011. In 2012, individual members of the SAC and the ISAR were invited to take part in the Midterm Assessment of the programme as reviewers.

Much of the research conducted within the Knowledge for Climate Programme focuses on eight specific locations in the Netherlands – [hotspots](#) – that are particularly vulnerable to the consequences of climate change and are therefore the key focus of the research programme. These hotspots are:

- 1) Dry Rural Areas;
- 2) Major Rivers;
- 3) Haaglanden Region;
- 4) Mainport Schiphol;
- 5) Shallow Waters and Peat Meadow Areas;
- 6) Rotterdam Region;
- 7) Wadden Sea;
- 8) South-West Delta.

The hotspot teams were made up of knowledge networks involving both researchers and practitioners². The research carried out within the hotspots was based on research questions raised by practitioners within the hotspots.

There was also an international hotspot so as to share knowledge of climate change adaptation internationally. This involved launching a knowledge platform focusing on deltas worldwide, the [Delta Alliance](#).

In order to ensure an in-depth scientific approach to knowledge generation, eight [research themes](#) were defined in the course of the Knowledge for Climate Programme:

- 1) Flood Risk Management;
- 2) Fresh Water Supply;
- 3) Rural Areas;
- 4) Cities;
- 5) Infrastructure and Networks;
- 6) High-Quality Climate Projections;
- 7) Governance;
- 8) Decision Support Tools.

² See the 2008 Knowledge for Climate annual report for the composition of the hotspot teams (in Dutch)

2 Key financial data

General information

The Knowledge for Climate research programme was approved by the Dutch Government in July 2007, and was allocated a budget of € 50 million from the Economic Structure Enhancing Fund (FES). The FES was terminated in 2011. Since then, the programme has received its funding from the normal budget of the Ministry of Infrastructure and the Environment, as the ministry responsible. The sum of € 50 million was allocated to the programme in three phases.

A **coordination phase**, with a budget of € 0.9 million. This budget was to be used to set up the programme organisation, carry out a strategic analysis, draw up and develop the Research programming, and make preparations for the programme. This phase was completed in March 2008.

A **preparatory phase**, with a budget of € 3.1 million. This phase was intended to bridge the period needed to gain a positive ruling from the European Commission on the provision of financial support to the parties taking part in the research programme. That positive decision was received in November 2008 by means of State aid [steunmaatregel] N 267/2008. The funds for the preparatory phase were intended (i) to initiate processes, and to design, develop, and coordinate procedures; (ii) to establish and organise the various programme components and bodies within the Knowledge for Climate Programme; and (iii) to prepare the actual research programme. The preparatory phase was completed in 2009.

The third phase involves implementation of the **main programme**. The sum of € 46 million has been allocated for this. Allocation of the grant money is conditional on co-funding being contributed – at programme level – amounting to at least 50% of the grant provided, i.e. at least € 23 million. These and other financial conditions have been laid down in key decision [kernbeschikking] FEZ2009005697, which applies to the main programme. The key decision was amended in 2013 in connection with the additional activities carried out as part of preparations for drawing up the Action Plan for Climate Change Adaptation, subject to the final responsibility of the Netherlands Environmental Assessment Agency (PBL). The sum of € 46 million that had been allocated was increased by € 390,000. The conditions imposed in the previous key decision remain unchanged. The new (supplementary) decision was issued on 18 December 2013 and was designated 5000001850A.

Final amounts regarding grant spending and co-funding are given in the final financial report of KfC. This report is available in the second half of 2015 on www.knowledgdeforclimate.nl

Use of grant money

Table 2.1 Use of grant money by programme component

Programme component	Number of projects	Grant (euros)
Projects 1st tranche	42	7.569.013
Projects 2nd tranche	8	20.905.000
Projects 3rd tranche	30	2.294.249
Other projects	18	2.748.969
Value Creation and Valorisation projects	21	2.472.906
Knowledge Transfer	-	2.901.280
Programme organisation	-	7.498.583
Total projects + programme organisation		46.390.000

Grant amounts have been determined on the basis of the actual funding for completed projects as of July 2014 and forecast on the basis of the grants allocated for projects that are yet to be completed. The 'Other projects' component of the programme mainly concerned projects in an international framework (Delta Alliance, JPI Climate), the projects in the framework of the Action Plan for Climate Change Adaptation, and the Sustainable Area-Specific Development project.

Table 2.2 Use of grant money by hotspots in each tranche

Hotspot	Grant (euros)			
	1st tranche	2nd tranche	3rd tranche	Total
Haaglanden Region	1.076.145	2.872.466	664.800	4.613.411
Mainport Schiphol	1.237.892	2.755.237	39.900	4.033.029
Rotterdam Region	1.421.433	2.786.881	896.191	5.104.505
Dry Rural Areas	201.735	571.271	338.000	1.111.006
Major Rivers	283.047	576.596	122.300	981.943
Major Rivers	290.000	560.638	226.000	1.076.638
Wadden Sea	69.710	597.872	39.930	707.512
South-West Delta	216.251	584.043	285.000	1.085.294
Total of grants for hotspots	4.796.213	11.305.004	2.612.121	18.713.338

The distribution of grants to research projects, knowledge Transfer, value creation/valorisation, and programme costs in the years 2009 to 2013 is shown in **Figure 2.1a**. This figure shows that – when calculated on the basis of the grants provided over this period – the overhead ratio amounts to 17%. If the overhead is calculated on the basis of the sum total of ‘grants awarded to projects’ and ‘co funding contributed’ (**Figure 2.1b**), then the overhead ratio for the period 2009 to 2013 is 9.9%, which is just below the 10% that is the Executive Board’s target for the entire duration of the programme. That target is expected to be achieved over the entire duration of the programme, after all the projects have been completed.

Financial control and accountability has received a lot of attention in the programme. Important aspects were an annual plan and the six-monthly monitoring of progress of projects, both in terms of content and financials. The Foundation Knowledge for Climate has made an annual financial report containing a report of the Board of Directors, annual accounts and notes to the balance sheet and profit and loss account. The financial report has been reviewed annually by a chartered accountant. The grant-giving authority (Ministry of Infrastructure and the Environment) has accepted the submitted annual financial reports. In 2015, a final Financial report will be drawn up over the whole duration of the programme with an audit certificate from a chartered accountant.

Figure 2.1a Distribution of grants, cumulative 2009-2013

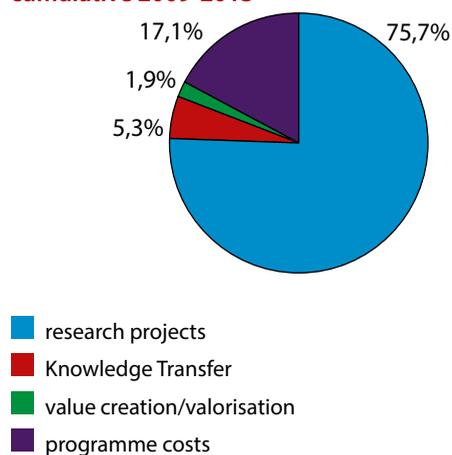
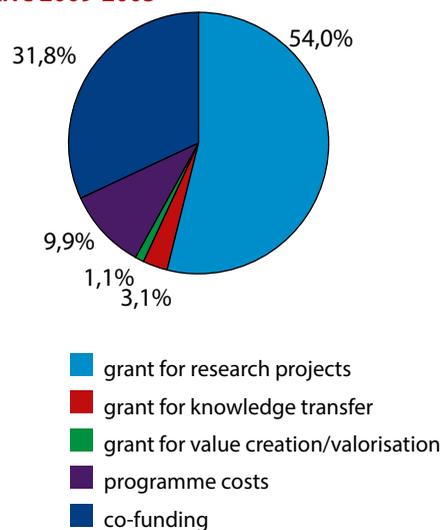


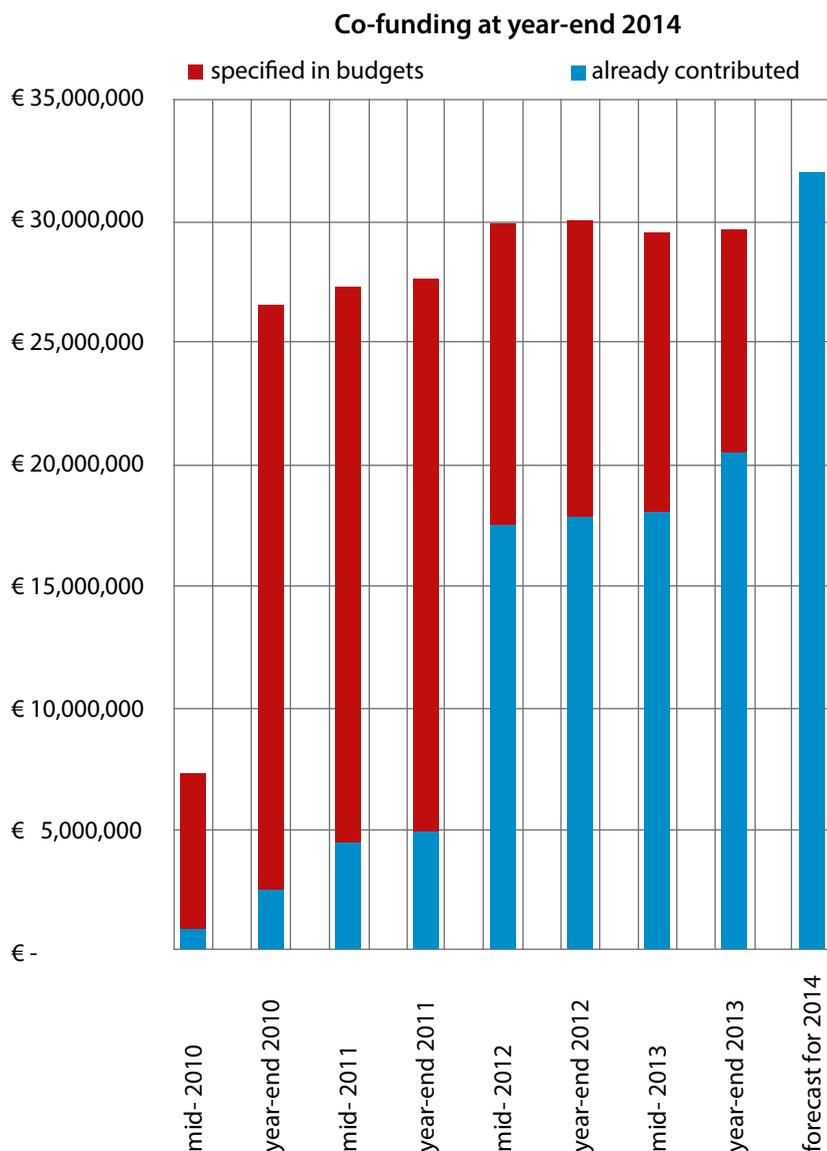
Figure 2.1b Distribution of grants and cofunding, cumulative 2009-2013



Co-funding

Allocation of the grant is conditional on co-funding being contributed – at programme level – amounting to at least 50% of the grant provided, i.e. at least € 23 million. Co-financing includes all forms of financial contributions by public, private and scientific institutions. Figure 2.3 shows the source of the € 20.6 million co-funding contributed by type of organisation.

Figure 2.2 Co-funding 2010 to 2014 (inclusive)

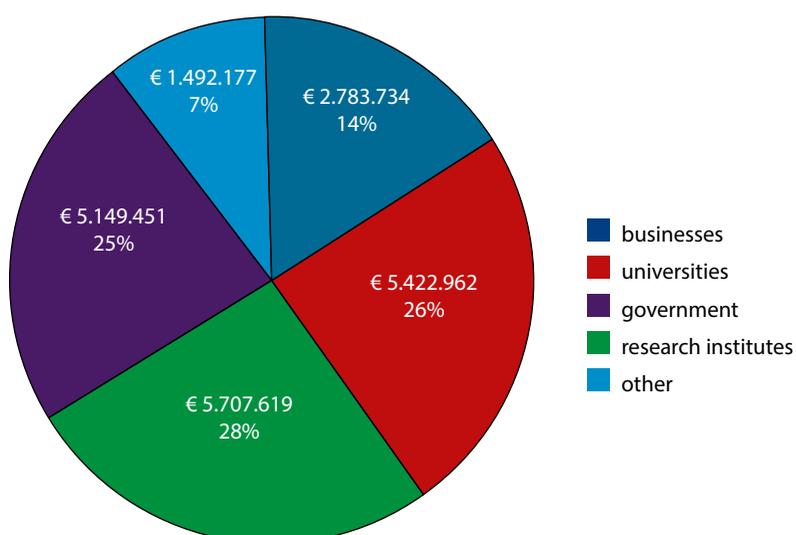


Contributed co-funding is the co-funding indicated in unqualified auditor's reports up to 31 December 2013. 'Specified' co-funding is the co-funding specified in funding agreements for projects for which an unqualified auditor's report has yet to be received.

Table 2.3 Co-funding provided, by programme component

Programme component	Grant (euros)	Co-funding (euros)	% co-funding to grant
Projects 1st tranche	7.569.013	7.113.542	94%
Projects 2nd tranche	20.905.000	18.249.702	87%
Projects 3rd tranche	2.294.249	2.711.173	118%
Other projects	2.748.969	1.997.923	73%
Value Creation and Valorisation projects	2.472.906	246.872	10%
Knowledge Transfer	2.901.280	1.263.918	44%
Programme organisation	7.498.583	456.178	6%
Total projects + programme organisation	46.390.000	32.039.308	69%

Figure 2.3 Source of co-funding contributed by type of organisation (as of year-end 2013)





3 Knowledge for Climate projects (per tranche)

Status on 1 August 2014. Amounts written in black indicate the final budget allocation (after provision of an unqualified auditor's report). Amounts in red indicate the provisional budget.

First tranche project						
Project number	Title	Consortium parties	Duration	KfC subsidy	Cofinancing	Total budget
Climate Knowledge Facility						
KKF01A	Modelplatform – Future Weather - phase 1	Alterra, KNMI	01-09-2009 / 31-12-2011	€ 488,445	€ 202,096	€ 690,541
KKF01B	Modelplatform - Coupling	Alterra, TNO, Deltares	01-02-2009 / 31-05-2011	€ 305,694	€ 181,987	€ 487,681
KKF01C	Modelplatform - Tailoring	Alterra, KNMI, VU-FALW, VU-Feweb, WUR-PPS, Deltares	01-06-2009 / 30-06-2011	€ 233,880	€ 114,605	€ 348,485
KKF02A	Building blocks National Adaptation Strategy (NAS)	Alterra, KNMI, PRI, UVA-IVAM, VU-Feweb, WUR-DOW, Deltares	01-11-2009 / 30-11-2011	€ 509,250	€ 234,362	€ 743,612
KKF03	Coordination, monitoring and strategy of the Climate Knowledge Facility	Alterra, KNMI, TNO, UU-BETA, UU-GEO, VU-Feweb, WUR-DOW, Deltares	01-01-2009 / 31-12-2009	€ 150,041	€ 53,784	€ 203,825
Hotspot Dry Rural areas						
HSDR00-09	Coordination hotspot Dry Rural areas	KWR	01-01-2009 / 31-12-2009	€ 14,607	€ 521	€ 15,128
HSDR01	Strategies to cope with climate change in dry rural sandy areas of the province of Gelderland	Alterra, KWR, Prov Gelderland	04-01-2010 / 31-12-2010	€ 86,855	€ 80,540	€ 167,395
HSDR02	Spatial claims of adaptive strategies in densely populated rural areas	Alterra, KWR, Deltares	01-01-2010 / 01-07-2011	€ 99,420	€ 134,931	€ 234,351
Hotspot Major Rivers						
HSGR02	Assessment of upstream flood risk in the Rhine Basin	VU-IVM, Deltares	01-11-2008 / 31-12-2012	€ 92,010	€ 159,029	€ 251,039
HSGR06	Adaptation to Meuse flood risk: a scenario assessment	VU-IVM, Deltares	01-01-2010 / 31-12-2012	€ 90,000	€ 100,935	€ 190,935
HSGR07	Assessment of climate-proof flood defence alternatives along the Nederrijn/Lek	VU-IVM, Waterschap RL, WUR-DOW, Deltares, Grontmij, Movares	01-06-2009 / 08-10-2010	€ 38,672	€ 45,867	€ 84,539

Project number	Title	Consortium parties	Duration	KfC subsidy	Cofinancing	Total budget
Hotspot Haaglanden Region						
HSHL00-10/11	Coordination Hotspot Haaglanden en Regional Adaptation Hotspot Haaglanden region	SG-HAAGL	01-01-2010 / 31-12-2011	€ 95,037	€ 24,969	€ 120,006
HSHL01A	Climate in spatial planning	Arcadis, Dura Vermeer, TRIPLE-E, Deltares, Erasmus Universiteit	01-01-2009 / 30-11-2011	€ 160,777	€ 223,408	€ 384,185
HSHL02	Future of peat meadow areas in hotspot Haaglanden Region	Alterra, DHV	07-07-2009 / 29-02-2012	€ 134,500	€ 145,207	€ 279,707
HSHL05 / HSR04	Regional climate information for Haaglanden and Rotterdam region	Gem Rdam, KNMI, WUR-DOW, HHDelfland	03-03-2009 / 30-06-2011	€ 134,370	€ 151,488	€ 285,858
HSHL06 / HSHL12	Broad, region specific reconnaissance of effects of climate change in relation to future scenarios and trends	Alterra, HKV liw, TNO, Deltares, Geodan	01-05-2009 / 31-12-2010	€ 142,969	€ 185,567	€ 328,536
HSHL08	Demonstration project multifunctional land use for water storage in the greenhouse sector	St. Waalblok, HHDelfland	01-04-2009 / 31-12-2010	€ 380,735	€ 380,735	€ 761,470
Hotspot Mainport Schiphol						
HSMS01	WindVisions - Wind visibility monitoring at Mainport Schiphol	AAS, LVNL, WUR-DOW	01-10-2009 / 15-07-2012	€ 285,582	€ 287,452	€ 573,034
HSMS02	Climatology and climate scenarios Mainport Schiphol	AAS, KNMI, LVNL	01-04-2009 / 01-09-2012	€ 437,246	€ 452,111	€ 889,357
HSMS03	IMPACT - Improved meteorological predictions for airport capacity tuning	AAS, KNMI, LVNL, TUD, WUR-DOW	01-10-2009 / 31-05-2012	€ 471,174	€ 770,341	€ 1,241,515
HSRS01	Climate scan Schiphol region	Alterra	01-04-2009 / 31-10-2009	€ 20,000	€ 7,916	€ 27,916
Hotspot Shallow waters and Peat meadow areas						
HSOV01A	Climate effects on decomposition in drained peat meadows: implications for peat subsidence and water quality	UU-BETA	01-05-2009 / 01-07-2013	€ 100,000	€ 444,658	€ 544,658
HSOV01B	Climate influence on water quality: which trends are already apparent?	KWR, WUR-DOW	01-01-2009 / 31-10-2011	€ 80,000	€ 272,627	€ 352,627
HSOV01C	Managing climate effects in peat meadows and shallow lakes	VU-IVM	01-03-2009 / 01-05-2013	€ 108,810	€ 109,999	€ 218,809

Project number	Title	Consortium parties	Duration	KfC subsidy	Cofinancing	Total budget
Hotspot Rotterdam Region						
HSRR00-09	Coordination hotspot Rotterdam Region	Gem Rdam, HHSchie	01-01-2009 / 31-12-2009	€ 65,022	€ 92,230	€ 157,252
HSRR00-10	Rotterdam Adaptation Strategy and Coordination Hotspot Rotterdam Region 2010	Gem Rdam	01-01-2010 / 31-12-2010	€ 58,656	€ 58,655	€ 117,311
HSRR01	Urban development - Urban water systems	Gem Rdam, TUD-CT-GEO, Deltares	01-02-2009 / 31-10-2010	€ 111,158	€ 115,766	€ 226,924
HSRR02	Flood risk in unembanked areas	Gem Rdam, HKV liw, Rhask, UNESCO, Deltares	23-03-2009 / 31-07-2010	€ 63,086	€ 99,962	€ 163,048
HSRR03B	Closing the open Rijnmond - waterfront	HKV liw, RIVM, TUD-CT-GEO	01-12-2008 / 30-06-2010	€ 185,594	€ 261,804	€ 447,398
HSRR05	Heat stress in Rotterdam	Alterra, Gem Rdam, SBR, TNO, WUR-MAQ, Deltares	01-01-2009 / 01-06-2011	€ 314,721	€ 333,780	€ 648,501
HSRR06	Safe and multifunctional urban levees	Gem Rdam, HHSchie, Rhask, Waterschap HD, HHDelfland, Deltares	01-02-2009 / 31-12-2010	€ 98,529	€ 104,555	€ 203,084
HSRR07/ HSGR08	Relationship between perceived flood risks, problem ownership and household and business adaptation choices	Gem Rdam, HKV liw, VU-IVM, Deltares	01-06-2010 / 01-03-2012	€ 146,674	€ 156,936	€ 303,610
HSRR08	Consequences of climate change for inland shipping	Arcadis, Havenbedr. Rdam, TNO-B&O, TUD-CT-GEO, VU-Feweb, Deltares	01-01-2009 / 30-06-2011	€ 154,759	€ 192,875	€ 347,634
HSRR09	Adaptive strategies for the urban floodplain of Hotspot Rotterdam	Gem Rdam	01-03-2009 / 01-04-2010	€ 72,199	€ 72,198	€ 144,397
Hotspot Wadden Sea						
HSWZ04	Need to know or nice to know? Developing the knowledge agenda for climate change and adaptation in the Wadden Sea	Prov Fryslân	03-02-2009 / 09-07-2010	€ 68,400	€ 16,008	€ 84,408
Hotspot South-West Delta						
HSZD01	Negotiating uncertainties: defining climate proofing and assessing associated uncertainties in the South-west Delta Region of the Netherlands	Alterra	01-01-2009 / 31-07-2011	€ 50,000	€ 60,873	€ 110,873

Project number	Title	Consortium parties	Duration	KfC subsidy	Cofinancing	Total budget
HSZD02	Climate change effects on the restoration of estuarine dynamics within the delta region	IMARES, NIOO-KNAW, Deltares	01-07-2009 / 01-05-2011	€ 49,985	€ 57,886	€ 107,871
HSZD03	Climate change as an opportunity for entrepreneurs	Hogeschool Zeeland, LEI, PRI	01-12-2010 / 01-04-2013	€ 103,000	€ 105,410	€ 208,410
Other projects						
MSZD01	Exploring the fresh water supply for the South West Delta	ACACIA, Alterra, KWR, TNO, Deltares	01-03-2009 / 30-11-2009	€ 70,516	€ 82,441	€ 152,957
ORASKvK01	Options for Regional adaptation strategies	Alterra	01-03-2009 / 31-12-2011	€ 196,652	€ 99,140	€ 295,792
NWO	NWO Sustainable earth	NWO	01-01-2010 / 31-12-2014	€ 500,000	€ -	€ 500,000
SSA01	Comparative monitoring of Knowledge for Climate Rathenau Instituut	Rathenau Instituut	01-01-2010 / 15-10-2014	€ 599,988	€ 437,887	€ 1,037,875

Second tranche projects						
Project number	Title	Consortium parties	Duration	KfC subsidy	Cofinancing	Total budget
Theme 1	Climate proof flood risk management	Alterra, HKV liw, TUD-CT-GEO, VU-IVM, WUR-DOW, Deltares Flood Hazard Research Centre (FHRC), UK Helmholz-Centre Potsdam GFZ German Research Center for Geosciences, Germany	01-01-2010 / 31-12-2014	€ 2,050,000	€ 1,610,000	€ 3,660,000
Theme 2	Climate proof fresh water supply	ACACIA, Alterra, KWR, TNO, TUD-TBM, UT, UU-GEO, VU-FALW, WUR-DOW, Deltares ASR Systems, USA British Geological Survey, Ecole Polytechnique Federal Lausanne, Switzerland, Federal Institute of Hydrology, Germany, Institute National de Recherche en Genie Rural, Eaux et Foret, (INRGREF), Tunisia, United States Geological Survey (USGS)	01-01-2010 / 31-12-2014	€ 2,500,000	€ 2,424,999	€ 4,924,999
Theme 3	Climate adaptation for rural areas (CARE)	Alterra, KWR, UU-GEO, VU-Feweb, VU-IEW, WUR-DOW, Deltares, University of Edinburgh, UK	01-01-2010 / 31-12-2014	€ 1,700,000	€ 1,337,455	€ 3,037,455
Theme 4	Climate Proof Cities (CPC)	Alterra, KWR, Radboud Universiteit, TNO, TUD-BK, TUD-OTB, TUD-TNW, TUE, UNESCO, UU-GEO, UVA, WUR-DOW, Deltares University of Manchester, UK, Albert-Ludwigs-Universität, Germany, Universität Kassel, Germany	01-01-2010 / 31-12-2014	€ 4,185,000	€ 3,647,942	€ 7,832,942

Project number	Title	Consortium parties	Duration	KfC subsidy	Cofinancing	Total budget
Theme 5	Infrastructure and networks (INCAH)	KWR, TNO, TUD-TBM, VU-Feweb, Deltares Louvain School of Management, Belgium, Australian Commonwealth Scientific and Industrial Research Organisation, Australia, Southern Cross University, Australia, University of Michigan, USA, Massachusetts Institute of technology and United States, Geological survey, USA, Purdue University, USA, Swedish Geotechnical institute, Sweden	01-01-2010 / 31-12-2014	€ 1,920,000	€ 1,949,230	€ 3,869,230
Theme 6	High quality climate projections	Alterra, KNMI, KWR, PRI, TNO, TUD-TNW, TUE-EUR, UU-BETA, VU-FALW, VU-Feweb, WUR-DOW, Deltares Deutscher Wetterdienst (DWD), Germany, SMHI, Sweden, Exeter University, UK	01-01-2010 / 31-12-2014	€ 3,050,000	€ 3,206,539	€ 6,256,539
Theme 7	Governance of adaptation	Radboud Universiteit, UU-GEO, VU-IVM, WUR-BMW, Erasmus Universiteit, University of East Anglia, UK, Carl von Ossietzky University, Germany, Stockholm University, Sweden	01-01-2010 / 31-12-2014	€ 2,900,000	€ 1,796,113	€ 4,696,113
Theme 8	Decision support tools	Alterra, Deltares, PBL, Studio i2D, TNO, TUD, VU-Feweb, VU-IVM, WUR-BMW, WUR-DOW IIASA, Laxenburg, Austria, Potsdam Institute for Klima Forschung, Germany, JRC Department primary industries, State of Victoria, Australia, Reg. Env. Center for Central and Eastern Europe, University of British Columbia, Canada, RWTH Aachen, Germany	01-01-2010 / 31-12-2014	€ 2,600,000	€ 2,277,424	€ 4,877,424

Third tranche projects						
Project number	Title	Consortium parties	Duration	KfC subsidy	Cofinancing	Total budget
Hotspot Dry Rural areas						
HSDR3.5	Adaptive implementation arrangements: a learning approach towards the implementation of climate adaptation strategies	Alterra, UU-REB, VU-IVM, Deltares, Erasmus Universiteit	01-03-2012 / 30-09-2013	€ 149,470	€ 191,918	€ 341,388
HSDR3.6	Towards a long-term vision on water space and climate for waterboard Vallei en Veluwe	Alterra	01-01-2012 / 01-05-2014	€ 35,271	€ 54,073	€ 89,344

Project number	Title	Consortium parties	Duration	KfC subsidy	Cofinancing	Total budget
HSDR3.7	Active management of Groundwater storage in Unconfined Aquifers in the Stippelberg forests (AGUA-Stippelberg): a case study of climate adaptation through improved regional self sufficiency in water supply	KWR	01-04-2012 / 31-05-2014	€ 85,000	€ 105,000	€ 190,000
HSDR3.8	Vision document Hotspot Dry Rural areas	Overland	01-10-2013 / 01-04-2014	€ 53,240	€ -	€ 53,240
Hotspot Major Rivers						
HSGR3.1	Analysing the robustness of the Meuse river valley to certain discharge waves	Deltares	01-10-2012 / 30-04-2013	€ 36,365	€ 36,365	€ 72,730
HSGR3.2	Inspiration document Regional Adaptation strategies hotspot Major Rivers	Aquae	01-10-2013 / 31-03-2014	€ 52,635	€ -	€ 52,635
HSGR3.3	International cooperation in climate adaptation	Radboud Universiteit	21-02-2014 / 31-10-2014	€ 30,000	€ 30,752	€ 60,752
Hotspot Haaglanden Region						
HSHL3.2	Optimized Aquifer Storage and Recovery of freshwater in saline aquifers	B-E De Lier, KWR	01-02-2013 / 01-04-2014	€ 184,000	€ 321,032	€ 505,032
HSHL3.3	3Di water management applicable for end users	NelenSchuurmans, Deltares	15-04-2012 / 31-07-2013	€ 300,000	€ 475,483	€ 775,483
HSHL3.4	Regional Adaptation Strategy Hotspot Haaglanden Region	SG-HAAGL	01-06-2013 / 01-04-2014	€ 40,800	€ 239,292	€ 280,092
Hotspot Shallow waters and Peat meadow areas						
HSOV3.1	Manual for Options for Regional Adaptation Strategies in peat meadow areas including shallow waters	Alterra	01-09-2012 / 31-12-2013	€ 98,290	€ -0	€ 98,290
HSOV3.2	Regional adaptation strategies in Frisian peat meadows	Alterra, UU-BETA, VU-IVM	01-09-2012 / 01-11-2013	€ 115,346	€ 139,908	€ 255,254
Hotspot Mainport Schiphol						
HSMS3.1	Mainport Schiphol and adaptation to climate change – a long-term and multi-sectoral perspective	BB&C	01-07-2013 / 28-02-2014	€ 39,930	€ -	€ 39,930
Hotspot Rotterdam Region						
HSRR00-11	Rotterdam Adaptation Strategy and Coordination Hotspot Rotterdam	Gem Rdam	01-01-2011 / 31-12-2011	€ 58,063	€ 70,920	€ 128,983
HSRR00-12/13	Coordination Hotspot Rotterdam Region 2012 and 2013	Gem Rdam	01-01-2012 / 31-12-2013	€ 53,299	€ 80,216	€ 133,515

Project number	Title	Consortium parties	Duration	KfC subsidy	Cofinancing	Total budget
HSRR3.1	Adaptive development strategies in unembanked areas in the Rotterdam region	Arcadis, DSA, Gem Rdam, UNESCO, UU-GEO, VU-IVM, Deltares	01-03-2011 / 01-03-2013	€ 177,417	€ 172,286	€ 349,703
HSRR3.2	Eco-adaptation in the urban delta	Gem Rdam, Deltares	14-10-2011 / 31-10-2012	€ 26,428	€ 28,682	€ 55,110
HSRR3.3	Drought problems in urban areas	Gem Rdam, Deltares	11-10-2011 / 01-08-2012	€ 29,842	€ 16,913	€ 46,755
HSRR3.4	Adaptation Strategy Rotterdam region	Gem Rdam	01-01-2012 / 01-04-2014	€ 187,500	€ 212,500	€ 400,000
HSRR3.5	Proposal for addressing small research questions	Gem Rdam	01-07-2012 / 01-10-2013	€ 36,864	€ 36,865	€ 73,729
HSRR3.6	Business case climate adaptation Rotterdam region: area-specific value creation with adaptation	Gem Rdam	11-02-2013 / 01-07-2014	€ 31,195	€ 31,195	€ 62,390
HSRR3.7	Valorizing adaptation knowledge for sustainable delta cities	TNO	11-02-2013 / 31-12-2013	€ 39,998	€ 39,998	€ 79,996
HSRR3.8	Valorizing adaptation knowledge for sustainable delta cities	TNO	21-08-2012 / 01-03-2013	€ 17,264	€ 17,002	€ 34,266
HSRR3.10	Flood risk management and area development: towards mutually benefiting partnerships and financial arrangements in the Feijenoord district	Gem Rdam, Deltares, Erasmus Universiteit	01-09-2012 / 01-09-2013	€ 33,838	€ 57,524	€ 91,362
HSRR3.11	Literature review 2nd tranche research results hotspot Rotterdam Region	Gem Rdam	20-02-2013 / 31-03-2014	€ 60,264	€ -	€ 60,264
Hotspot Wadden Sea						
HSWZ3.1	ISWSS symposium 2012 Leeuwarden	-	01-09-2011 / 30-11-2012	€ -	€ -	€ -
HSWZ3.2	Exploration adaptation strategy	BB&C	01-03-2013 / 31-12-2013	€ 39,930	€ -	€ 39,930
Hotspot South-West Delta						
HSZD3.2	Towards implementation of promising measures for local freshwater supply and salinity control in the South-western Delta	ACACIA, Alterra, Hogeschool Zeeland, KWR, Deltares	01-03-2012 / 01-03-2014	€ 220,000	€ 335,700	€ 555,700

Project number	Title	Consortium parties	Duration	KfC subsidy	Cofinancing	Total budget
HSZD3.3	Science in de Delta (Rijn, Maas en Schelde). Feasibility study for an academy	Alterra, WUR-DOW	01-02-2013 / 30-06-2014	€ 12,000	€ 17,549	€ 29,549
HSZD3.4	The Dutch Southwest Delta and adaptation to climate change – a longterm and multi-sectoral perspective	Climate Adapt	01-07-2013 / 31-05-2014	€ 50,000	€ -	€ 50,000

Value creation projects						
Project number	Title	Consortium parties	Duration	KfC subsidy	Cofinancing	Total budget
By second tranche consortia; 'Where do the consortia make the difference?'						
WCT1	Unbreachable dikes	Deltares	01-06-2013 / 30-06-2014	€ 51,650	€ -	€ 51,650
WCT2	Fresh Water Options Optimizer	ACACIA, Alterra, Deltares	01-06-2013 / 15-09-2014	€ 50,000	€ 100,000	€ 150,000
WCT3T8	Scanner opportunities and bottlenecks in rural areas	Alterra	15-03-2013 / 31-07-2014	€ 65,000	€ -	€ 65,000
WCT4	Development of course on local climate adaptation strategies in urban areas	Open Universiteit	04-06-2013 / 01-09-2014	€ 80,000	€ 15,360	€ 95,360
WCT5	What can we learn from Sandy; what to learn about the effects on critical networks?	TNO	12-03-2013 / 01-10-2013	€ 29,000	€ 384	€ 29,384
WCT5b	Infrastructure Dependencies Assessment Framework; Assessing and coping with infrastructure dependencies in relation to extreme weather events in the Netherlands (INDEPAS)	TNO	01-01-2014 / 30-06-2014	€ 20,000	€ -	€ 20,000
WCT7	Co-creation for action strategies on governance issues	WUR-BMW	01-08-2012 / 31-12-2014	€ 172,000	€ -	€ 172,000
Valorisation and value creation general						
VWC01	Economic aspects of climate adaptation	-	01-09-2013 / 31-12-2013	€ -	€ -	€ -

Project number	Title	Consortium parties	Duration	KfC subsidy	Cofinancing	Total budget
VWC02	Maps salt vulnerability of agricultural crops, saline seepage and service levels surface water	Alterra	21-10-2013 / 31-12-2013	€ 24,200	€ -	€ 24,200
VWC03	Climate adaptation business challenge	BusinessChall	04-05-2013 / 15-11-2013	€ -	€ -	€ -
VWC04	Feasibility study Experience Centre multi level safety Dordrecht	St. IHE Delft	07-01-2014 / 30-09-2014	€ 40,000	€ 30,000	€ 70,000
VWC05	Study on the consequences of new water safety norms	TwijnstraGudde	01-05-2014 / 30-09-2014	€ 29,960	€ 13,372	€ 43,335
VWC06	Organization knowledge and innovation workshop KfC-Delta Programme Fresh Water	KvK/DPZ	10-02-2014 / 12-05-2014	€ -	€ -	€ -
VWC07	Exploration knowledge transfer KfC knowledge to waterboards	Centre for Climate Adaptation B.V.		€ 29,911		€ 29,911
Foundations						
StCAS01	Business plan and website Climate Adaptation services (CAS) Foundation	St. Klim.Atlas	20-12-2012 / 31-12-2013	€ 50,000	€ 1,756	€ 51,756
StCAS02	Phase 2 CAS Foundation: contribution to the costs for the portal function of CAS	St. Klim.Atlas	01-09-2013 / 31-12-2014	€ 67,500	€ -	€ 67,500
StCAS03	Development Knowledge portal	St. Klim.Atlas	21-01-2014 / 31-12-2014	€ 90,015	€ -	€ 90,015
StCAS WCT	New functionality and access Geoportal Climate Adaptation Atlas	St. Klim.Atlas	01-04-2013 / 31-07-2014	€ 113,000	€ -	€ 113,000
StDD01	Feasibility study launching Sustainable Delta Cities Foundation	Grontmij	01-11-2013 / 31-01-2014	€ 60,500	€ -	€ 60,500
StWB01	Definition phase Waterbuffer Foundation	St. Waterbuffer	15-11-2012 / 20-11-2013	€ 12,788	€ -	€ 12,788
StWB02	Waterbuffer Foundation: work-plan 2014	St. Waterbuffer	21-11-2013 / 01-11-2014	€ 107,212	€ 86,000	€ 193,212
Other projects						
International						
HSINT01A	Launching Delta Alliance – First phase	Alterra	01-04-2009 / 01-11-2009	€ 145,891	€ -	€ 145,891
HSINT01B	Launching Delta Alliance – Second phase	Alterra	01-09-2008 / 31-12-2010	€ 788,851	€ 1,147,731	€ 1,936,582
StDA01 (HSINT01C)	Delta Alliance phase 3	St.DA	01-01-2011 / 15-09-2014	€ 800,000	€ -	€ 800,000
HSINT02	Knowledge for Climate Hotspot Jakarta, definition phase	Royal haskoning, VU-IVM, WUR-BMW	01-03-2009 / 01-05-2011	€ 53,079	€ 59,873	€ 112,952

Project number	Title	Consortium parties	Duration	KfC subsidy	Cofinancing	Total budget
HSINT02A	Jakarta Climate Adaptation Tools (JCAT)	VU-IVM, WUR-BMW	01-01-2011 / 31-12-2014	€ 150,000	€ 186,598	€ 336,598
Other						
METEO-01	Review about climate change applications	Meteoconsult	01-04-2011 / 01-11-2011	€ 10,000	€ 10,297	€ 20,297
JPI-2011	JPI Climate / Supporting the development of the Joint Programming Initiative Connecting Climate Knowledge for Europe (CliK'EU)	Alterra, KNMI, TNO, UU-GEO, VU-IVM, Deltares	01-01-2011 / 31-12-2011	€ 73,706	€ 24,483	€ 98,189
JPI-2012	Supporting the development of the Joint Programming Initiative Connecting Climate Knowledge for Europe (JPI Climate)	Alterra, KNMI, TNO, UU-GEO, VU-IVM,	01-01-2012 / 31-12-2012	€ 68,211	€ 26,985	€ 95,196
JPI-2013	Supporting the development of the Joint Programming Initiative Connecting Climate Knowledge for Europe, 2013 (JPI Climate)	Alterra, KNMI, UU-GEO, VU-IVM,	01-01-2013 / 30-6-2014	€ 50,000	€ 50,000	€ 100,000
DGO-2010	Platform Sustainable spatial planning (Platform 'Duurzame gebiedsontwikkeling' -DGO) 2010-2011	St. Urgenda	01-07-2010 / 31-12-2011	€ 102,913	€ 173,504	€ 276,417
DGO-2012	Platform Sustainable spatial planning (DGO) 2012-2013	St. Urgenda	01-01-2012 / 31-10-2013	€ 194,158	€ 318,451	€ 512,609
Plan of Strategy Climate Adaptation (PBL)						
PBL01	Analysis studies climate risks ICT, Energy, Transport	TNO	01-01-2014 / 01-10-2014	€ 105,000	€ -	€ 105,000
PBL02	Climate change and health: Actualization of risks	RIVM	11-02-2014 / 01-10-2014	€ 35,000	€ -	€ 35,000
PBL03	Risk analysis and opportunities for nature	Stroming	11-02-2014 / 01-09-2014	€ 35,000	€ -	€ 35,000
PBL04	Climate change: risks and opportunities for fishery and aquaculture	IMARES-LEI	03-02-2014 / 01-09-2014	€ 25,000	€ -	€ 25,000
PBL05	Vulnerabilities agriculture and horticulture	PRI	03-02-2014 / 01-07-2014	€ 30,000	€ -	€ 30,000
PBL06	Research on innovation in climate adaptation	Innovation Boosters	04-03-2014 / 01-11-2014	€ 31,460	€ -	€ 31,460
PBL07	Public and/or private responsibilities for climate adaptation	UU-GEO	03-02-2014 / 15-11-2014	€ 50,700	€ -	€ 50,700

4 Knowledge for Climate Midterm Assessment 2012

1. Approach

On 4 October 2012, the Knowledge for Climate Programme (KfC) organised the 'Midterm Assessment: A preview of end results.' The eight consortia and the SSA01 project¹ presented a status report on their research and looked ahead to the (expected) final results in 2014. For the hotspots, the intention of this Midterm Assessment was to present the outlines of their regional adaptation strategies and to indicate how the (expected) results of the first, second, and third phases ('tranches') could be combined and be taken up in practice.

In preparation for this session, the hotspots, consortia, and Rathenau Institute researchers set out their interim and expected results in a midterm report. Each report was assessed by a team of societal and scientific reviewers, both Dutch and foreign (a total of some 60 reviewers). The key question for the review was: *How can we arrive at the best possible final result in 2014, in terms of scientific excellence and societal impact*. The midterm reports and reviews formed the basis for the debate that was held during the midterm meeting in Amsterdam on 4 October.

The Knowledge for Climate Programme decided that the Midterm Assessment should feature an open approach. The interim results and reviews were not only presented and discussed within the KfC community but also to and with representatives of the international science world, governments, civil society organisations, and businesses. This formula has not only resulted in a great deal of information and input for optimising research and knowledge uptake in the final two years, but also in engagement on the part of researchers and stakeholders, both within and beyond KfC. The number of those attending – about 300 – exceeded our expectations, and they were very much in favour of the chosen approach.

¹ *Comparative monitoring of Knowledge for Climate by the Rathenau Institute*

² <http://knowledgeforclimate.climate-research-netherlands.nl/midtermassessment2012> (in Dutch)

The midterm reports, presentations, and other information from the meeting can all be accessed via the KfC website².

2. Results (main points)

Scope and scientific quality

In general, the reviewers considered that the right research questions had been posed. The scientific quality of the research was also given a positive or very positive assessment.

Particularly where the meta-level is concerned, reference is made to 'cutting-edge research', with an emphasis on transdisciplinary research and the interface between science and policy. The KfC programme can therefore position itself as an international research programme (or do so to a greater extent). Some reviewers pointed out that a great deal can be learned from the successes and failures within the programme. They therefore recommended publishing more about the research approach. The 'cutting-edge topics' within the programme should be defined clearly and made the subject of publications. They suggested using the results of the international comparative study by the Rathenau Institute (SSA01).

The research theme reviewers mentioned a number of points to consider (these are not relevant to all the consortia):

- Highlight *scientific distinctiveness* more clearly in the context of international research discourse.
- Define key findings, and where the consortia have made a difference.
- Devote greater attention to *international comparisons* in the research.
- Ensure more effective embedding within international discourse by means of *peer-reviewed publications*.
- *Scale up research results* (to higher levels of scale, but also by focusing on broader applicability elsewhere).

The hotspot reviewers also put forward a number of points to consider:

- The reviewers advocate emphasising a mitigation-adaptation approach to the challenges.
- There should be greater emphasis on *economics and competitiveness*. It is extremely important to carry out cost-benefit analyses and to develop economic indicators (including for urban hotspots).
- The theme of *ecology* (including urban hotspots) came in very relatively little attention.

Knowledge co-creation

The reviewers praised the KfC's knowledge co-creation approach – i.e. joint knowledge generation by the researchers and the stakeholders – as pioneering. During the plenary session that concluded the midterm meeting, one of the reviewers even said that by international standards this 'effort' by the KfC was 'absolutely heroic', and definitely necessary where climate change adaptation research is concerned. It was noted that the programme brings parties together and creates unique partnerships between research institutions (many of them 'dedicated' institutions) and universities, and between researchers and policymakers.

The innovative approach to research adopted within the KfC also implies a number of challenges; many of the criticisms and recommendations in the Midterm Assessment concerned improving the knowledge co-creation process. Most of the problems were due to the KfC's aim of pursuing outstanding scientific research while also producing results that can be utilised in actual practice.

It was apparent that the balance between scientific and societal impact regularly led to frictions within the research, for example when selecting case studies.

Researchers looked for case studies that yielded the most useful results from the scientific perspective, whereas stakeholders wanted their most urgent problems to be solved, with concrete information being provided in the short term. Hotspots were not always able to provide suitable cases for study, and in some instances researchers decided to make use of case study locations outside the hotspots. There was also a supply/demand disparity between theory and practice in terms of sharing the research results. Stakeholders requested specific knowledge and information in the short term, whereas researchers were ultimately aiming for generic results of great scientific merit. One recommendation was to consider what knowledge and information the consortia could share with stakeholders at an early stage, with the hotspots needing to clearly identify what information they need. A further point of concern was to adapt scientific knowledge for application in actual practice, certainly for the purpose of drawing up regional adaptation strategies.

PhD candidates

During the discussion of co-creation within KfC, special attention was paid to the PhD candidates within the programme. These researchers are judged mainly by the scientific quality of their results, and it was a major challenge for them to align their research with the KfC's stakeholders. Their supervisors play an important role in this context. During the PhD dinner on 4 October, it became clear that many PhD candidates were perfectly willing to apply their knowledge more broadly or more quickly, but did not always receive the support they needed to do so³.

Besides closer supervision, it was recommended that – where possible and desirable – PhD candidates should gain experience out in the field, for example by accepting temporary positions with stakeholders. Another approach would involve organising short workshops with experts working in the field so as to discuss preliminary results.

³ In the light of that discussion, two Rathenau students produced a blog about co-creation and PhDs - <http://rathenaunl.wordpress.com/2012/10/11/promovendi-kijk-verder-dan-je-proefschrift/>

It should be noted here that scientists should also have the opportunity to act as a ‘gadfly’ by critically analysing and confronting policymaking, and by occasionally adopting contrary positions.

Stakeholder interaction

The reviewers generally had a positive opinion of the interaction with the many stakeholders within the KfC, but they emphasised the importance of selecting stakeholders carefully. The recommendation was not to focus too much on the paying stakeholders (shareholders) but also to look closely at the ‘drivers for change’. The reviewers frequently pointed out the lack of private organisations. They regarded more interaction with the private sector as an important factor in the adoption of climate change adaptation measures and KfC knowledge by practitioners.

The hotspot reviewers found that technical measures had come in for considerable attention, but that there was less concern for the implementation of those measures within the hotspots (governance). How does one get the right information across to policymakers and public administrators, and how does one ensure that an overall strategy enjoying broad support is developed, in addition to all the technical knowledge needed to arrive at decisions and to make investments? One of the recommendations was to facilitate more dialogue between scientists and policymakers (specifically public administrators), for example with the aid of the Touch Table interface and discussion platforms.

Finally, the reviewers addressed the topic of interaction with the public. A number of reviewers considered that the public should be more closely involved in the research, as researchers, sounding boards, or in some other role. This would ensure more awareness, something that is important when people themselves are made responsible for implementing adaptation measures.

Cohesion and integration

The Midterm Assessment made clear that cooperation between the parties could produce more benefits in terms of integrating research results.

The theoretical frameworks for integrating the research themes had been well defined, but their practical implementation turned out to be problematical for various consortia. Researchers should be more actively involved in the integration process, and encouraged to interact more with other projects and work packages.

The reviewers recommended improving cohesion and cross-connections between the research themes at programme level as well. Particular reference was made to the cross-cutting themes of Climate Projections (T6), Governance (T7), and Decision Support Tools (T8):

- Closer coordination and more information-sharing between Theme 6 and the other consortia, particularly regarding the climate scenarios.
- There was a major need for more applied knowledge in the area of governance. This would be an important point to address in the final two years of the programme.
- More interaction between Theme 8 and the other themes. For this theme in particular, several disciplines should be involved in the research process. The reviewers recommended making more use of joint workshops (including on multiple research themes) and taking better advantage of opportunities to learn about stakeholder interaction in policymaking processes across the various research themes.

Relationship with Delta Programme

The reviewers noted the many connections between KfC research and the National Delta Programme. However, those connections needed to be made clearer and more explicit so that the two programmes could benefit more from one another. That applied in particular to the Wad-

den Sea, South-West Delta, and Major Rivers hotspots. It was very important for the two programmes to cooperate more closely in order to furnish knowledge that would support and enhance the Delta Programme.

Conclusions and follow-up action

Based on the overall programme conclusions, follow-up action has been identified for the final two years of the programme, with two priorities: value creation (valorisation) and the conclusion of the programme.

1. The KfC is a pioneer in climate change adaptation research in terms of both substance and approach. The programme could do more to disseminate its scientific quality and progressive approach, particularly in the area of knowledge co-creation.

- More publications and presentations about the overall programme approach and results. The results of the SSA01 project can be utilised in this context.
- Identification and dissemination of 'breakthroughs' (or encouraging the consortia to do this).

2. The programme is innovative and ambitious in bringing together disciplines, sectors, and actual practice at various levels of scale, and has thus created a solid knowledge infrastructure for climate change adaptation in the Netherlands. The connection between consortia and hotspots is not yet as good as it might be. Extra efforts must be made to ensure adoption of second phase results in actual practice and in the regional adaptation strategies.

- Support for the hotspots in developing their Regional Adaptation Strategies and ensuring that the relevant consortia input knowledge and expertise (part of the Hotspots Completion Pathway).
- Support for the consortia's communication and knowledge dissemination efforts; ensuring timely and effective sharing of results and expertise, including on a cross-theme basis (for example 'knowledge montages', action strategies booklets, workshops). The Knowledge Transfer unit may be able to play a role in this.

3. It is the PhD candidates who make the greatest contribution to the results of the second phase. More efforts must be made to ensure that the knowledge they generate can be applied by the stakeholders.

- Offer more encouragement/support through their supervisors (including discussion during progress interviews) and KfC-wide initiatives (for example showcasing good examples in newsletters, organising competitions, etc.).

4. The KfC is an important knowledge supplier for the Delta Programme. The relationship between the KfC and the Delta Programme can be further improved.

- A Task Force will be set up to survey and strengthen the connection between the Delta Programme and the KfC.

5. Interaction with the private sector is important to promote the adoption of climate change adaptation and KfC knowledge among practitioners. The KfC can make greater efforts to involve private parties.

- In the final two years, the KfC will focus more on business development with private parties.

5 Activities of the Knowledge Transfer unit 2008–2014

This appendix lists the activities carried out by Knowledge for Climate's (KfC's) Knowledge Transfer unit (KT) over the past seven years. From 2008 to the end of 2011, a number of activities were carried out in collaboration with the Climate Changes Spatial Planning Programme (CCSP). With the exception of the final conference of the CCSP ('Climate Node' [Knooppunt Klimaat] (2011)), this appendix does not include the meetings that took place solely in the context of the CCSP.

The KT carried out the following activities continuously throughout all years of the programme:

- Maintaining, improving, and redesigning the following websites: Climate Research Netherlands (CRN), Climate Changes Spatial Planning, and Knowledge for Climate. A number of small websites were also set up; these were often later integrated into the above three research sites.
- Editing and distributing the quarterly CCSP/KfC digital newsletter.
- Social media: LinkedIn, Facebook, and Twitter (from 2010).
- Writing KfC flyers and having them formatted and printed.
- Writing and distributing press releases.
- Updating the database of publications.
- Front office work: answering enquiries from interested parties.
- Writing an annual communication plan and progress reports.
- Arranging lectures at universities of applied sciences (Saxion, The Hague) and Wageningen University and Research Centre (WUR).

The activities listed below were carried out independently by KT, often, in collaboration with other organisations. If 'KT provided support' is indicated, then another KfC body or another organisation initiated and implemented the activity.

2008

Symposiums, conferences, debates

- Festive event: 'KfC in the Starting Blocks' (June 2008); KT provided support; 100 participants.
- Focused debate: 'Climate Change and its Impact on Human Health' (September 2008); 110 participants.
- Focused debate: 'Climate Change and Recreation and Tourism', in collaboration with the Recreation Knowledge Centre (November 2008); 30 participants.
- Conference: 'On the Way to a Climate-proof Society' (November 2008); speakers included Ken Livingstone and James Hansen; 500 participants.

The latter three events were organised in collaboration with CCSP.

Specials, publications, presentations, and interviews

- Change magazine was published especially for the conference 'On the Way to a Climate-proof Society'.
- Short radio interview with Florrie de Pater about urban heat in the light of a new city to be built near Dubai.
- Various presentations by Florrie de Pater: Darmstadt, The Hague Environment Round Table, Wassenaar Rotary Club, etc.

2009

Symposiums, conferences, debates

- Focused debate: 'Climate in the City' (February 2009); 30 participants.
- Expert meeting: 'Climate in the City' (July 2009) for CCSP and KfC researchers; 20 participants.
- Meeting: 'Climate Knowledge for Consultants' (September 2009), together with ONRI; 14 participants.
- Expert meeting: 'Climate Change and the Soil' (October 2009); 15 participants.
- International symposium: 'Boundary Work' (September 2009); KT was involved in all kinds of different ways and chaired a session; 60 participants.
- Projects Day 2009: 'Get to Know Climate' (September

2009) for all KfC researchers; 150 participants.

- Mini symposium on fresh water supply (November 2009), with presentation of the report 'Fresh Water Supply and Demand in the South-West Delta' to Dutch parliamentarians; 110 participants.
- Holland Climate House during the UN Climate Change Conference (COP15) in Copenhagen (December 2009); eight days of presentations, workshops, and films; about 1500 participants.
- Workshop at the Maarssen Day (November 2009) about the salinization of the South-West Delta; 30 participants.

Specials, publications, presentations, and interviews

- International KfC/CCSP newsletter (December 2009), KT was involved in all kinds of different ways and wrote an article on the hotspot approach.
- Experts in the Picture' [Experts in beeld]: booklet with the names and photos of people who can help the hotspots with stakeholder-related activities.
- Radio interviews on various radio and TV programmes about Holland Climate House.
- Interview with De Gelderlander newspaper about Holland Climate House.

The manager of KT also coordinated preparations for a Climate and Health research programme for the Dutch Ministry of Health, Welfare and Sport.

2010

Symposiums, conferences, debates

- International conference: 'Deltas in Times of Climate Change' (September 2010), in collaboration with the City of Rotterdam; 1150 participants.
- Symposium: 'The Broad Dike' (December 2010), in collaboration with Movares; 85 participants.

Specials, publications, presentations, and interviews

- Booklet: 'First-phase Projects' (May 2010).
- Booklet: 'Climate as an Opportunity' (September 2010).

Other:

- Exhibition: 'Climate as an Opportunity' (September 2010).

2011

Symposiums, conferences, debates

- KfC Projects Day (April 2011) for all KfC researchers; 150 participants.
- Knowledge and Network Day: Climate-proof Cities (April 2011), in collaboration with CROW, CURNET, and Future Cities; 270 participants.
- Brainstorming session: Framing the Climate Problem (June 2011) for KfC researchers; 10 participants.
- Four public climate debates (autumn 2011), in collaboration with the NRC Handelsblad newspaper; a total of about 1000 participants.
- Climate Node (December 2011), final meeting of Climate Changes Spatial Planning Programme; 700 participants.

Specials, publications, presentations, and interviews

- Meeting report: Deltas in Times of Climate Change (January 2011).
- Climate Changes Spatial Planning Programme, practical guide on Climate-proof Spatial Planning (December 2011), in collaboration with KfC with the ruimtevoorklimaat.nl website.
- Interactive web document with building blocks for the National Adaptation Strategy (NAS) (April 2011).

Courses:

- Master class on climate change in rural areas (November 2011), in collaboration with the Wageningen Business School; 14 participants.
- Four meetings with frontrunner municipalities to work out strategies for urban heat; 15 participants.
- Young Scientist Workshop during International Water Week Amsterdam (October 2011); five days; 25 participants.

2012

Symposiums, conferences, debates

- Midterm Assessment 2012 (October 2012), KT handled the logistics; 150 participants.
- KfC debate series: Perspectives on Climate Change Adaptation: Historical Perspective (November 2012); 80 participants.
- KfC debate series: Perspectives on Climate Change Adaptation: Philosophical Perspective (October 2012); 70 participants.
- Symposium: 'How about the peatland?' (November 2012), in collaboration with DHV; 70 participants.
- Workshop: Knowledge Gaps in the Water System (September 2012), in collaboration with the Delta Programme's New Construction and Restructuring sub-programme; 30 participants.
- International symposium: Governance of Adaptation (March 2012), KT dealt with the social media aspect; 150 participants.

Specials, publications, presentations, and interviews

- Book: Bedenk, Ontwikkel en Gebruik [Invent, Develop, and Apply] (October 2012).

2013

Symposiums, conferences, debates

- Delta Programme Knowledge Conference 'For a Safe, Green Delta' (April 2013); 250 participants.
- ECCA Hamburg (March 2013), the first European confe-

rence on adaptation. KT organised the practice-based component, with 25 sessions; 750 participants.

- Conference on Action Strategies 'Eureka! What's Next? From Knowing to Action' (October 2013), in collaboration with STOWA; 100 participants.
- Infrastructure and Networks Mini-Seminar: Worst Case Scenario! (June 2013), Theme 5 KfC; KT provided substantive and logistical advice; 40 participants.
- Symposium: 'Options for Adaptation Strategies in the Peat Meadow Areas' (November 2013); KT provided logistical and substantive support; 50 participants.
- Climate Adaptation Business Challenge (November 2013); KT provided substantive advice and all kinds of logistical services, 100 participants.

Specials, publications, presentations, and interviews

- Circle-2 'Adaptation Inspiration Book' (March 2013); KT provided logistical and substantive support.

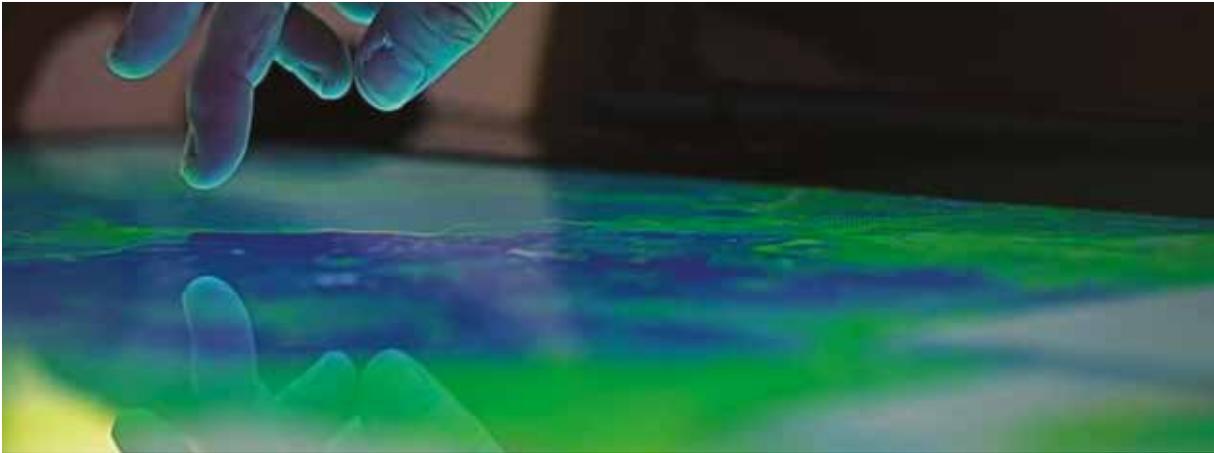
Courses:

- Course: Climate Change and Spatial Planning for Planners (March 2013), in collaboration with Platform 31; 15 participants.

Other:

- Climate TV: Seven short videos about climate change (2013), some with English subtitles. Viewed more than 12,000 times.





2014

Symposiums, conferences, debates

- Workshop: 'Further with Knowledge Co-creation' (January 2014), in collaboration with the Inspirator project (NWO/KfC project); KT provided logistical and substantive support; 30 participants.
- Work conference: 'A Fresh Look at Rivers in the Dutch Delta' (January 2014); KT provided a great deal of logistical support; 100 participants.
- Symposium: 'Calculating the Costs and Benefits of Climate Adaptation Measures' (February 2014); 100 participants.
- Study day: "'Unbreachable" Dikes: Pipedream or Feasible?' (March 2014), in collaboration with STOWA; 80 participants.
- Symposium: 'The Climate-Proof City' (March 2014), in collaboration with Master City Developer. KT provided substantive and logistical support; approx. 150 participants.
- Practice-based conference: 'Action strategies for Governance of Climate Change Adaptation' (March 2014); KT provided substantive and organisational support; 140 participants.
- Symposium: 3Di Water Management (March 2014), in collaboration with Neelen and Schuurmans; KT took the initiative and also provided logistical support; 250 participants.
- Work conference: 'Natural Solutions for Consequences of Sea Level Rise in the Wadden Sea Region' (March 2014); KT provided logistical support; approx. 50 participants.
- Workshop: 'Further with Knowledge and Innovation: Fresh Water Issues after the Delta Decision' (May 2014), in collaboration with the Delta Programme's Fresh Water sub-programme; KT provided logistical support; 60 participants.
- Work meeting: 'Climate Change Adaptation elevated Sandy Soils' (May 2014); KT provided logistical support; 15 participants.
- Five stakeholder meetings about: risks and opportunities for nature, fisheries, health, transport and ICT, agriculture and horticulture (May/June 2014); KT provided support.
- Symposium: 'Knowledge Portal for a Climate-Proof and Water-Robust Space' (June 2014); 60 participants.
- International conference: 'Deltas in Times of Climate Change II' (September 2014), in collaboration with the City of Rotterdam, the Ministry of Infrastructure and the Environment, and the Ministry of Foreign Affairs; 1250 participants.
- Presentation: 'Climate Change Adaptation Strategy for Mainport Schiphol' (October 2014); KT provided logistical support; approx. 30 participants.

Specials, publications, presentations, and interviews

- Ten booklets for policymakers and practitioners, eight thematic booklets describing the results of KfC research for each theme, and a booklet with KfC-wide results, with an English translation (September 2014).

6

The hotspots in the Knowledge for Climate Programme



The Haaglanden Region

The Haaglanden region includes The Hague conurbation and a large concentration of greenhouse horticulture. An important issue in this region is how to deal with the major demand for room to buffer or store water, which is to a large extent associated with climate change.

The Haaglanden Region hotspot was coordinated by the Haaglanden urban region (previously Water Framework Haaglanden [Waterkader Haaglanden]). The nine Haaglanden municipalities, the Delfland Regional water authority, and the Province of Zuid-Holland were also involved.

The first-phase projects focus on generating region-specific climate data (in collaboration with the Rotterdam Region hotspot), climate-robustness and spatial planning decisions, adaptation strategies for the peat meadow areas, climate change effects in relation to socio-economic trends, and water storage in the greenhouse horticulture sector.

The Haaglanden Region hotspot was involved in the following themes in the second phase:

- ✓ Theme 2 Climate-Proof Fresh Water Supply;
- ✓ Theme 4 Climate-Proof Cities;
- ✓ Theme 7 Governance of Adaptation;
- ✓ Theme 8 Decision Support Tools.

The hotspot has chosen to focus in the third phase on putting ‘delta innovations’ into practice, specifically an innovative technique for underground water storage for greenhouses, and a three-dimensional modelling platform (3Di) for imaging the spatial distribution of flooding over time. The parties in the region – in collaboration with Knowledge for Climate and Royal Haskoning/DHV – also worked to develop the Haaglanden Regional Climate Change Adaptation Strategy.



Mainport Schiphol

The focus of the Mainport Schiphol hotspot is on making the airport’s operations climate-proof. These operations are extremely sensitive to changing climate and weather conditions.

The Mainport Schiphol hotspot was coordinated by the Schiphol Group. Other parties involved were Air Traffic Control The Netherlands (LVLN), Knowledge and Development Centre Schiphol (KDC), the Royal Netherlands Meteorological Institute (KNMI), and Wageningen University and Research Centre (WUR).

Three projects were carried out in the first phase that studied changes in the local climate and their impact on the airport’s operations. A system was also developed for monitoring visibility and wind so as to ensure more efficient use of airport capacity.

The Mainport Schiphol hotspot was involved in the following themes in the second phase:

- ✓ Theme 2 Climate-Proof Fresh Water Supply;
- ✓ Theme 4 Climate-Proof Cities;
- ✓ Theme 5 Infrastructure and Networks;
- ✓ Theme 6 High-Quality Climate Projections.

Active participation via co-funding was limited to Theme 6, which covers the most relevant research for the airport. Two of the studies in the first phase (HSMS01 and HSMS03) were followed up in the context of this research theme. In the third phase, an overall strategy for a climate-proof Mainport Schiphol was developed for the hotspot.



Rotterdam Region

Major investments have been planned in the Rotterdam Region in the years ahead, aimed at facilitating economic growth, increasing the capacity of the port, and improving accessibility and urbanisation. How can that investment be made in a climate-proof manner?

The hotspot was coordinated by the City of Rotterdam. Other parties involved were various municipal departments in Rotterdam, the Rotterdam urban region, the regional water authorities in the region, the Province of Zuid-Holland, and the Port of Rotterdam Authority.

The ten projects that commenced in the first phase focus on studying flood safety, the effects of climate change on inland waterway transport, urban water systems, adaptive construction, heat stress, the need for region-specific climate information (in collaboration with The Haaglanden Region hotspot), and risk perceptions and problem ownership (in collaboration with The Major Rivers hotspot).

The Rotterdam Region hotspot was involved in the following themes in the second phase:

- ✓ Theme 1 Climate-Proof Flood Risk Management;
- ✓ Theme 2 Climate-Proof Fresh Water Supply;
- ✓ Theme 4 Climate-Proof Cities;
- ✓ Theme 5 Infrastructure and Networks;
- ✓ Theme 7 Governance of Adaptation.

In the third phase, ten projects were carried out that built largely on research conducted during the first and second phases, and that tackled a number of knowledge gaps that became apparent when developing the adaptation strategy for the City of Rotterdam and the Rotterdam region. Projects concerned adaptive development strategies outside the dike protection zone, green adaptation strategies, drought in the city, linking adaptation and mitigation, opportunities for innovation in our knowledge of urban climate change adaptation, and social cost/benefit analysis for the purpose of area development. Finally, a 'knowledge montage' was undertaken in order to integrate the second-phase research and to make it applicable for policy-making purposes. For Rotterdam, this report provides an important basis for the adaptation strategies that have been developed.



Dry Rural Areas

Large stretches of countryside in the elevated sandy areas are undergoing a transition from a food production landscape to a more multifunctional landscape linked to urban areas. Climate change is putting that transition under serious pressure due to greater hydrological dynamics.

The hotspot was coordinated by the Province of Noord-Brabant. Also involved were the Province of Gelderland, the KWR Watercycle Research Institute, and the Foundation for Applied Water Research (STOWA).

Two hotspot projects commenced in the first phase of Knowledge for Climate. Adaptation options for water systems, agriculture, and nature conservation were investigated in the Province of Gelderland. Options for multifunctional land-use were investigated in the Province of Noord-Brabant.

The Dry Rural Areas hotspot was involved in three themes in the second phase:

- ▼ Theme 3 Climate Adaptation for Rural Areas;
- ▼ Theme 7 Governance of Adaptation;
- ▼ Theme 8 Decision Support Tools.

Some of the research in Theme 3 involves more in-depth study of the issues investigated in the Province of Gelderland in the first phase.

Four projects were carried out in the third phase. The first of these explores options for underground water storage in a nature conservation area for use in agriculture and by nature. This was one of the ideas that emerged from the multifunctional land use project carried out in



the first phase. The second project involved developing a method for flexible arrangements of adaptation measures. The third project contributed to the development of a long-term overall strategy for a regional water authority and a number of municipalities in the same region. Finally, the hotspot produced an end product in the form of an overall strategy for climate-proof spatial planning in the elevated sandy areas of the Netherlands.

The Major Rivers

The consequences of climate change for the Major Rivers hotspot are higher discharge levels in winter and more or extreme drought in summer, as well as more precipitation and evapotranspiration. Changes in land use in the Major Rivers region have a direct impact on its water-buffering capacity.

The hotspot was coordinated by VU University Amsterdam's Institute for Environmental Studies (IVM) and later by the Water Service [Waterdienst] of RWS (the national public works agency). Other parties that participated were the Province of Gelderland, Deltares, and the Municipality of Dordrecht.

Four projects in the first phase studied flood risk, adaptation strategies and spatial planning options, climate-proof dike reinforcement, and risk perceptions and problem ownership (in collaboration with the Rotterdam Region hotspot).

The Major Rivers hotspot was involved in the following themes in the second phase:

- ▼ Theme 1 Climate-Proof Flood Risk Management;
- ▼ Theme 2 Climate-Proof Fresh Water Supply;
- ▼ Theme 6 High-Quality Climate Projections;
- ▼ Theme 7 Governance of Adaptation;
- ▼ Theme 8 Decision Support Tools.

As far as possible, the hotspot collaborated and coordinated with the Delta Programme's Rivers sub-programme in the third phase. One project, for example, dealt with the robustness of the River Meuse; this produced a tool that can be used in the Rivers sub-programme at regional level. A study was also carried out on cross-border cooperation. As the final product, a 'knowledge montage' was undertaken that clustered the relevant knowledge to promote effective knowledge uptake at regional level in the Rivers sub-programme.



Shallow Waters and Peat Meadow Areas

Climate change is leading to drought, peak water levels, salinization and changes in water quality (eutrophication) in peat meadows and shallow waters. Water depletion is leading to more rapid peat degradation.

The hotspot was coordinated by Utrecht University (Landscape Ecology). Other parties involved were Wageningen University and Research Centre (WUR), VU University Amsterdam's Institute for Environmental Studies (IVM), STOWA, and a number of regional water authorities and provinces.

Three research projects were carried out in the first phase on the consequences of climate change for peat degradation and the effects on soil subsidence and water quality. Interactive spatial planning tools were used to generate and evaluate adaptation strategies together with stakeholders.

The Shallow Waters and Peat Meadow Areas hotspot was involved in the following themes in the second phase:

- ✓ Theme 3 Climate Adaptation for Rural Areas;
- ✓ Theme 6 High-Quality Climate Projections;
- ✓ Theme 7 Governance of Adaptation;
- ✓ Theme 8 Decision Support Tools.

The hotspot coordinator was also a member of the group supervising the 'Green Backbone' case study, which was carried out in Theme 2 Climate-Proof Fresh Water Supply.

In the third phase, the hotspot helped develop the overall peat meadows strategy for the Province of Friesland and the Friesland Regional water authority [Wetterskip Fryslân]. It also developed building blocks for climate change adaptation strategies for the peat meadow areas. The end result is a website that is now being managed and maintained by STOWA.

Wadden Sea

The Wadden Sea is an important ecological and leisure area but also serves as a safety buffer for the Dutch coastal zone and the northern regions. In terms of governance it is a complex region that used by many different parties for many different purposes. It is therefore important to join stakeholders in the region in identifying gaps in our knowledge of the effects of a changing climate.



In the first few years, the hotspot was coordinated by the Province of Friesland. Various parties in the region also participated, for example the regional water authority and the northern division of the State Forest Service. In 2010, the chairperson of the Wadden Sea hotspot team decided to step down. The Knowledge for Climate Programme Office and Executive Board now represent the interests of the Wadden Sea hotspot.

In the first phase, an exploratory project was carried out with the aim of developing a knowledge agenda for the hotspot, at the same time seeking alignment with other programmes and initiatives within the Wadden Sea Region. The main conclusion of this study was that to effectuate climate change adaptation, governance in and around the Wadden Sea first had to be examined closely.

The Wadden Sea hotspot was involved in the following themes in the second phase:

- ▼ Theme 1 Climate-Proof Flood Risk Management;
- ▼ Theme 3 Climate Adaptation for Rural Areas;
- ▼ Theme 7 Governance of Adaptation.

Knowledge for Climate was one of the parties that organised an international Wadden Sea Conference in Leeuwarden in November 2012. The Knowledge for Climate organisation also explored sand replenishment as a long-term regional adaptation strategy. Knowledge for Climate is offering this as a framework for the Delta programme's Wadden Sea sub-programme.



South-West Delta

The Netherlands' south-west delta will be coping with sea level rise, changing wind patterns, and changing river discharge levels (lower in summer and higher in winter) in the coming years. These phenomena will bring about changes in flood risk levels, water quality (salinization), water availability, ecology, and estuarine dynamics, all of which will have an impact on how land is used in the region.

The hotspot was coordinated by the Province of Zeeland. Other parties involved were Zeeland University of Applied Sciences, Deltares, Wageningen University and Research Centre, RWS and the Tourism Knowledge Centre.

Three projects were carried out in the first phase of the programme. The first of these focused on the certainties/uncertainties regarding the long-term availability of fresh water. The second dealt with the effects of climate change on the recovery of estuarine dynamics. The third project generated sector-specific information about climate change.

The South-West Delta hotspot was involved in the following themes in the second phase:

- ▼ Theme 1 Climate-Proof Flood Risk Management;
- ▼ Theme 2 Climate-Proof Fresh Water Supply;
- ▼ Theme 3 Climate Adaptation for Rural Areas;
- ▼ Theme 7 Governance of Adaptation.

In the third phase, a pilot project was carried out drawing on knowledge generated within Theme 2 about underground fresh water buffering. An exploratory study was also carried out on the viability of a 'Delta Academy'. Research within the hotspot was increasingly linked to the Delta Programme's South-West Delta sub-programme. Knowledge for Climate developed a long-term overall strategy for climate change adaptation in collaboration with the Delta Programme. This strategy gave the sub-programme a conceptual framework and benchmark that can be used to streamline strategic policymaking.



7 Steering committees consortia

Consortia Steering Committees Duties

- The steering committee supervises and advises the consortium on content, knowledge uptake and valorisation, and where necessary recommends adjustments to the research.
- The steering committee's work is subject to the conditions laid down in the funding agreement and the approved project proposal. Major interventions – for example budget shifts, changes that cause the research to deviate from the project proposal – are submitted to the Executive Board, as are any disputes.
- The steering committee informs the Executive Board on the progress and quality of the research (outside the formal procedures for monitoring progress as laid down in the funding agreement).
- Together with the consortium, the steering committee determines what additional supervisory structures are necessary to promote the quality and progress of the research, for example supervisory committees at work package or case study level. These supervisory committees report to the steering committee.

Responsibilities

- Monitoring the progress of the research:
 - The steering committee ensures that the research is carried out in accordance with what has been agreed, and that the demand for knowledge of the hotspots is taken into account.
- Monitoring the cohesion and coordination of the research, focusing on :
 - cohesion and coordination within work packages;
 - cohesion and coordination within the theme itself;
 - positioning with respect to other lines of research, research programmes, and projects.
- Advising the Executive Board – whether or not requested to do so – on progress and findings. When advising on controversial matters and far-reaching adjustments, the chair of the steering committee consults the Executive Board before issuing recommendations. Formal and far-reaching interventions in the consortium are reserved for the Executive Board.
 - Advising on adapting the research results for use in practical policymaking.
 - Acting as a sounding board for the consortium.
 - Keeping the consortium and the Executive Board informed about relevant societal and administrative trends.



Members of the steering committees

Theme 1

Pieter Huisman (chair)
Koos Poot (Ministry of Infrastructure and the Environment)
Pieter Jacobs (RWS, Zuid-Holland division)
Lein Kaland (Province of Zeeland)
Ludolph Wentholt/Rob Ruijtenberg (STOWA)

Theme2

Sybe Schaap (chair)
Ans van den Bosch (Ministry of Transport, Public Works and Water Management)
Jan Smits (Regional water authority Holland Delta)
Rob Ammerlaan (Haaglanden)
Erik de Haan (Province of Zuid-Holland)
Rob Ruijtenberg (STOWA)
Henk Ketelaars (EVIDES)
Theo Olsthoorn (Delft University of Technology)

Theme 3

Tom Veldkamp (chair)
Erik de Haan (Province of Zuid-Holland)
Felix Helmich (Province of Noord-Brabant)
Arnold Bregt (ESG, Wageningen UR)
Teun Spek (Province of Gelderland)
Maarten Verkerk (Delta Plan High-lying Sandy Soil, Aa & Meuse Regional water authority)
Laurens Gerner (Rijn & IJssel Regional water authority)
Martijn Root (Ministry of Economic Affairs)

Theme 4

Wim Hafkamp (NICIS, chair)
Carl Paauwe (Delfland Regional water authority/Haaglanden Region hotspot)
Arnoud Molenaar (City of Rotterdam/Rotterdam Region hotspot)
Bert Palsma (STOWA)
Hans van Ammers (City of Arnhem)
Paulien Hartog (Waternet)
Mirelle Kolnaar (City of Utrecht)
Garnt Arbouw (Ministry of Infrastructure & Environment)
Joseph Kuijpers (Province of Noord-Brabant)

Theme 5

Ben Immers (chair)
Rik Timens (Ministry of Economic Affairs, Agriculture and Innovation)
Jan Peter van der Hoek (Waternet)
Paul Fortuin (RWS)
Hetty van Rhijn-Stumphuis (City of Rotterdam, Urban Planning & Public Housing Department/dS+V)

Theme 6

Fonds Baede (chair)
Marc de Rooy (Ministry of Infrastructure and the Environment)
Ralph Schielen (Major Rivers hotspot)
Peter van den Brink (Mainport Schiphol hotspot)
Joost Knoop (PBL)
Harry Otten
Günter Können

Theme 7

Roel in 't Veld (chair)
Eke Joustra (Ministry of Infrastructure & Environment)
Frank van Lamoen (Dry Rural Areas hotspot)
John Jacobs (Rotterdam Region hotspot)
Koos Beurskens (South-West Delta hotspot)
Thecla Westerhof (Province of Zeeland)
Carl Paauwe (Delfland Regional water authority)

Theme 8

Peter Nijkamp (chair)
Marten van der Gaag (vice chair)
Eke Joustra (Ministry of Infrastructure & Environment)
Arno Lammers (Haaglanden)
Harold van Waveren (Major Rivers hotspot)
Henk Scholten (Geodan)
Carl Koopmans (SEO)

8 Who is who

Supervisory Board

Sybilla Dekker

Sybilla M. Dekker is former Minister of Housing, Spatial Planning and Environment – May 2003 till October 2006 (Balkenende II and III). Sybilla Dekker has extensive experience at both organizational and political level, as she has been on various boards of directors within the industry (AKZO-Nobel, Dutch Railways, Heineken Nederland BV and Rabobank Nederland). Currently she is chair of the Taskforce and Foundation Talent naar de Top (Talent to the Top), the Supervisory Board Kadaster (the Netherlands' Cadastre, Land Registry and Mapping Agency), the Strategic Advisory Board of TNO Built Environment, the National Board of Public Transport, the Round Table on Project Mainport Rotterdam Maasvlakte II and the Diabetes Fund. Furthermore, Sybilla Dekker is a member of the Supervisory Board of Bank Nederlandse Gemeenten, the Supervisory Board Royal Haskoning-DHV, the Financial Supervisory College (Board) for the Dutch Antilles, the Supervisory Board Know-



ledge for Climate Research Programme, and the Board of Recommendation Provada, Dutch trade fair for real estate. Sybilla Dekker is closely associated with various social and cultural organizations (a.o. the Scheepvaart Museum Amsterdam).

Prof. Gerlach Cerfontaine

Senior Executive with extensive experience in the aviation industry, healthcare, and the public sector in general. Former CEO of both the Schiphol Group and Utrecht University Hospital. Currently chairman of the supervisory board of the Dutch air traffic control, professor of innovation policy at the United Nations University, Maastricht, non-executive board member of the Dutch knowledge-for-climate foundation, and an advisor for Gilde, a private equity firm specialising in management buyouts. Additionally, holds several advisory and board positions in both profit and non-profit organizations. Trained medical doctor and psychotherapist who served in both medical and academic positions at the University of Utrecht, including professor of Corporate Governance. Specialist in the governance of private-public corporations and the economical development of regions.



Marga Kool

Marga Kool is a member of the Supervisory Board of the Foundation Knowledge for Climate. During the first 15 years of her career she worked in various areas within the field of Education. Additionally and subsequently, she performed several positions in Public Administration. As a representative of D66 she was a member of the city council of Zuidwolde and the provincial government of Drenthe. From 1991 until 1999 she was a deputy of the Province of Drenthe, responsible for Cultural and Environmental affairs. Since 2000 she has been the Dike-Reeve of the Regional Water Authority Waterschap Reest en Wieden. From 2001 until 2007 she was a member of the executive board of the Dutch Association of Regional Water Authorities as well. Marga Kool performed a number of additional functions. For example she was a member of the RMNO (Advisory Council for Research on Spatial Planning, Nature and the Environment) and chairwoman of the Steering Group for Water Education; member of the board of Inaxis; chairwoman of the Innovation Network of IPO



and member of the board of the Association for Water Governance and -Law. She was a member of the advisory board of Staatsbosbeheer, the committee of experts of Natuurmonumenten and the National Restoration Fund. In addition, Marga Kool works as a writer, poet and columnist. for instance for the Staatscourant and the Dagblad van het Noorden.

Prof. Vinus Zachariasse

Vinus Zachariasse (19-01-1942) holds a MSc in Agricultural Economics (1965) and a PhD in Agricultural Sciences (Wageningen University, 1974). Currently he is director/ owner of Synther Consultancy Ltd. Previously he was Director General of the Social Sciences Group of Wageningen UR (2001-2005) and of the Agricultural Economics Research Institute at The Hague (1990-2001). He was part-time professor at Wageningen University in Economic aspects of management and management information systems in agriculture (1988-1993) and in Strategic Farm Management in Agriculture (1993-2007). After his retirement he continued in consultancy and chaired several boards and committees inside and outside the agricultural sector. One of the positions is member of the supervisory board of the national research program 'Knowledge for Climate' (2007-2014). He was chairman of the Scientific Committee of the govern-



mental program on Biobased Economy (2008-2014) and is still chairman of the Board of the Green Knowledge Cooperative (members are all the agricultural 'schools' from primary level up to Wageningen University, 2009-)

Executive Board

Prof. Pier Vellinga

Pier Vellinga (1950) is professor in Climate Change at Wageningen University Research and at the Vrije Universiteit Amsterdam. He has an Msc and doctors degree from Delft University of Technology. At Delft Hydraulics Laboratory, now Deltares, (1976-1988) he specialised in coastal processes, in particular sandy beaches and floodprotection. His phd thesis (1986) provided the basis for the evaluation of the safety of the Netherlands coastal dunes, as primary sea defense system. In 1988 he joined the Ministry of Spatial Planning and Environment (VROM), as international advisor on Climate Change. He was directly involved in establishment of the United Nations panel on Climate Change, the IPCC, as vice chairman of the panel (1989 - 1994) Bureau. He was instrumental in preparing the UN Framework Convention on Climate Change (UNFCCC) agreed in 1992. In 1991 Pier Vellinga re-joined the research community as professor in Climate Change and director of the Institute for Environmental Sciences (IVM) of the Vrije Universiteit Amsterdam. From 2000 until 2007 he was dean of the newly established Faculty of Earth and Life Sciences and vice rector of the University. In 2007 he joined Wageningen University including the role of chairman of the board and scientific director of the National Program Knowledge for Climate. Pier Vellinga gives lectures, does research, publishes in scientific journals and actively participates in societal debates about Climate Change, Energy and Water. He presented his views on Climate Change in the book *Hoezo Klimaatverandering*, also



available in English (About Climate Change) and in French. In the period 1990-1994 he was Chairman of the Scientific and Technical Advisory Committee of the Global Environment Facility (GEF), of World Bank, UNDP and UNEP. In 2006 he presented the Erasmus Liga Lecture, that triggered a national debate on flood safety, which led to the establishment of the so-called Second Delta Committee in 2008. At present (October 2014) he is chairman of the Knowledge for Climate Programme, chairman of the board of the Netherlands NGO Urgenda, vice chairman of the supervisory board of the Netherlands Bank for International Development FMO, and member of Ufficio di Piano, overseeing flood safety works in Venice. Since October 2014 he is scientific director 'Climate and Water' of the Netherlands Wadden Academy.

Kees van Deelen MSc

Kees van Deelen (1952) has a background as a chemical engineer and holds a MSc degree from Technical University Delft. After having worked with Shell for 5 years he continued his career with TNO in 1984. During the first 10 years with TNO he was initially active as project leader in the area of industrial safety and subsequently as head of a research group in the field of (chemical) waste treatment. From 1994 onwards he has focused his activities towards the management of research within TNO. In this role he led business units in various areas including environmental research and building research.

As from 2007 his main working field is Climate Change. Since early 2008 he's acting as Managing Director of the Foundation Knowledge for Climate. This Foundation has been raised to conduct an ambitious 100 M€ research program on adaptation to climate change. Kees van Deelen has been involved in setting up Climate-KIC from its earliest phase and is chairman of the Dutch co-location and member of the General Assembly of



Climate-KIC. He's also one of the initiators of EURBAN-LAB. This multiyear innovation project has the objective to contribute to "accelerating urban innovation and the transitioning towards Low-Carbon Climate Resilient Cities".

Prof. Peter Driessen

Peter Driessen holds a MA in Urban and Regional Planning (1986) and a PhD in Policy Sciences (Nijmegen University, 1990). Currently he is Professor of Environmental Studies at Utrecht University, the Netherlands and chair of the research group 'Environmental Governance'. Previously, he was Director of Education and head of the Department of Innovation and Environmental Sciences, Faculty of Geosciences, Utrecht University (2000-2008). Most of his research is related to the analysis and evaluation of environmental policy and planning at the international, national and regional level. He is especially engaged in research on environmental governance. His research covers topics such as spatial planning, water management, climate adaptation policy, environmental impact assessment, policy analysis, and science-policy interactions. He has published more than 200 research reports, books, book chapters and journal articles. Recently he co-edited a special issue of *Regional Environmental Change* (J. Veraart, K. van Nieuwaal, P.P.J. Driessen & P. Kabat (2014)). From climate research to climate compatible development: experiences and progress in the Netherlands: Editorial, *Regional Environmental Change*, vol. 14(3), pp. 851-863). Currently, he also holds a position as scientific director of the national



research programme 'Knowledge for Climate' (2007-2014). Furthermore, he is project coordinator of a EU FP7 research project named STARFLOOD (which is focused on analyzing, explaining, evaluating and designing policies to better deal with flood risks from rivers in urban agglomerations across Europe; 2012-2016); he is member of the Governing Board of JPI Climate; and he is member of three Programme Committees of the Netherlands Organisation for Scientific Research NWO (URD, UDW, DBR).

Programme Office

Dr. Monique Slegers

Monique Slegers is a scientific project coordinator for the Dutch national research programme Knowledge for Climate. At Knowledge for Climate (KfC) she was also a secretary of several review committees (e.g. Delta Program review), coordinated reviews (e.g. Delta Alliance Progress Assessment) and was responsible for writing the annual reports and the annual activity plans of KfC. She holds a degree in Development Issues (a specialisation of Geography) from the Fontys university of applied sciences in Tilburg (1999) and a MSc in Rural Development Studies (specialisation: Rural Development Sociology) from Wageningen UR (2001). In 2003 she worked as a junior researcher at the Erosion, Soil and Water Conservation (ESW) Group of Wageningen UR, where she started her PhD research in 2004. Her PhD was on farmers' drought perceptions, their vulnerability and coping



strategies in two areas in Ethiopia and Tanzania (2008). This research brought her to the topic of climate change and climate adaptation.

Marit Heinen MSc

Marit Heinen (1981) holds a Bachelor degree in biology (University of Amsterdam) with a focus on biodiversity and ecosystems. She did her Masters at the VU University: Environment and resource management. In her internship at the Netherlands Environmental Assessment Agency she developed a model which computes the effect of changes in the Dutch diet on the availability of biofuels. In other words: how will changes in the Dutch diet lead to a more efficient use of the nutritional value of agricultural crops? With this thesis she was nominated for the National Thesis Award 2007. She started her career at the Dutch research programme Climate Changes Spatial Planning where she was responsible for coordinating and monitoring 15 different projects in the field of climate change for more than 4 years. She contributed to and edited publications and made sure that scientific knowledge was accessible for policy makers. She was work package leader for two EU projects (FP6 CIRCLE & its follow-up FP7 CIRCLE2) where she (co)organized several international workshops to share



knowledge on climate adaptation and promote long term cooperation among national and regional climate change programmers (34 institutions from 23 countries). Currently she works as a scientific project officer at the Dutch research programme Knowledge for Climate. Here she coordinates different projects such as the review of the quality of the preferential strategies and the Delta Decisions of the Delta Programme.

Dr. Kim van Nieuwaal

Kim van Nieuwaal is scientific coordinator for the Dutch national research programme Knowledge for Climate. He is one of the guest editors of the recently published special issue of *Regional Environmental Change* titled 'From Climate research to climate compatible development: Experiences and progress in The Netherlands'. In the editorial of this special issue the fifteen contributions are positioned in the context of the developments that research on climate adaptation has gone through in the last couple of decades. Kim was project leader of the scientific review conducted for the Dutch Delta Programme and one of the initiators of the synthesis reports that document the scientific underpinning of the policies proposed by the Delta Programme Commissioner. Kim is specialized in science-policy interactions, particularly in the field of adaptation to climate change. He holds a



MA in Public Administration from the Erasmus University Rotterdam and a PhD in Public Administration and Organization Studies from VU University Amsterdam.

Sonja Döpp MSc

Sonja holds a Master degree in Geochemistry and Petrology (Free University Amsterdam, 2007). She started her career at TNO, the Netherlands Organization for Applied Scientific Research. As researcher and consultant for TNO she gained experience in a broad range of interdisciplinary projects on topics like climate proof cities, sustainable buildings and infrastructure, and corporate social responsibility. Since 2012 she is working as project coordinator for the research programme Knowledge for Climate. In this position she is responsible for several programme-wide projects. She organized the Midterm Assessment of the programme, including a large-scale international scientific and societal review process and conference. She co-introduced and organized the (international) Climate Adaptation Business Challenge; the worlds first competition to stimulate new business and start-ups in the field of climate adaptation. In her work with researchers, practitioners, policy makers and business people she has developed skills of a versatile knowledge broker. She has a key-role in translating interdisciplinary knowledge for adaptation strategies and policy advice. For example: in 2013 she



coordinated the development of the Regional Adaptation Strategy of The Hague Region (formulated by nine municipalities, two water authorities and the province of South Holland) and was the editor of the final strategy document. Recently, she was the coordinator of several projects for the Dutch National Adaptation Strategy 2016, commissioned by the ministry of Infrastructure and Environment (including seven sectoral climate change risk assessments, and innovation and governance studies).

Mariëlle Hilkens

Mariëlle Hilkens (1963) has a background as a teacher in arts (drawing and painting) and holds a degree from the Secondary teacher college as well as the Art Academy both in Utrecht. Since the nineties she has worked in different administrative positions at the University of Utrecht. Besides these positions she has also worked as a teacher drawing and painting for the Utrecht Centre for the Arts. She has taught and developed workshops and courses for the primary school and high school. From 2009 until now she has worked as a secretary for the Knowledge for Climate research program, supporting administratively the scientific project coordinators, knowledge transfer coordinators and financial controllers.



Onno Piek

Onno Piek has worked his entire professional career in finance. Started in 1987 as Administrative Assistant, he is now Programme Controller for the Foundation Knowledge for Climate as well as Controller for the Foundation Climate Changes Spatial Planning and the Foundation Climate Adaptation Services. Onno is also founder of a consultants bureau for subsidy and project management named Subpoort. He has a higher vocational education and is currently studying for Qualified Controller (post-bachelor). Onno has wide experience in providing and optimizing financial administrations. He is also well up in producing estimates, management reports and annual accounts, and has specific expertise with various national- and international (European) subsidy programmes (ESF and ERDF). As a consultant he has worked for several commercial companies and



for the government (municipalities and provinces). From the year 2007 he worked via his own business company, FintOP bv, as a finance interim professional.

Steven Schelling

After finishing his Bachelor of Economics in 2006, Steven Schelling has worked in finance and accounting for numerous companies (Ad Interim). In 2008 he joined the foundation Knowledge for Climate during the start up phase of the programme. An interesting period where the Administrative Organisation, procedures and the contracts with project partners had to be set up and structured. During June 2009 his assignment ended as he was able to transfer his work as the Programme Administrator to a newly appointed employee. In the following years he continued working for a broad range of companies in the vicinity of Utrecht. As of September 2014 he has rejoined the foundation to assist in the completion of the programme.



Els van Eersel

Els van Eersel (1958) is a multi tasking professional in HR, PR, Project- and Office management / management assistance. She holds a bachelor degree in Human Resource Management. She started her HR-career at a hospital for epilepsy and research. Over the years she has broadened her knowledge and expertise and has worked at a number of profit and non-profit organizations all over the country.



Roos van Glabbeek

Roos (1989) holds a Bachelor degree in Earth Sciences from Utrecht University and followed a wide range of courses. From evolution and ecology to minerals and magmas, from sedimentary systems to deformation and metamorphose, she is a little bit a jack of all trades. After graduation, she started the master Earth, Life and Climate with the track Biogeology and Evolution and is currently finishing her master thesis about the response of dinoflagellates during the Messinian Salinity Crisis in a site at the Atlantic side of Morocco. She did several fieldworks and went this year for the fourth time volunteering with the first year students to the Ardennes as a mentor to help them experience their first fieldwork. She also did some student assistancy with courses on Utrecht University. In 2012 she started to work as a student



assistant with Knowledge for Climate and worked with finance and on the secretary.

Knowledge Transfer

Florrie de Pater

In the eighties of the last century Florrie started work in development cooperation in Mozambique, being employed in the water sector for which work she was professionally trained. After three years Oxfam/NOVIB offered her a job. Subsequently she held positions as project officer for the Lusophone countries, program coordinator in Zimbabwe and, back again in the Netherlands, as senior consultant.

After twelve years of work she followed a MSc course in environmental studies. Part of the study was a coastal zone management study in Poland and the Baltic states. The province of Noord-Holland then offered her a job as senior policy officer on strategic policy plans. Her main task was to lead teams to produce policy plans and to do research. In Utrecht Florrie led a team of 20 people mainly involved in strategic planning. After three years she was offered a job in the program 'Climate changes Spatial Planning', a research program on climate change. Her main task was to involve local and regional authorities, societal groups and the business community in the program by awareness raising about the problems of climate change and by setting up projects with direct relevance to those groups, such as projects in the field



of climate change and urban development, climate and health and the so called hotspots: projects in which research results were applied in practice. Besides she has been involved in a European Joint Programming Initiative and occasionally in consultancy work to plan for adaptation strategies elsewhere in Europe. At the moment Florrie manages a team of four people engaged in communication activities in the research program Knowledge for Climate.

Ottelien van Steenis

Ottelien has been involved in the organisation of numerous conferences, workshops etc in international contexts such as Benelux cooperation, US-Dutch cooperation and China Council in the Netherlands as well as abroad (USA and China). Besides that she has been working on the set up of several research programmes (organisation, communication) from the Dutch Priority Programme on Acidification Research - Dutch National Research Programme on Global Air Pollution and Climate Change – Climate Changes spatial Planning. She was also involved in the set up of the Platform Communication on Climate Change: a collaborative venture of PBL, KNMI, Wageningen UR, VU University Amsterdam, Utrecht University, Deltares and NWO to improve the quality, efficiency and effectiveness of communication of Dutch climate research (meetings, publications, website). Since 2008 she has been working for the Dutch research programme Knowledge for Climate, a.o. working on



publications, websites, and a large number of (international) conferences a.o. the very successful international conferences Deltas in Times of Climate Change I (2010) and II (2014).

Fokke de Jong MSc

Fokke de Jong (1969) is an internet and project manager in the working field of climate, water and soil science and holds a MSc degree Soil Science from Wageningen University. Currently he is working at the Research group Climate Change and Adaptive Land and Water Management (CALM) of Alterra, Wageningen UR. Previously, he was web manager at LTO Nederland organisation and Elsevier Bedrijfsinformatie BV. From 2007 onwards he works in fifteen European and Dutch research programmes and projects, often within a team of knowledge transfer. He coordinates as a web manager and as an editor tens of websites with regard to climate change research and land- and water management (see overview at <http://greenwebcontent.webklik.nl/page/overzicht-websites>) and coordinates 5 LinkedIn Groups, 5 Twitter and 8 Facebook accounts, mostly carried out within an editorial team or only by himself. Users sessions are being organised to assess the needs and wishes of target groups, and he is sometimes involved in a team for organising conferences. In the past years he contributed to tens of brochures, flyers, newsletters and to books. One important project is the website for the Kennis voor Klimaat Research Programme (www.kennisvoorklimaat.nl) and related activities such as Waterbuffer, ORAS Veenweidegebied, Klimaat voor Ruimte Programme, Ruimte voor Klimaat Praktijkguides, conferences websites and Delta Alliance Foundation. Besides, he is working on voluntarily basis together with 50 inhabitants in the city of Amersfoort to make a neighborhood sustainable, in the position of a steering board member of two associations and as a communication manager. His motivation is to make adaptation and mitigation studies into the practice: at home, at street level and in the neighborhood.



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Marjolein Pijnappels MSc

Marjolein Pijnappels (1982) holds a MSc degree in Biology from Radboud University Nijmegen. After working three years in the journalistic field as chief editor for B4U, a science magazine targeting teens, and as an editor for the Radboud University Magazine, she returned to science as a researcher for Wageningen University, the only university in the Netherlands to focus specifically on the theme 'healthy food and living environment'. There she was committed to helping scientists transfer knowledge to stakeholders and the public and vice versa. As a member of the Knowledge Transfer team for two national climate change research programmes, Climate Changes Spatial Planning and Knowledge for Climate, and the international ERAnet programme CIRCLE-2, she helped scientists rethink the way their research is shaped. Among researchers she stimulated the notion that communication, dissemination and even cocreation of knowledge can – or as she thinks, should – be an integral part of research in the 21st century. She's author of the Adaptation Inspiration Book (2013), describing 22 cases of local climate change adaptation, distributed throughout Europe, and contributed to the Climate Change Adaptation Manual published by Routledge in 2014. In 2010 Marjolein Pijnappels founded Studio



Lakmoes, a design studio helping scientists, governments and non-profit organisations disseminate knowledge through visualisations and infographics. She has remained active in giving lectures and workshops for scientists on the importance of open science and communication of research results in innovative ways. Her ultimate goal is a fully transparent and open research community where knowledge is shared as early in the discovery process as possible, fuelling beautiful visualisations that enable communication towards multiple stakeholders, including fellow scientists, politicians and children.

Anne Martens MA

Anne Martens (1983) studied Earth Sciences (VU University Amsterdam), Journalism (University of Amsterdam) and a year at the Gerrit Rietveld Academy. Transferring (scientific) knowledge to a broad public is what she loves to do. She likes to dive into a complex topic, read all about it, talk to experts, and transform the topic into an understandable story. She makes television and radio programs and documentaries for the Dutch broadcasting companies VPRO and NTR. To name a few of those topics: the evolution of flight, changes in Aleppo, and a search for a lost asylum seeker. Previously she was assistant press officer at the yearly congress of the European Geosciences Union, where she organized press conferences about the newest research results in geology and climatology. She also coached scientist with giving interviews and made the daily conference newspaper. She currently combines her interests in a job for research programme Knowledge for Climate. To share knowledge about climate adaptation, she organizes symposia



and workshops. These symposia are meant for scientist, policy makers and policy practitioners of authorities and water boards. Themes of symposia were: broad dikes, adaptation strategies for the Wadden Sea region, underground fresh water storage and climate adaptation business opportunities.

Colophon

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