



Knowledge
for Climate

Midterm review Report

Hotspot Dry Rural Areas





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Preface

Research in the Knowledge for Climate programme has reached its halfway point. During the first half of the programme, stakeholders from the Hotspot Dry Rural Areas together with the research consortia developed projects. Central question was: how to deal with a shifting balance in supply and demand for fresh water in the dry rural areas due to climate change. In the next years we will be able to harvest the results and use them in designing and implementing regional adaptation strategies. For this, the research programme Knowledge for Climate is linked to two regional adaptation projects: the Deltaplan Hoge Zandgronden (DHZ) in Brabant and Limburg and the Zoetwatervoorziening Oost Nederland in Gelderland, Overijssel and Drenthe. This report describes the status quo of research, knowledge dissemination and cooperation for the mid-term review.



1 Introduction

The Netherlands is known for its long history of fighting against sea and river floods. Over the past centuries powerful institutions for flood control and water management – such as the water boards - have developed. Because of expected changes in climate, flood risk management will continue to be a major issue in the Netherlands. Much less known is that a large part of the country also faces problems of water scarcity and drought. Despite the annual precipitation surplus, water scarcity occurs because of an uneven distribution of rainfall and river discharge over the seasons, a lack of buffering and conservation capacity and a growing water demand. In rural areas this results in competition for distribution of the available water between various land use functions, such as agriculture and nature preservation in brook systems and wetlands. Climate change will increase this – seasonal - imbalance between water supply and demand.

A complicating factor for climate adaptation in dry rural areas is the current process of change in land use. Large areas of countryside are undergoing a transition from a food production landscape to a more multi-functional landscape in which leisure and living become more important. This means future spatial claims may differ greatly from current land use patterns. Therefore solutions for adaptation to climate change - including institutional arrangements - must be flexible and resilient

Climate adaptation implies dealing with long term and uncertain developments in a setting with many different parties, aiming at many different goals. Being a relatively new issue, available legislation and policies for dealing with (seasonal) water scarcity are limited. Focus in adaptation is on the development of new strategies, combining technical measures and governance arrangements.

The Netherlands has an image of being covered with rivers, polders and coastal land. Therefore it might surprise some that the dry rural areas in the Netherlands cover almost half of the country (see figure 1). Having in common a sandy subsoil and a relatively high elevation of the land, these areas are vulnerable for (seasonal) drought. In many regions this vulnerability has been increased by all kinds of measures promoting fast drainage for agricultural land use.

Figure 1: The dry rural areas cover almost half of the Netherlands.



Sharing the same challenge, solutions may differ greatly between regions, depending on current and projected land use. Some areas, like the central part of Brabant, are highly urbanised, resulting in a patchwork quilt of farmland, nature, villages and industrial areas. Other regions, like the eastern part of Gelderland have a more distinct rural character. This implies that there will be no such thing as *the* adaptation strategy for the dry rural areas. Adaptation measures will be tailored to regional needs.



2 Regional actions

Dealing with water scarcity in the dry rural areas of the Netherlands is organised in two – interlinked regional projects: Zoetwatervoorziening Oost Nederland (Fresh Water Supply for the Eastern part of the Netherlands, www.overijssel.nl/thema's/water/projecten/zoetwatervoorziening) and the Deltaplan Hoge Zandgronden (Deltaplan for the Sandy Regions, www.deltaplanhoge-zandgronden.nl). Both projects focus on cooperation between stakeholders (waterboards, provinces, farmers' organisations, NGO's) in planning and implementation of concrete measures. The projects can be considered the 'policy and practice' counterparts of the scientific consortia in the Knowledge for Climate programme.



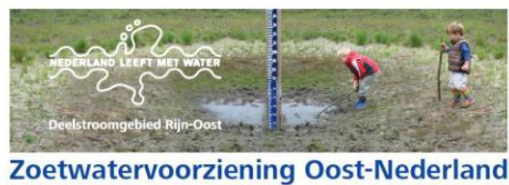
2.1 Deltaplan Hoge Zandgronden

In 2009, the Dutch Provinces of North Brabant and Limburg, government agencies (provinces and water boards) which are responsible for water management, spatial planning and nature management, along with agricultural organizations, water companies, the State Forestry Service and the national Ministry for Water Management have started preparing a 'Deltaplan' for the dry rural areas. The study area covers large parts of the Dutch provinces of North-Brabant and Limburg. The plan outlines a strategy for climate adaptation and dealing with water scarcity, promoting innovative pilot projects for water conservation by increasing water availability during periods of scarcity.

The cooperation widened its scope after a kick off meeting in September 2009) with regional and national decision makers in Deurne (Brabant). During this meeting, Cees Veerman, former Minister of Agriculture and Nature protection and at that moment chairman of the National Delta Committee, called for further cooperation in the field of fresh water supply within a framework for climate adaptation. This initiative – the 'Deltaplan Hoge Zandgronden' - would

become part of the National Delta Programme – Sub Programme Fresh Water Supply.

In 2010 a second meeting was organised in Geijsteren (Limburg), focusing on sharing best practices between the stakeholders. National support for the initiative was confirmed by Wim Kuijken, the newly appointed National Delta Commissioner, in charge of developing and implementing the National Delta Programme.



2.2 Zoetwatervoorziening Oost-Nederland

Parallel to this Deltaplan, a comparable initiative was started in the provinces of Overijssel, Drenthe and Gelderland. Starting off as a project for the National Delta Programme (sub programme Fresh Water Supply), this cooperation between provinces, waterboards, the water company (Vitens) and the national government now also focuses on the development and implementation of regional adaptation measures.

2.3 Interregional cooperation

Recently, in June 2012, a joint meeting of the two regional processes Deltaplan Hoge Zandgronden en Zoetwatervoorziening Oost-Nederland took place (Symposium Hoog en Droog, Arnhem). Focus of this meeting was on connecting fresh water supply to regional economic activities, thus strengthening the sense of urgency for action and exploring new possibilities for public-private cooperation. A manifesto on this was presented to the Delta Commissioner by regional ministers from the provinces of Overijssel, Gelderland, Noord-Brabant and Limburg. (www.deltaplanhogezandgronden.nl/symposia)

The manifesto stresses the importance for economy and society of a sustainable supply of fresh water for the dry rural areas in the Netherlands. It makes an appeal for regional cooperation. The national authorities are requested to include this challenge in the national Deltaprogramme.



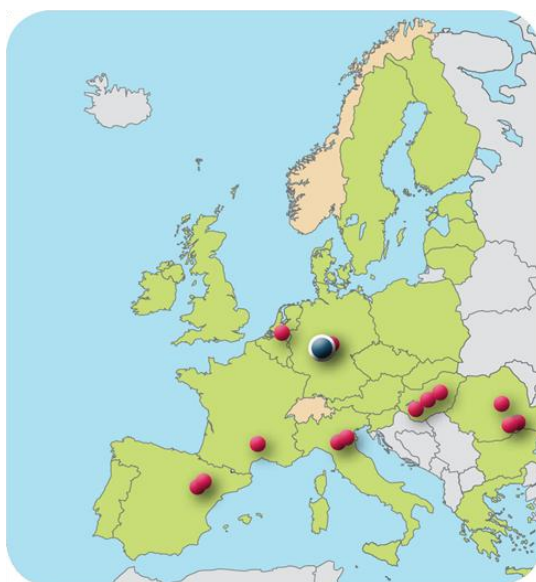
2.4 International cooperation

Noord-Brabant is participating in the Interreg IV project WaterCoRe. The project focuses on water scarcity and drought. In the project, both the Deltaplan Hoge Zandgronden and the Knowledge for Climate programme are presented as good practices. Through WaterCoRe, Brabant is connected to activities in the German project KLIMZUG Nord-Hessen.

The overall objective of WaterCoRe is to create tools for responsible authorities in order to improve water management in all regions of Europe. The 14 partners from 7 EU Member States are committed to exchange their good practices and adapt these to their local or regional conditions. In addition, the partners wish to raise the awareness of inhabitants and stakeholders in partner regions about the water saving potential. The thematic working groups cover various topics such as the demand-side of water management, handling drought periods, climate change effects, public awareness and participation.

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Figure 2:
Partner regions in the
WaterCoRe project



The project will result in a digital exchange platform for water scarcity and drought issues on regional and local level for all European regions, a good practice handbook, a survey specifying the opportunities to exchange good practices within the partnership, regional action plans to transfer experiences between regions, an e-learning programme with thematic modules as well as policy recommendations. Project results are available on www.watercore.eu.

The current status of the project is that the good practice handbook and guide are ready, regional cases have started, the focal point for Central and Eastern Europe is established and a draft version of the digital exchange platform is available.

3 Research approach and hotspot organisation

The Knowledge for Climate programme contributes to both regional adaptation processes by providing means and knowledge for research on effects of climate change and adaptation measures. Research for the hotspot Dry Rural Areas is coordinated by the Province of Noord Brabant. Instead of a formal hotspot organisation and regular meetings, activities are performed in a network of stakeholders. Main actors are the provinces of Gelderland and Noord-Brabant and their waterboards. Case studies focus on the regions of the Baakse Beek (Gelderland) and De Peel (Noord-Brabant and Limburg).

Research in the Knowledge for Climate programme is commissioned in three workpackages:

- Explorative studies
- In depth studies (post doc and PhD projects)
- Regional adaptation projects

The hotspot Dry Rural Areas participates in all three work packages. Research questions all relate to the central issue of dealing with a shifting balance in supply and demand for fresh water. The main challenge in the hotspot is sustainable fresh water supply for agriculture and nature.

In workpackage 1 (explorative studies), research was done on adaptation of brook systems (Baakse Beek and Blauwe Bron, Gelderland) and multifunctional land use as an adaptation strategy (Brabant). Brook systems are the backbone of the landscape in many parts of the hotspot. As these systems perform a key role in regional water supply, insight in the effects of climate change on brooks is essential for the design of adaptation measures. Regarding these measures, a spatial planning problem arises in most of the regions in the hotspot. In many areas land use is very intensive, leaving little space for additional adaptation measures. Therefore combining functions in multifunctional land use may be a strategy for the implementation of adaptation measures.

Adaptation in the dry rural areas covers both technical and governance issues. Therefore in the second workpackage (in depth studies), research within the hotspot focuses on two Knowledge for Climate consortia: Climate Adaptation in Rural Areas (CARE) (Theme 3) and Governance of Adaptation (Theme7). In Brabant – with its patchwork landscape of rural and urban land use, there is also a link with the Climate Proof Cities consortium (CPC) (Theme 4), connecting rural and urban adaptation.

In June 2011 a meeting of stakeholders (provinces, waterboards, agricultural organisations and NGO's) in the hotspot network took place. The aim of this meeting was to define building blocks for adaptation strategies and to make an inventory of research questions for the KfC consortia. According to the stake-



holders, the main ingredients for a successful adaptation strategy in the dry rural areas are:

- Developing a long term perspective for freshwater supply for agriculture and nature
- Connecting scales (from local to international) in designing solutions
- Sharing responsibilities between public and private parties
- Linking practical measures to policy development and legislation

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Most of these issues are covered in some way by research in the second work-package. However regarding regional adaptation strategies still some questions remained unanswered. These questions are addressed in projects in the third work package (regional adaptation).

An overview of projects and case studies is presented in table 1.

Table 1:
Project overview

Project	Tranche	Consortium	Results
<u>HSDR01</u> : An inventory of strategies to cope with climate change in dry rural sandy areas with a temperate climate: a case study in the Province of Gelderland	1	Alterra, Province Gelderland, Waterboard Veluwe, Waterboard Rijn en IJssel	Good practices and business cases (report available on KfC site)
<u>HSDR02</u> : Combining spatial claims of land use functions and adaptive strategies to climate change in densely populated rural areas	1	Deltares, KWR, Alterra, Province Noord-Brabant, Waterboard Aa en Maas	Inventory of challenges (report available on KfC site)
Multifunctional land use (PhD)	2	KfC consortium Governance (theme 7), Province Noord-Brabant, Deltaplan Hoge Zandgronden	Case research not started yet
Policy experiments	2	KfC consortium Governance (theme 7), Province Noord-Brabant, Deltaplan Hoge Zand-	Case research not started yet

(PhD)		gronden	
Leadership (post-doc, PhD)	2	KfC consortium Governance (theme 7), Province Noord-Brabant, Deltaplan Hoge Zandgronden	Paper on case Deltaplan Hoge Zandgronden
Agent Based Modelling (post-doc, PhD)	2	KfC consortium CARE (theme 3), Province Noord-Brabant, Deltaplan Hoge Zandgronden	Method developed with data from Baakse Beek. Application for Tengelroyse beek in preparation
Water demand for nature and agriculture (post-doc, PhD))	2	KfC consortium CARE (theme 3), Province Noord-Brabant, Deltaplan Hoge Zandgronden	<i>Research on evapotranspiration of vegetation finished.</i> <i>Modelling in progress</i>
Follow up Baakse Beek (post-doc)	2	KfC consortium CARE (theme 3), Province Gelderland, Waterboard Rijn en IJssel	<i>Design of regional adaptation strategies</i>
Regional Case (PhD)	2	KfC consortium CPC (theme 4), Province Noord-Brabant, City of Tilburg	Contribution to symposium Cool Brabant (26 April 2012) Case research not started yet
Adaptive arrangements	3	Deltares, Waterboard De Dommel, Waterboard Aa en Maas, Province Noord-Brabant, KfC consortium Governance	First inventory of cases and instruments
AGUA	3	KWR, Waterboard Aa en Maas, Province Noord-Brabant	Project started September 2012
Vallei en Veluwe	3	Alterra, Waterboard Vallei en Eem, Waterboard Veluwe	Spatial plan for a sustainable water system



In most of the project there is a close cooperation between researchers and the regional stakeholders. This approach of 'co-creation' supports an effective transfer of knowledge from the scientific community to policy and decision makers in the regions.

On a higher level of abstraction, research is guided by the steering groups of the consortia. The hotspot is represented in the steering groups of Theme 3 CARE (Provinces of Gelderland and Noord-Brabant, Waterboard Aa en Maas), Theme 4 Governance (Province of Noord-Brabant) and Theme 4 CPC (Province of Noord-Brabant).

4 Summary of project results

4.1 HSDR01: An inventory of strategies to cope with climate change in dry rural sandy areas with a temperate climate: a case study in the Province of Gelderland

The aim of this project is to give an overview of the consequences of climate change and possible adaptation measures on dry sandy areas in the rural areas of the province of Gelderland, the Netherlands. This is needed for the inclusion of climate adaptation measures in landscape development processes in two case study areas 'Baakse Beek' and 'Blauwe Bron'. Scientists and stakeholders from the two areas shared knowledge about relevant themes.

Climate change increases the probability of summer drought as well as water surplus. The current design of the water management in the areas aims at a quick drainage of water surplus. This enhances problems with drought, for nature and agriculture. Still the risk of damage caused by extreme precipitation is real.

Figure 3:
Baakse Beek



There is a need for more insight in the effects of climate change on the hydrology, especially the groundwater recharge. There is a need for further knowledge of the spatial cohesion of ecological networks needed for sustainable ecosystems under climate change. From agriculture there is a need for more knowledge about the consequences of drought and possible adaptation measures for farming systems. Many of these questions are included in the workpackage 2 of the Knowledge for Climate program (theme 3, CARE).

The final report of the project (in Dutch, KvK 034/2011) is available on the website www.kennisvoorklimaat.klimaatonderzoeknederland.nl/publicaties

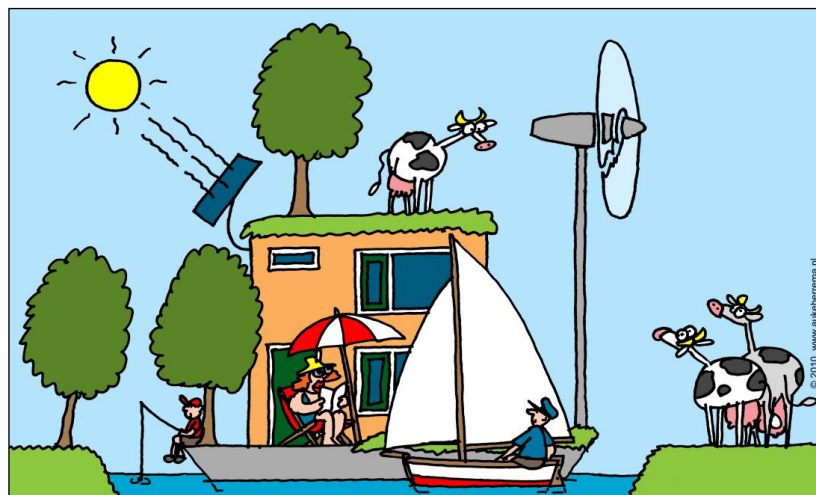


4.2 HSDR02: Combining spatial claims of land use functions and adaptive strategies to climate change in densely populated rural areas

The Brabant countryside – although still retaining a rural character – is a densely populated and regulated area. Demands for available space are many and often conflicting. Land prices are high. Adaptive measures to cope with climate change impacts can be space consuming, adding even more pressure on available space. One of the solutions may be multifunctional land use, increasing land use efficiency and providing added value in economic, ecologic (biodiversity) and public sense.

A complicating factor is the process of transformation (driven by social and economic changes) happening already in the regions concerned. As future spatial claims may differ greatly from current land use patterns, solutions for multifunctional use must bear a certain amount of flexibility and resilience.

The main objective of the project was to analyse the spatial claims associated with climate change ‘proofing’ of water, agriculture, nature and housing and to identify possible adaptive strategies in dry rural areas. Central question was how these claims and strategies can be combined with current or future land use types, focusing on multifunctional land use.



Key deliverables are a good practice guide, offering examples of existing multifunctional land use and two concrete business cases. The two business cases are:

- Combining water storage for agriculture and nature (location De Stip-pelberg);
- Combining water storage, biomass production and ecological corridors

Both cases are adopted by the Waterboard Aa en Maas, to be integrated in the Deltaplan Hoge Zandgronden. Additional research for the case Stippelberg has started in workpackage 3 (AGUA).

The final report of the project (in Dutch, rapport KvK/036/2011) is available on the website of Knowledge for Climate project:

www.kennisvoorklimaat.klimaatonderzoeknederland.nl/publicaties

4.3 Theme 3: Climate Adaptation in Rural Areas (CARE)

Regional adaptation strategies in the dry rural areas have been strongly focused on securing fresh water supply. Attention for developments in water demand has received less attention. By joining research in theme 3, the regional stakeholders want to gain more insight in changing water demand for agriculture and nature due to climate change. Key instrument is Agent Based Modelling, used for projecting future land use patterns.

At the moment, a first version of the ABM is operational. Based on interviews and statistical analyses of census data it was estimated which farmers are selling land, which are interested in buying land, and which farmers do not participate in the land market. Land that is put on the market is evaluated by both the expanding farmers and by the nature organizations. Both parties evaluate for-sale parcels based on specific criteria, and try to buy it when it fulfils these criteria. As such, land use change is simulated, as a result of parcels changing owner.

The current version of the ABM is able to, but does not yet incorporate exogenous change. In due time, time series of climate-change-induced yield losses will be incorporated, as well as price developments of agricultural produce. It is foreseen that these variables will affect how farmers and nature managers will evaluate parcels, as well as the purchasing power of the different agricultural sectors.

The current version was calibrated on the agricultural census data of the Baakse Beek study area. This implies that relationships between farm attributes (e.g. farm size, farmer age) and the probability of selling or buying land are specific for the Baakse Beek region. Also the rules that determine how farmers evaluate their land was calibrated on Baakse Beek data. By the end of 2012, the consortium hopes to recalibrate the ABM on data of the Tengelroyse Beek. It will then become clear if the found relationships are region-specific, or that they are more widely applicable to the Droge Zandgronden.

On a more fundamental level, research was done on evapotranspiration of vegetation in nature areas, with special attention to mosses and lichens. Methods have been developed to incorporate the influence of stress due to lack of



oxygen and lack of water on vegetation development. These methods will be applied in ecohydrological modelling in the case areas of Baakse Beek (Gelderland) and Tengelroyse Beek (Limburg).

Additional attention will be given to the effect of ecological corridors on the migration of species and the role of organisations in charge of nature preservation.

4.4 Theme 7: Governance of adaptation

Emphasis is on multilevel governance and connectivity. Key subjects are multifunctional land use, leadership and the role of policy experiments in adaptation.

Cases for multifunctional land use and policy experiments have not started yet in the hotspot.

For the subject of leadership, a study was carried out for the case Deltaplan Hoge Zandgronden. Climate adaptation implies dealing with long term and uncertain developments in a setting with many different parties, aiming at many different goals. In the case study, this regional network of parties working on climate adaptation is conceived of as a complex adaptive system in which new adaptation policies and measures emerge from the interactions between the actors involved. One of the key questions is: what are the drivers behind actions within that system and what is the role of leadership?

The Deltaplan Hoge Zandgronden outlines a strategy for climate adaptation and dealing with water scarcity and promotes innovative pilot projects for water conservation thus increasing water availability during periods of scarcity. As this Deltaplan is seen as a forerunner when it comes to climate adaptation in rural areas in the Netherlands, it serves as a case in which the performance of various leadership functions can be assessed and analysed. The hypothesis is that the leadership exercised by a number of individuals is the key to success of this initiative, in terms of deciding on a common strategy and starting innovative pilots. In contrast to the classic hierarchical notion of leadership, leadership in this case is fragmented and includes individuals who possess a formal leadership position and those who do not have such a position.

The approach draws on the application of complexity leadership theory to inter-organizational networks and an integrative framework for analyzing leadership functions in climate change adaptation. In the case study, the various leadership functions that are relevant in complex adaptive systems were assessed. Preliminary results of this study were presented in a paper for the MOPAN congress in Wageningen (July 2012, www.mopan2012.wur.nl/UK/).

4.5 HSDR3.5: Adaptive implementation arrangements: a learning approach towards the implementation of climate adaptation strategies

Implementing adaptation strategies is a difficult job. Developing promising strategies does not seem to be the main problem. Most problems arise when actors enter the phase before implementation and try to realize consensus about the distribution of costs and benefits, the allocation of responsibilities and risks and the formalization of agreements. The final step before implementation – the phase of drafting arrangements and signing agreements and contracts – is a major barrier for actors to get across. Each actor tries to minimize his own (potential) risks and tries to maximize the guarantees that other actors will do what was agreed.

The project aims to develop – in interaction with real-life cases – prescriptions how to organize combinations of reflexive monitoring and flexible (legal, financial and organizational) arrangements. We assume that implementing adaptation strategies can be simplified when actors attach less importance to formalizing their agreements, but put effort in developing tools for monitoring (their collaboration during) the implementation phase and rely on arrangements which can be tightened or released when deemed necessary, depending on the outcomes of the monitoring process. In two cases, we develop and test arrangements based upon this dual approach of making appointments and reflexive monitoring.

The project started in January 2012. The first stage of literature review and selection of cases is completed.

4.6 HSDR3.6: Naar een langetermijnvisie Water Ruimte en Klimaat voor waterschap Vallei en Veluwe

The Waterboard Vallei en Eem is going to merge with the Waterboard Veluwe. One of the first results of this process is a joint plan for sustainable water management, to be used as input for spatial planning.

Using the instrument of the Climate Adaptation Atlas (<http://klimaateffectatlas.wur.nl>), the project is aimed at creating a long term vision on water management. Climate change effects, social and economic scenarios and spatial developments are input for this vision. After completing an analysis of problems and challenges, two interactive map table sessions were organised. The result of these sessions is a draft spatial vision. During the remainder of the project runtime, this vision will be worked out in more detail.



4.7 HSDR3.7: Active management of Groundwater storage in Unconfined Aquifers in the Stippelberg forests (AGUA)

Climate change and water scarcity result in a growing demand for water storage in dry rural areas in the Netherlands. Temporary storage of excess water in unconfined aquifers may be an effective way of realising self sufficiency in water supply for agriculture and nature in times of water scarcity. Advantages of water storage in unconfined aquifers are optimal use of regional water resources and limiting the volume of external supply water required to fulfil the demands of land use functions.

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Figure 4:
Stippelberg area



The objective of this study is to contribute to the knowledge about the effectiveness of active management of groundwater storage in unconfined aquifers (AGUA) under the current and foreseen, future climate. In this case study (Stippelberg), AGUA is considered to be effective if both hydrological conditions for nature development and regional self sufficiency in water supply for agriculture are improved.

The project is a follow up of the business case 'Stippelberg' in project HSDR02. Research started in September 2012

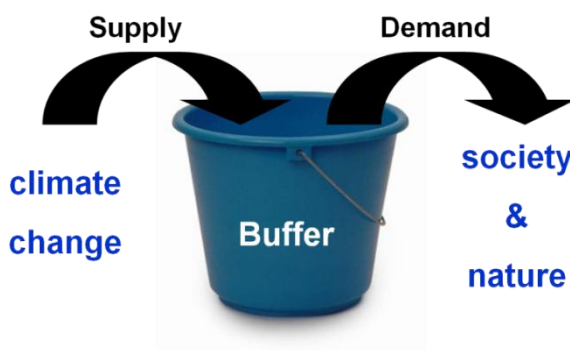
5 Towards regional adaptation strategies

Looking at the hotspot Dry Rural Areas, there are two parallel regional projects that can be distinguished. Both processes – the Deltaplan Hoge Zandgronden and Zoetwatervoorziening Oost-Nederland – aim at the same goal: sustainable water supply. Both projects have the same chain of products: problem analysis – inventory of solutions – adaptation strategy. These steps are linked to the planning of the national Delta programme, subprogramme Fresh Water Supply.

What they also share is a focus on *technical* solutions for maintaining an ample *supply* of fresh water in the future, all within existing organisational structures and based on existing land use. Less attention is given to governance issues and solutions that influence water demand (for nature, agriculture, industry and drinking water).

Research and cooperation in the Knowledge for Climate programme helps to fill this knowledge gap. In allocation funding and other means, the regional stakeholders seek for innovative solutions by participating in the CARE and Governance themes. Added to the technical knowledge already present in many waterboards and other organisations, this research helps to complete the picture needed to develop strategies that can handle the balance between supply and demand in a sustainable way.

Figure 5:
Main challenge is maintaining the balance between water supply and water demand



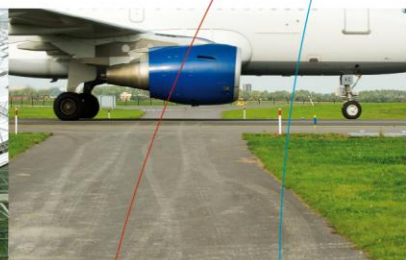
Actions in the Knowledge for Climate programme however will not result in just one strategy for the complete hotspot. Differences between the two main regions – both in the physical environment and the governance of water resources – are too big for this. Rather than one vision, the programme will provide building blocks for separate regional strategies

The first results of KfC are promising and have found their way to the regional adaptation projects. In the remains of the programme's runtime more results will follow as some of the cases and projects have only just started.



Special attention should be given to the endorsement of KfC by decision makers in the regional partner organisations. Climate as a theme is slowly sliding off the agenda. Reframing issues – like the Deltaplan Hoge Zandgronden has done in presenting climate change not as an environmental but as an economic challenge – helps, but constant monitoring of the sense of urgency is needed.

Both regional projects ZON and DHZ focus on fresh water supply. This is an important adaptation issue, but not the only relevant one in the hotspot. The challenge for KfC – and its regional counterparts - is to link issues such as biodiversity or health to the agenda of planners and decision makers, thus laying the foundation for truly comprehensive regional adaptation strategies.



To develop the scientific and applied knowledge required for
Climate-proofing the Netherlands and to create a sustainable
Knowledge infrastructure for managing climate change

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