Wageningen University – Department of Social Sciences

MSc Thesis Chair Group Public Administration and Policy

Innovative water system governance arrangements

An evaluation of three projects in which authorities and local stakeholders cooperate

Photo: Field excursion Buffer Farmers, 2013

December, 2014

MSc program: Public Administration and Policy

Name of student: Evelyne van Dongen

Specialization: Economics, Environment and Policy

Name of supervisor: Prof. Dr. Ir. K. Termeer

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Contents

Summary

In recent years, the Netherlands has been confronted with periods of extreme drought on the one hand, and waterlogging on the other. Current water management in the Netherlands is the collective responsibility of the central government, the provinces, municipalities, water boards, and freshwater companies. Governmental policy focuses on managing incidental periods of alternating drought and waterlogging. However, it is likely to be expected, that, due to climate change, periods of drought and waterlogging will intensify, occur more frequently, and alternate faster. Policy makers assume that a more 'down-to-earth' approach will contribute to the necessary flexibility to adjust the water system.

In literature, a group of theorists focuses on 'managing the resilience' of natural resources. The Social Ecological System theory, the theory of Adaptive Governance of Social ecological systems, and the institutional design principles of enhancing arrangement of self-governance of common pool resources, consider self-organizing local communities and collective learning as 'sources' (key features) for the sustainable governance of natural resources with open access.

The aim of this thesis is to find an answer to the question: "to what extent cooperative governance arrangements with local (private) stakeholders contribute to adaptive water management?"

To learn and benefit from gained experiences this research evaluates three cases in which cooperation between water authorities and private parties takes place. All cases focus on adapting to drought and waterlogging. The first case is the project Farmer, Beer and Water, initiated by private actors and supported by water authorities. The second case is the project Buffer Farmers, initiated by all stakeholders collectively. The last case is the project GGOR AHS in which the water board Waterschap Aa en Maas implements national policy for water management on regional level. The cases are situated in the operational area of water board Waterschap Aa en Maas, part of the upland sandy soils (locations above sea level).

For the analyses of the governance processes, special focus is laid on social memory, leadership, learning and congruence between costs and benefits.
The period of data collection was limited between October 2013 and February 2014. During this period, documents were analyzed, meetings were participated in, and semi-constructed interviews were conducted.

Results of this research prove, that cooperation with local stakeholders adds to address practical solutions 'at source', and increases developing strategies and measures that offer chances for expansion and adjustment of a robust water system. Adaptive co-management, in which cooperation between local and regional private actors and governmental authorities takes place, makes it possible that ecological and institutional spaces and scales are crossed. The inclusion of self-organizing communities in the governance arrangement increases the diversity of ideas and solutions and a variety of management responses. However, to balance economic and ecological goals, the governance of the common pool resource cannot be left to the self-organizing community alone. Introduction of additional incentives strengthens the effectiveness of the governance arrangement and the commitment of the stakeholders.
To make governance truly adaptive it is important to realize that this involves managing social memory, changing leadership and an ongoing learning process. Social memory evolves and is fundamental for a fruitful cooperation. The competences and power of key leaders determine the success of leadership actions. For adaptive governance, leaders are sense-makers in many ways, and manage the social memory and learning dynamics. The power distribution between water authorities and project management of self-organizing groups is ambiguous and affects leaderships actions negatively. To increase the resilience

of the governance arrangement, learning to live with change concentrates on reading the ecological system feedback, the understanding of incentives for actor groups to cooperate, learning to produce renewed social memories, and learning to reorganize power and rules to strengthen leadership of governance arrangement that includes self-organizing groups. Inclusion of scientists strengthens the objectivity of the outcomes and, therefore, makes experiments more trustworthy. Collective learning sets back barriers and creates trust for the implementation of adaptive measures.

To make the governance arrangements more effective, complementary incentives and the reallocation of power must be considered. Innovative technology and advancing knowledge give a good opportunity to delegate power, meanwhile controlling the effectiveness of adaptive measures.

1 Introduction

1.1 Background

In recent years, the Netherlands has been confronted with periods of extreme drought on the one hand, and waterlogging on the other. Even in years of average rainfall and temperature, areas that cannot dispose of external water supplies like rivers, either because there are no rivers or because the water level of the river is too low, are faced with a moisture deficiency in the soil and decreased groundwater levels, thus contributing to a declining water quality.
At other times, regions near the main rivers and lower areas may be confronted with increased water levels due to heavy rainfall, causing damage and dangerous situations (Ministry of Infrastructure and the Environment, Ministry of Economic Affairs, Agriculture and Innovation, 2012).

Current water management in the Netherlands is the collective responsibility of the central government, the provinces, municipalities, water boards, and freshwater companies. Because of the bureaucratic structure and, in consequence, the processing of these organizations, the organization of an adaptive water system (i.e. a system that is capable of a flexible and fast response to abrupt or gradual changes) is hampered (Ministry of Infrastructure and the Environment, Ministry of Economic Affairs, Agriculture and Innovation, 2012).

Governmental policy focuses on incidental periods of alternating drought and waterlogging. However, it is likely to be expected, that, due to climate change, periods of drought and waterlogging will intensify, occur more frequently, and alternate faster. (Ministry of Infrastructure and the Environment, Ministry of Economic Affairs, Agriculture and Innovation, 2012).

Periods of drought in 2003 and 2011 proved that the absence of a flexible response to gradual or sudden changes is not just a theoretical problem, but rather a practical issue. Policy makers assume that a more 'down-to-earth' approach will contribute positively to the aforementioned adaptive water system. This approach requires addressing a practical solution 'at source', and developing strategies and measures that offer chances for expansion and adjustment (Ministry of Infrastructure and the Environment, Ministry of Economic Affairs, Agriculture and Innovation, 2012).

Aiming to find out whether other forms of water governance can contribute to a robust water system, water authorities are cooperating with (local) private parties in several projects. In addition, experiments are being carried out to combine innovative technology and advancing knowledge (Ministry of Infrastructure and the Environment, Ministry of Economic Affairs, Agriculture and Innovation, 2012).

1.2 Objective and research question

This thesis focuses and evaluates three projects in which cooperation between water authorities and private parties takes place. These projects are carried out at the water board Waterschap Aa en Maas.
There are two objectives to this thesis. The first is to learn from these projects and benefit from the gained experience, so that future projects can use the success factors, while at the same time constraints can be targeted and eliminated. Secondly, this thesis aims to verify the theories of Adaptive Governance of common pool resources in these embedded cases of water management.

The general research question of this thesis is: "to what extent do cooperative governance arrangements with local (private) stakeholders contribute to adaptive water management?"

To address these questions, I will use three theories: the Social Ecological System theory developed by Berkes, Colding and Folke (2003; the theory of Adaptive Governance of Social Ecological Systems (Folke, C., Hahn, T., Olsson, P., & Norberg, J., 2005); the institutional design principles of enhancing arrangement of self-governance of common pool resources developed by Dietz, T., E. Ostrom and P. C. Stern (2003). These theories consider self-organizing local communities and collective learning as 'sources' (key features) for the sustainable governance of natural resources with open access (= governance of common pool resources) (Dietz *et al.* 2003).

1.3 Thesis outline

To introduce the theoretical framework, the Social Ecological System theory, that claims that there is a dynamic relation between the ecological and social systems, will be discussed briefly. This study is based on the concepts of social resources as stipulated in the theories of Adaptive Governance of Social Ecological Systems, and the institutional design principles of enhancing self-governance of common pool resources. In Chapter 2 the theoretical framework and concepts will be defined and explained. Chapter 3 describes the research design and methodology of this in-depth case study. The next chapter, Chapter 4 Setting the Scene, provides the context for this thesis. For this goal, insight of the area and the features involved will be provided. In Chapter 5, the three cases will be briefly introduced. The results of the research will be presented in Chapter 6. For each case separate findings will be labeled, referring to the theoretical concepts as introduced in Chapter 2.
In the final chapter, Chapter 7, I will discuss the results and draw conclusions.

2 Theoretical Framework

The biggest challenge in the management of water is managing its *'resilience'.* That is managing the extent to which the system can absorb natural and human perturbations and continue to regenerate without slowly degrading or even unexpectedly changing into less desirable states (Berkes *et al.*, 2003). Due to climate change, the dynamics of change in the water system become less predictable. Gradual and incremental pathways of climate change alternates with abrupt, disorganizing or turbulent moments of drought, waterlogging or even flooding. The water supplies, and in consequence biodiversity, livelihood, and economic progress are threatened to decline (Folke *et al.*, 2005).
In literature, a group of theorists focusses on 'managing the resilience'. Folke, Olsson, Berkes and Colding, as leading theorists in this field, claim that it is possible to make the ecological system more resilient. According to them the social and the ecological systems should not be seen separately, but must be regarded as a single entity. Contiguous to these theories, Ostrom, Dietz and Stern claim self-organizing local communities to be most suitable for managing the resilience of natural resources.
In this chapter I will describe the theories as described by these scientists, the Social Ecological System theory that focus on the management of natural resources, the theory of Adaptive Governance of Social Ecological Systems, and the institutional design principles of enhancing self-governance of common pool resources. All theories come up with features that are crucial for effective governance of natural resources. Each theory will be described separately in the next paragraphs.
In the continuation of this thesis, key features of these theories will be used to find out to what extent successes and failures in the cases examined are related to the factors as described in these theories and to what extent the projects meet the institutional design principles of self-governance.

2.1 The Social Ecological System theory

According to the Social and Ecological System Theory (Berkes, Colding and Folke, 2003), three main issues must be considered for the management of natural resources.

1. The social and ecological systems cannot be seen as isolated entities, but are mutually connected and interdependent. Therefore, the social system and the ecological system are to be considered as one 'social ecological system'. Each part of the system has a dynamic relation with the other parts (Berkes *et al.*, 2003). Figure 2.1 illustrates the dynamic relation between the elements of the ecological and the social systems. The figure is inspired by the model of Berkes, Folke, and Colding, *Navigating Social Ecological Systems* (2003). The ecological system comprises climate, water, soil, geology, and flora and fauna. The social system is a cohesive composition of policies, regulations, norms and economic activities and must be seen in a holistic way. Fragments of the social system are called 'institutions', defined by Hodgson as "a system of established and prevalent social rules that structure social interactions" (Hodgson, 1988, page 2).
   Figure 2.1 below shows the cyclic transformation of management practices that shape the ecological system. The ecological system in its turn generates system feedback. Based on the system feedback policies, regulations, and norms are adjusted. The ecological system supplies the resources to be employed in economic production and consumption. It is strongly influenced by environmental laws and regulations, economic activities, as well as by changing values in society (Berkes *et al.*, 2003).

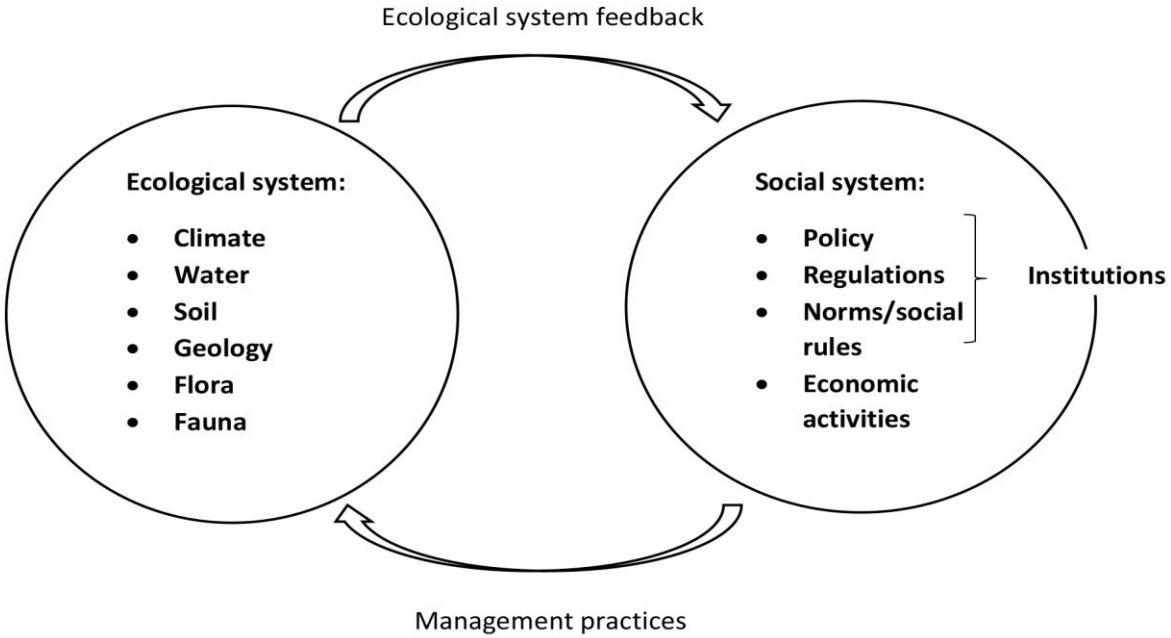


Figure 2.1 Cyclic transformation of the social ecological system

2. The management of the social part of the social ecological system focuses on managing of the ability of human actors to sustain the combined system of humans and nature in a desirable state in response to change. Management of resources can be improved by making them adaptable and flexible, capable of dealing with uncertainty and surprise, and by building capacity to adapt to change (Berkes *et al.*, 2003). So far, experiences with abrupt changes tend to be insufficient for an exact understanding of which management practices may offer the best results in enhancing the resilience of the ecological system. In addition, the consequences of (management) actions are ambiguous. As a result, adapting to sudden or gradual change is difficult. Current complex ecological and social systems and periods of rapid change force society, including science and policy makers, to shift from 'seeking exact knowledge' towards 'understanding the dynamics of the whole system' (Berkes *et al.*, 2003).

3. Existing institutional structures and ecological scales fail to match. In literature this is called 'the problem of fit' (Folke *et al.*, 2007). The issues that water management must deal with, illustrate this mismatch of scales. Drought, waterlogging and flooding as effects of climate change cross different physical scales. The causes of climate change are locally initiated, cause global effects, affect the ecological system on an extended level, but have to be solved on a local level (Berkes *et al.*, 2003)(Bulkeley, 2005). The management of resources can be improved by making organizations, networks and problem solving flexible, by including diversity of expertise and knowledge, and by balancing power among interest groups (Berkes *et al.*, 2003).

For enhancing the right fit between management actions and the ecological system, the ability to make the right links, at the right time, around the right issues, is crucial (Olsson *et al.*, 2007, p. 1).

2.2 The theory of Adaptive Governance of Social Ecological Systems

Adaptive governance uses important characteristics of collaborative management with important elements of network governance. The next part of this paragraph starts with the explanation of, for this thesis, relevant characteristics of both theories.

Collaborative governance

To address complex societal problems, an increasing emphasis on collaborative arrangements as part of governance regimes can be observed. Collaborative management is based on a negotiated structuration of a problem domain; main actors have a stake in the problem and are interdependent. Collaborative governance in general starts from a position in which negotiation partners have fundamentally different values, natures or scopes (Gray, 2007, p. 30).

Well-organized leadership actions, in collaborative governance also called 'convening', can enhance the collaborations (Gray, 2007). During the process, information exchange, sense making, decision making, negotiation, and learning take place among individual representatives (Dewulf, 2007, p. 6). Collaborative governance empowers stakeholders, claims cost-effectiveness, takes learning from the process as an important feature and is thought to be especially appropriate for the coordination of public services (Gray, 2007).

Network governance

In network governance mutually dependent actors or actor groups cooperate around a policy problem or clusters of resources (finance, authority, knowledge, relations, social capital), following a rather stable pattern of social interaction. The series of action between actors (=games, bounded by formal and informal rules) structures the changes and outcomes of the governance process. The social role of individual actors, (actor) groups, or teams within the network determines the capacity of these teams to process information, make sense of scientific data, and transform all this to an empirical context, to mobilize the social memory of experiences from past changes and responses, and to facilitate adaptive and innovative responses. The problem with governance networks is that although they can avoid the tensions of bureaucracy, they lack the accountability that hierarchical institutions do have (Klijn *et al.*, 1995). Network governance is thought to be especially well fitting for complex, unstructured problems (Klijn *et al.*, 1995).

Adaptive governance

In fact, adaptive governance involves a transfer of management rights and power to an arrangement that facilitates and promotes participation of and a shared understanding among stakeholders and social networks (Folke *et al.*, 2005, p 449). Adaptive governance expands adaptive management practices of ecological systems to address the broader social contexts that enable ecosystem-based management (Folke *et al.*, 2005, p. 444). In addition "adaptive co-management extends adaptive management into the social domain and is a way to operationalize adaptive governance" (Folke *et al*., 2005, page 448).

The desired governance in the context of this research fits best in the description given by Stoker (1998) as referred to by Folke *et al.* (2005) who states that "governance must be seen as creating the conditions for ordered rule and collective action or institutions of social coordination" (Folke *et al.*, 2005, p. 444).

The theory of adaptive governance states that the capacity of the social system to respond to and shape the ecosystem dynamics depends on the processes that generate learning, meaning, knowledge, and experience. This theory assumes that the knowledge of ecosystem dynamics and associated management practices exists among the people of various communities and is culturally embedded (Dietz *et al.* 2003).

The theory of adaptive governance identifies four critical factors that interact across temporal and spatial scales. These factors seem to be required for coping with and adapting to social-ecological dynamics during periods of rapid change and reorganization (Folke *et al.*, 2005):

1. Nurturing sources of resilience for renewal and reorganization;

2. Learning to live with change and uncertainty;
3. Combining different types of knowledge for learning;
4. Creating opportunity for self-organization toward social-ecological resilience.

All four factors depend on the social processes between and within people. Governance that uses this social component ensures the vital flexibility to be prepared for adaptation, and even take advantage of system changes. (Folke *et al.*, 2005).

2.2.1 Nurturing sources of resilience

Social memory, social capital, and visionary leadership, bridging and bridging organizations can be seen as the social resource of resilience (Folke *et al.*, 2005).
Although the elements cannot be seen as isolated entities, in the aim to explain clearly, each item will be discussed separately.

1. Social memory

Individuals do not only make rational choices, but also interpret the world around them. Values, norms, conventions, customs, practices and laws or regulations shape their 'mental maps'. Individuals acquire information about nature, technology and society from the results of past experiences. In communities, people share experiences with others and through mutual interaction these mental maps are shaped and adjusted. Communication and language facilitate the convergence of individual mental maps into the social memory of the community. When making decisions, people make a trade-off based on these mental maps. The habits and shared mental maps reproduce (informal) institutions. The collective choice is driven by social memory (North, 1993).

In accordance to this, social memory is defined by McIntosh (2000) as referred to by Folke *et al.* (2005) as "the arena in which captured experiences with change and successful adaptations, embedded in a deeper level of values, is actualized through community debate and decision-making processes into appropriate strategies for dealing with ongoing change" (Folke et al, 2005 p. 453). The evolution of social and ecological systems requires that society develops institutions that permit exchange of information across time and space to create mental models that capture the gains from change (North, 1993).

2. Social capital

Social capital refers to relations of trust, reciprocity, common rules, norms, sanctions and connectedness in institutions. Social capital is built by investing in social relationships and the social networks that emerge (Gintis and Bowles, 2002).
The social networks are informal policy communities organized across different organizational levels around a common problem or resource (area) and encourage the development of common perspectives on policy issues (Folke *et al.*, 2005). Social networks, by exchange of information, provide flexibility, novelty and innovation in times of change. Social capital is the glue for collaboration (Folke *et al.*, 2005).

3. Visionary leadership

The resilience of the social ecological system, the so-called adaptability, depends on the presence of visionary leaders. In the process of social and ecological change key individuals with visionary leadership are able to direct change and to transform governance (Folke *et al.*, 2005). Visionary leaders fabricate new and vital meanings. Key leaders can build trust, make sense, manage conflicts, link actors, initiate partnership among actor groups, identify constraints, combine and generate knowledge and mobilize broad support for change (Nooteboom, S. G., & Termeer, C. J. (2013). In times of crises and change strong leadership prepares the system for change, notices opportunity for change, navigates the transition, and, finally, charts a new direction for management (Boin *et al.*, 2013).

4. Bridging

Bridging (weak connectedness) and bonding (strong connectedness) depend on the social relationship and the strength with which the social networks of the involved stakeholders are connected. Weak connections between stakeholders stimulate learning dynamics and

are valuable for generating new knowledge; they facilitate the process of combining multiple sources of knowledge and help to identify new opportunities. Consequently, bridging enables creating a macro effect of integrated management crossing different scales (Olsson *et al.*, 2007).

5. *Bridging organization*

The involvement of a neutral party that functions as a bridging organization enables to detect social and ecological drivers and stimulates comprehensive and effective responses to changes in the social ecological systems (Olsson et al, 2007). This bridging organization, having the same role as the convenor in collaborative governance, finds common ground, frames the problem, structures and designs the negotiation process, handles conflicts and brokers between stakeholders (Dewulf, 2007).

2.2.2 Learning to live with change and uncertainty

The unpredictable and self-organizing properties of complex ecosystems and associated management systems cause uncertainty over time. To adapt to changes in social and ecosystem dynamics, understanding of these changes should continuously be updated. Learning increases the capacity for innovation and renewal. Robust adaptive strategies do not only allow for change, but also take advantage of it (Folke *et al.*, 2005).
Learning involves following practices that evoke change, practices that survive change, and practices that nurture sources of reorganization. Expressed in terms of the Social Ecological System theory, learning focuses on generating knowledge of ecosystem dynamics; 'reading' environmental system feedback, understanding social incentives for generating knowledge, and gathering knowledge of adequate governmental actions (Folke *et al.*, 2005).

In adaptive governance, learning is 'an ongoing process of learning by doing'. For the continuous updating of understanding, policies become hypotheses and management actions become experiments to test those hypotheses. To respond to ecosystem changes, the ongoing learning 'experiments' need to be monitored, evaluated and adapted over time (Dietz *et al.*, 2005).
The exchange of outcomes and effectiveness of actions is referred to as 'social learning', and 'institutional learning'. Institutional learning is the knowledge exchange by presenting outcomes of performed experiments. As such, institutional learning contributes to building social memory that shapes future decisions. *Best practices* are positive experiences that should be taken as an example and used on an extended scale to adapt to changes of the ecological system. At the same time, outcomes (re)shape mental models, objectives, social norms and underlying assumptions, and, therefore, social learning on a deeper level of awareness. Social and institutional learning are mutually connected and function as a double loop, that intensifies learning (Blann *et al.*, 2005).

2.2.3 Combining different types of knowledge for learning

To enhance the capacity for understanding, traditional and scientific knowledge systems should be combined.
Local (indigenous) communities interact over a long period of time and on a daily basis with the environment for their benefit and livelihood. Based on their experiences, local communities build traditional, ecological knowledge (Berkes, 2004). Self-organized local responses of communities, proved to have the capacity for adaptation to environmental change. This traditional knowledge is culturally embedded and is of significant value to the management of the ecosystem (Berkes, 2004).
In adaptive governance, scientists, become active participants in the learning process; different learning environments are used, and local actor groups are included in the experiments.
Combining different knowledge systems decreases the problem of imperfect (=unequal and/or incomplete) information necessary for management, and supports risk sharing between stakeholders. Working partnership between resource users and management (experts) provides an opportunity to improve actions (Berkes, 2004).

2.2.4 Creating opportunity for self-organization

In adaptive governance, besides inclusion of scientist and the boarder network of stakeholders, stimulating participation of communities is regarded a critical factor for adapting to change (Folke *et al.* 2005).

Self-organizing communities, community-governance, and self-governance are all different terms for the same concept. Self-governance is the collective action and collective decision-making of a group of people that interact directly, frequently and in multi-faceted ways. In this process, actors take responsibility in finding solutions for societal problems (Ostrom, 1990). The criteria for successful self-organization will be illuminated in paragraph 2.3 of this chapter.
Self-organizing communities use strong social features and conditions to govern. Due to their practical engagement, community-based institutions can apply informal rules for compliance (social penalties and group pressure), traditional knowledge, face-to-face contacts, short communication lines, strong social networks and assigning value of the environment for livelihoods (Berkes, 2004).

2.3 The Institutional design principles of enhancing self-governance of common pool resources

Water as a natural resource is called a 'common pool resource' (CPR). Common pool resources are characterized by one person's use subtracted from another person's use; because of its open access for users it is difficult and costly to exclude certain users; because it is scarce, a resource might become exhausted and even disappear (Ostrom, 1990).
Expressed in terms of property rights and rivalry, common pool resources are non-exclusive and at the same time rival (Gardner & Walker, 1994). If the community that uses a specific resource manages it carefully, continuous exploitation might be possible. If not, the common pool resource might collapse. This phenomenon is described by Harding (1968) as 'The tragedy of the commons' (Hardin, 1968).

Elinor Ostrom, Nobel prize-winner for economics and scientist in the field of governing the 'commons' (= a general term for shared resources in which each stakeholder has an equal interest (Ostrom, 1990)) defines self-governance as the capacity of local entities to govern themselves (Kooiman, 2003, p. 79). She claims that effective governance of the commons is easier to achieve if the governance meets the following criteria:

- ✓ The resources and the use of the resources by people can be monitored and the information can be verified and understood at relatively low cost;
- ✓ Rates of change in resources, resource-user populations, technology, economic and social conditions are moderate;
- ✓ Communities maintain frequent face-to-face communication and dense social networks;
- ✓ Outsiders can be excluded at relatively low cost from using the resource;
- ✓ Users support effective monitoring and rule enforcement.

(Dietz *et al.*, 2003, page 1908).

To address the adaptive resource management in the social ecological system, the institutional design principles of enhancing self-governance of common pool resources as formulated by Dietz, Ostrom, and Stern (2003) and adjusted by Termeer *et al.*, (2013) for heavily regulated fields, can be used:

1. Clearly defined boundaries: the resource in question should be clearly defined (stocks, flows, and processes being governed). In addition, it should be made clear exactly who is and who is not allowed to use the resource. Information about resources and participants should be congruent with decision maker's needs, contain information about timing and content, interests and values;
2. Congruence between costs and benefits: the investments that participants are required to make should be proportional to their gains from the arrangement and equal for all of them. Uncertainties must be 'calculated' and decisions making is

based on trade-offs. For this trade-off social and financial values should be taken into account;
3. Collective-choice arrangements: governing the use of collective goods should be well matched for local needs and conditions and flexible enough for resource users to comply with. Flexibility, in this context, means the ability to be prepared for change, a continuous update of understanding, the adaption of innovative knowledge and the adjustment of agreements and rules over time;
4. Monitoring: a thorough monitoring system should be implemented to avoid perceived inequalities in costs and benefits. In addition, effectiveness of actions and behavior should be monitored. A good infrastructure should facilitate the effective communication of outcomes. Inclusion in the dialogue of scientists, resource users, and an interested public that is informed by analysis of key information, provides the transparency and accountability that is crucial for cooperation;
5. A graduated system of sanctions is used: all participants should agree with the procedures and consequences that follow when someone breaks the rules;
6. Conflict-resolution mechanisms: disagreements should be resolved in a low-cost and orderly manner. Community members have free access to conflict resolution mechanisms. Inducing rule compliance can make use of subtle social sanctions or financial instruments (ballots and polls);
7. Minimal recognition of the right to organize: local, regional and national governments should acknowledge the rights of the self-governance collective to create their own institutions and rules. Formal government should facilitate key features and reallocate authority;
8. Nested enterprises: if the self-governance arrangement concerns a larger resource or area, then it would be useful to create smaller, 'nested' enterprises. Institutional arrangements (meeting point 1 to 7) must be nested in multiple layers.

2.4 Synthesis of concepts

To make the water system resilient, flexibility of cooperative arrangements is crucial. In the former part of this thesis, based on the theory of Adaptive Governance of Social ecological systems and the institutional design principles of self-governance of common pool resources, features that contribute to a successful adaptive governance have been formulated. Figure 2.2 presents how these features distilled from these theoretical concepts can be combined.

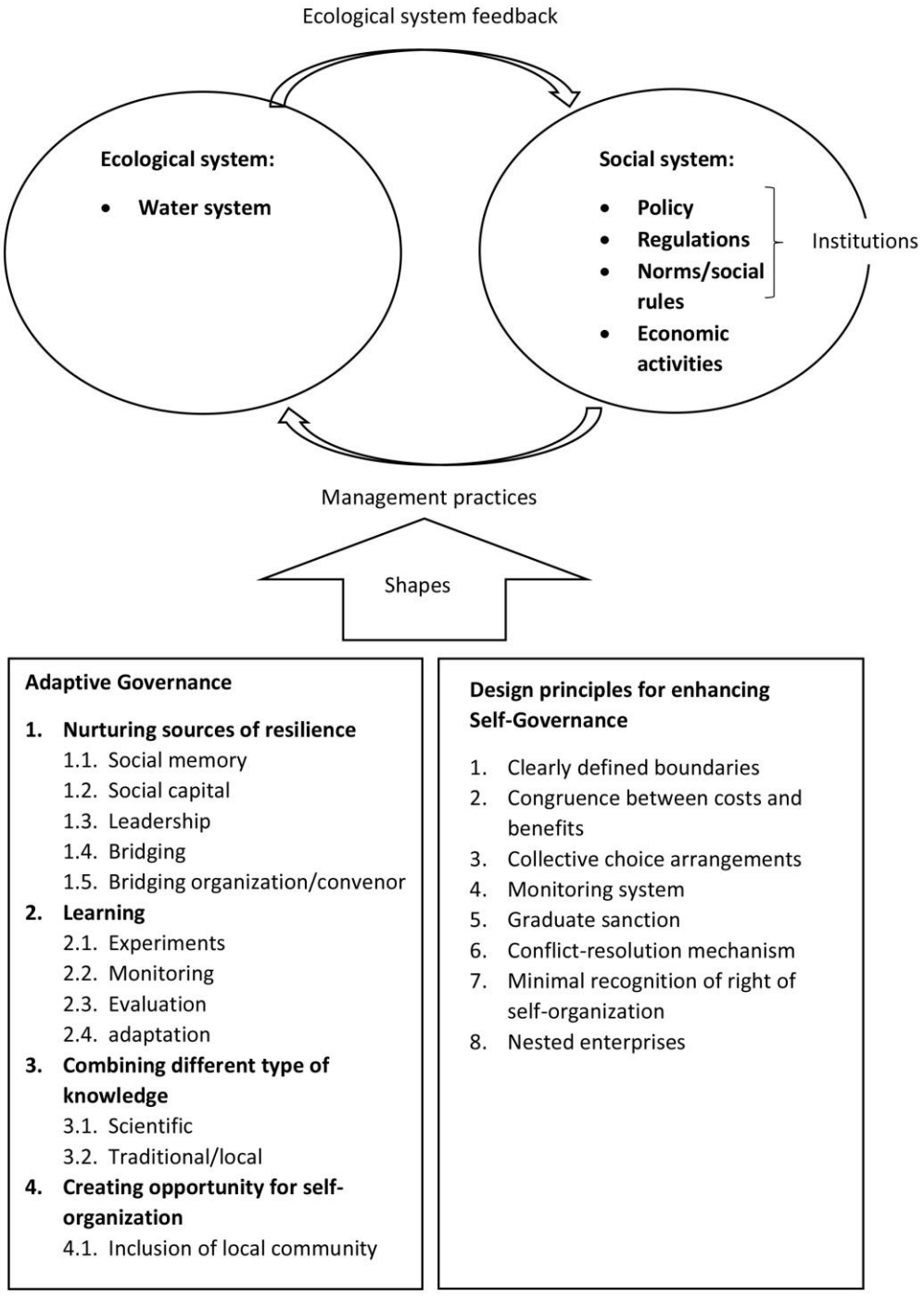


Figure 2.2 Synthesis of concepts and features for adaptive cooperative arrangements based on the theories of Berkes et al., (2003), Folke et al., (2005) and Dietz et al., (2003)

3 Research Methodology

This thesis will focus on the four criteria social memory, leadership, learning and congruence between costs and benefits, as the driving forces behind adapting to ongoing change. Figure 3.1 presents how the research is operationalized.

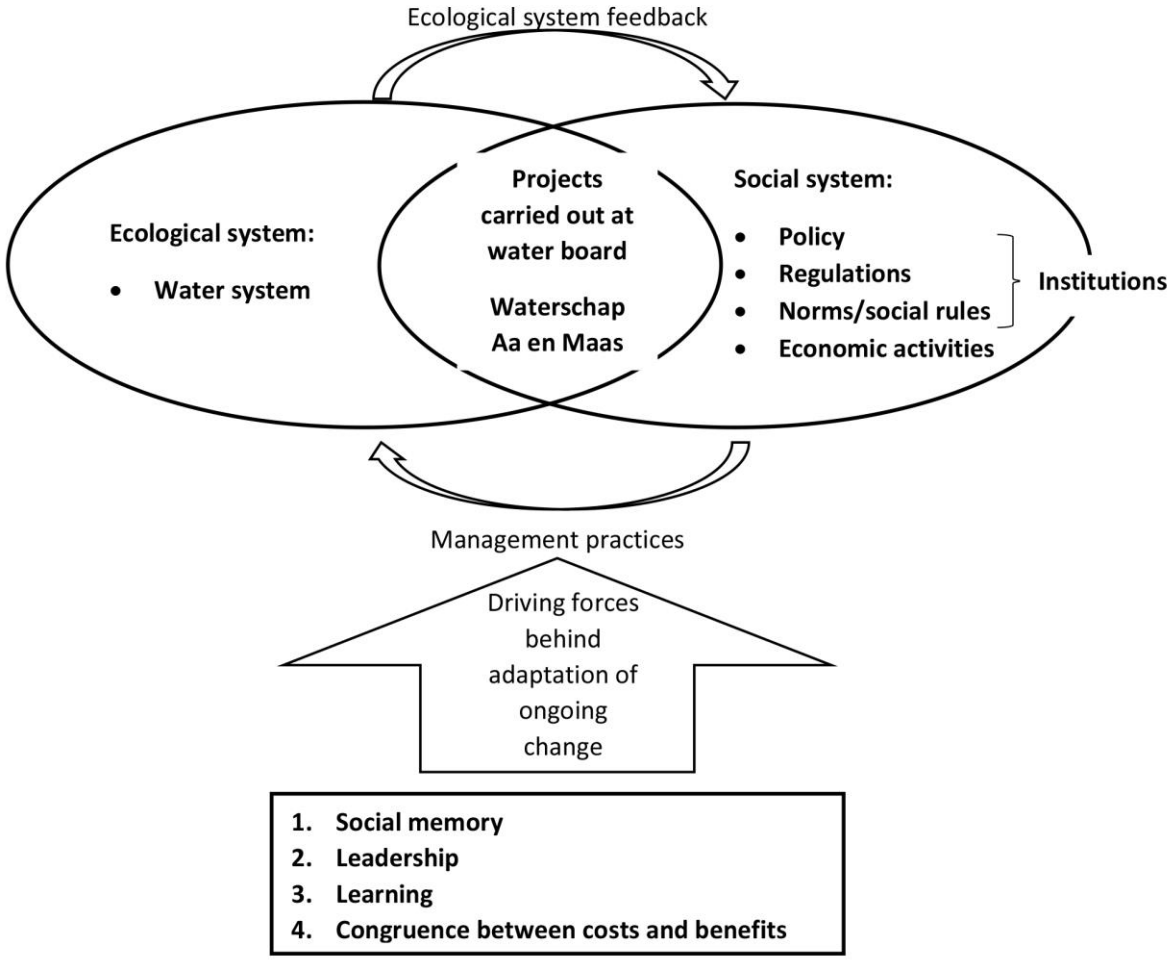


Figure 3.1 operationalized research

3.1 Research design

To find out to what extent cooperative governance arrangements with local (private) stakeholders contribute to adaptive water management, this research focuses on and evaluates three different projects in which cooperation between water authorities and private parties takes place. All projects are carried out at the water board Waterschap Aa en Maas aiming to make the water system more flexible by addressing practical solutions 'at source', and trying to develop strategies and measures that offer chances for expansion and adjustment.

The first selected case is the pilot project 'Farmer, Beer and Water'. In this project, water authorities, local agrarians and Bavaria Brewery cooperate to diminish effects of drought for agrarians by reusing the process water of the brewery on the one hand, and increase water quality by the deployment of new technologies on the other. The initiative in this project is primarily taken by the private stakeholders. This pilot project is also taken as an example for launching water governance strategies on a subnational level.

The second selected case is the pilot project 'Buffer Farmers'. In this project local agrarians, science and the water board Waterschap Aa en Maas cooperate to test measures that contribute to water retention as a solution for desiccation problems. This project was put on track after the provincial drinking water company Brabant Water, moved the place for subtraction of groundwater for drinking water needs to another area. This moment was chosen by all stakeholders collectively to develop alternative water management arrangements and measures. Furthermore, this project has been selected as an example for launching water governance strategies on subnational level.

The third case is the project 'Optimal Ground and Surface water Regime agriculture' (Gewenst Grond- en Oppervlaktewater Regime Agrarische Hoofdstructuur, in Dutch abbreviated as GGOR AHS), hereafter called 'GGOR AHS'. Contrary to the former two projects, this project was initiated by the water board Waterschap Aa en Maas. Water board Waterschap Aa en Maas is responsible for the implementation of the national water management policy on a subarea level. The goal of this policy is the reduction of the use of surface or groundwater for irrigation and reduction of waterlogging. The ambition of this policy is to contribute to long-term solutions for climate change. The national policy prescribes a step-by-step process management to develop and implement 'smart' solutions on an operational level. To this aim, water authorities cooperate with local (private) parties. The starting point for measures in this project are formulated climate scenarios.
Table 3.1 summarizes the characteristics of the cases selected.

Table 3.1. Characteristics per case selected

Characteristic	**Case**		
	Farmer, Beer and Water	*Buffer Farmers*	*Optimal Ground and Surface water Regime agriculture (GGOR AHS)*
Initiative for cooperation arrangement	Agrarian and Brewery	Drinking water company Brabant Water	National government
Participants	Private stakeholders, water authorities	Agrarians, water authorities	Water authorities, agrarians, parties for nature conservation
Goal	Reuse of process water	Develop effective strategies for climate adaptation for the agricultural areas in the upland sandy soils	Optimization of fresh water use
Inducement	Obligation for building a new sewage installation	Subtraction by drinking water company of ground water, causing drought	Implementation on subarea level of National water policy

3.2 Data collection

The period of data collection was between October 2013 till February 2014.
To create triangulation, different data sources and methods of data collection are being used.

1. *Content analysis*

Documents and literature related to the subject of this thesis were being used. Documents on national and regional water policy and regulations, and agriculture policy were consulted. In addition, technical information about the water system itself and measures to adjust the water management were analyzed.

Finally, project plans and reports of previous meetings (e.g. 'kitchen table' meetings between agrarians and employees of the water board Waterschap Aa en Maas to inventory constraints in the water system), were studied.

2. Observations

For the data collection, I participated in four meetings. In the project Farmer, Beer and Water I joined an in-depth meeting at Bavaria Brewery during which stakeholders (Bavaria Brewery, local agrarians, water authorities, project managers of the agrarian association and water board Waterschap Aa en Maas and a hydrologist) discussed, based on factual knowledge, results obtained so far, possible solutions and measures to be implemented, constraints to be solved, and future steps to be made for progress.
In the project Buffer Farmers I joined a field excursion during which the effects of the implementation of a level sent drainage system were presented by experts (a scientist, drainage experts, a hydrologist and an experienced expert agrarian) and discussed with colleague agrarians. The meeting ended with an opportunity for informal social interaction between participants.
I joined two meetings related to the GGOR AHS project. The first meeting was a creative workshop session during which local agrarians, hydrologists, ecologists and fieldworkers of water board Waterschap Aa en Maas cooperatively tried to find solutions for constraints in the water system on area level. Priorities were given and feasibility determined as far as possible. After this meeting employers in charge of water board Waterschap Aa en Maas calculated and evaluated the options based on actual water policy, and available budgets. In the next feedback meeting, the chosen measures were presented and discussed. In this meeting a final list of measures was agreed on and formally authorized.
In the presence of these meetings I observed the social interaction between actors and actor groups, tried to become sensitive to the power relations between stakeholders and felt the atmosphere people were working in. During the meeting I took notes of remarkable quotes and afterwards I made a summary of my main observations.

3. Interviews

A third method of data collection was to conduct in-depth semi-structured interviews. The interviews focused around topics that were situation-specific, process-related or that illustrated the institution context. The interview guide is inspired by the topic list, as constructed by Yaffee *et al.*, (1997) (see Appendix I), was previously used in the research by Olsson *et al.*, (2007) to analyze the (adaptive) governance of the Kristianstads Vattenrike Biospere Reserve and captured all relevant criteria. For each interview a global questionnaire with main questions, based on the topic list mentioned above, was tailored in accordance with the position, role or expertise of the respondent.
To create triangulation of data sources, representatives from each stakeholder group actively involved in the projects were selected. The selection of participants for these interviews was based on the recommendation of former respondents. The first respondents that were selected were formal leaders and project managers, because they have a good overview of the system they operate in. The second group of interviewees represented a selection of twenty two persons working on various functional levels, like in the agro-sector (agrarians and agrarian business association), Bavaria brewery, municipality, province, and water board Waterschap, and science or consultancy. All interviews were recorded. Appendix II presents an overview of people being interviewed and meetings being joined.

3.3 Data analyses

The three cases will be analyzed, based on the four criteria: social memory, leadership, learning and congruence between costs and benefits. Although the sources of resilience (social memory, leadership and learning) are no isolated entities but instead interact, for the analysis of results, effort will we given to allocate the results as much as possible to a relevant criterion. The criteria are operationalized as shown in table 3.2. Next, based on these four criteria, the strengths and weaknesses of each project will be identified and a comparison between the projects will be made.

Table 3.2. Indicators per criterion

Criteria	Indicators
1. **Social memory** *Provides context for social response and helps the Social Ecological System to prepare for change.*	• The *content* and existence of shared mental maps about adaptation of experiences with changes, or the creation of mental models that capture the gains from change, or the captured collective experiences with resources and ecosystem management • The *embeddedness* of shared mental maps in cross scale, social networks; a collective internalized image based on former collective experiences that affects the trust relation for cooperation.
2. **Leadership** *Navigating the process through turbulent times*	• The *identification of leaders* and *type of leadership* (e.g. visionary leadership, or convenor) they perform • The *leadership acts* (e.g. fabricating new and vital meanings, trust building, sense making, managing conflicts, linking actors, initiating partnership among actor groups, identify constrains, combining and generating knowledge, mobilizing broad support for change, noticing opportunity for change, navigating the transition, charting a new direction for management)
3. **Learning** *Gathering knowledge via the ongoing process of learning by doing for the continuous updating of understanding*	• Identification of *phases* in the learning process (carrying out experiments, monitoring of results of actions and behavior, evaluation of effectiveness and adaptation of best practices on extended scale), • The presence of a good *infrastructure* that facilitates communications of outcomes (in advantage of users and interested broader public) • The inclusion of *scientists in the dialogue*
4. **Congruence between costs and benefits** *The investments that participants are required to make should be proportional to their gains from the arrangement and equal for all of them.*	• *Trade-off* being made based on financial costs and benefits and other experienced (social) incentives (depending on risk management, mental maps, trust, sense of urgency).

4 Setting the Scene

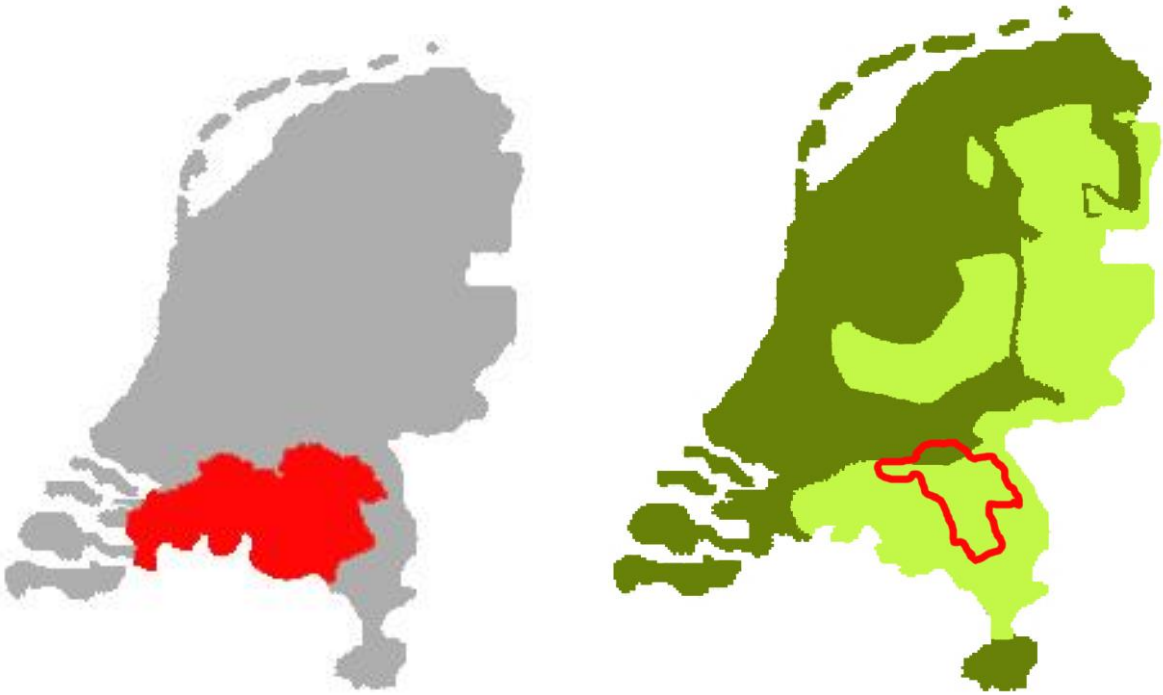
The cases in this study are situated in the operational area of water board Waterschap Aa en Maas, a region in the province of North Brabant part of the upland sandy soils (locations above sea level). The water management in these areas is challenged because of climate change.
For a better understanding the outcomes, in this chapter the context of this study's cases, which is identical for all three cases, will be defined. This chapter will ensue the aspects from the theory of Adaptive Governance of Social Ecological Systems as presented in *Chapter 2 Theoretical framework*. Because climate change challenges adaptive governance, I will start this chapter with the description of the effects of climate change on the water system in paragraph 4.1. In the next section, paragraph 4.2, the water system with its elements and its location will be designated. As the adaptive capacity of the social ecological system is determined by the ability of human actors to sustain the combined system of humans and nature, paragraph 4.3 labels the actor groups involved. Paragraph 4.4. exemplifies the policy and regulations crossing different governmental levels and places. This paragraph illustrates the complex policy field the water management is placed in. The last section of this chapter, paragraph 4.5, recounts the strategic measures as part of the management practices to be taken for a robust water system management design.
The projects in this study focus on adapting to drought and waterlogging, and therefore the issues that are related to flooding will be disregarded during the further discussion in this section. Appendix VI gives an overview of all terms and abbreviations translated from English into Dutch of all names and abbreviations of organizations and policies used hereafter.

4.1 Climate change affecting the water system

It is likely to be expected that, due to climate change periods of drought and waterlogging will intensify, occur more frequently, and alternate faster. Warm, dry summers will cause a reduction of the fresh water reserves and a decline of ground and surface water levels. As a result of rainy summers and heavy rainfall, temporary waterlogging, on a smaller or larger scale, should be taken into account (Ministry of Infrastructure and the Environment, Ministry of Economic Affairs, Agriculture and Innovation, 2012).
In the Netherlands, experts state that in the year 2050 the most likely scenario is that of an increased number of periods of drought. Due to periods of drought, compared to 2010 the demand for irrigation will rise with about 50% per summer period; the demand for water will increase with 15-35% on average; water discharge of the Meuse river will decrease by 50% on average; the groundwater levels will decrease by 10 to 20 cm on average; the discharge of freshwater by streams will decrease with 20 to 50%, and desiccation will increase with 20 to 30%. In addition, due to a rising water temperature, water quality will decline (Rosenboom *et al.*, 2011). Appendix III shows the above-mentioned changes presented in a map of the Netherlands. The first map displays the current situation, during a dry and warm year, the second map displays the expected freshwater situation in 2050 during a dry and warm year. Such situations are to be expected to occur once every ten years.
Notwithstanding this expected scenario of drought, demonstrated by the heavy rainfall during the summer of 2014, the effects of heavy rainfall must also seriously be taken into account. With regard to the aspect of waterlogging, the upland sandy soils for the water management should buffer the water coming from streams and must be prepared on the lower parts to face a discharge of high water coming from the major rivers (Ministry of Transport, Public Works and Water Management, Housing, Spatial Planning and the Environment and Agriculture, Nature and Food Quality, 2009).

4.2 The water system

Figure 4.1 illustrates where the area of water board Waterschap Aa en Maas is located on the map of the Netherlands.



Left: the location of North Brabant (red) in the Netherlands
Right: the location of Water board Waterschap Aa en Maas (red outline) on the soil map of the Netherlands (light green: upland sandy soils)

Figure 4.1 Location of the province North Brabant the soil map of the Netherlands and the location of water board Waterschap Aa en Maas

The water system elements
The water system of water board Waterschap Aa en Maas is part of a water system dominated by the rivers' catchment basin of the Meuse and the groundwater system. The rivers' catchment basin is divided into smaller sub-basins. The main water system (Meuse, Wilhelmina Canal, and Zuid-Willemsvaart) and the regional water system (many small and little streams, like Leigraaf and Goorloop, river Aa, river Dommel) are interconnected at several locations. In the event of excessive rainfall, the regional system combined with groundwater on both deep and shallow levels, drains into the main system, while the regional system can be fed by the main system in periods of drought.
The operational area of water board Waterschap Aa en Maas is divided in subareas. Some subareas are categorized as suffering from drought, some suffer from water logging and some suffer from both over time (Rijkswaterstaat, 2011), (Waterschap Aa en Maas, 2009).

Figure 4.2 illustrates the total area covered by water board Waterschap Aa en Maas; its water elements, towns and villages.

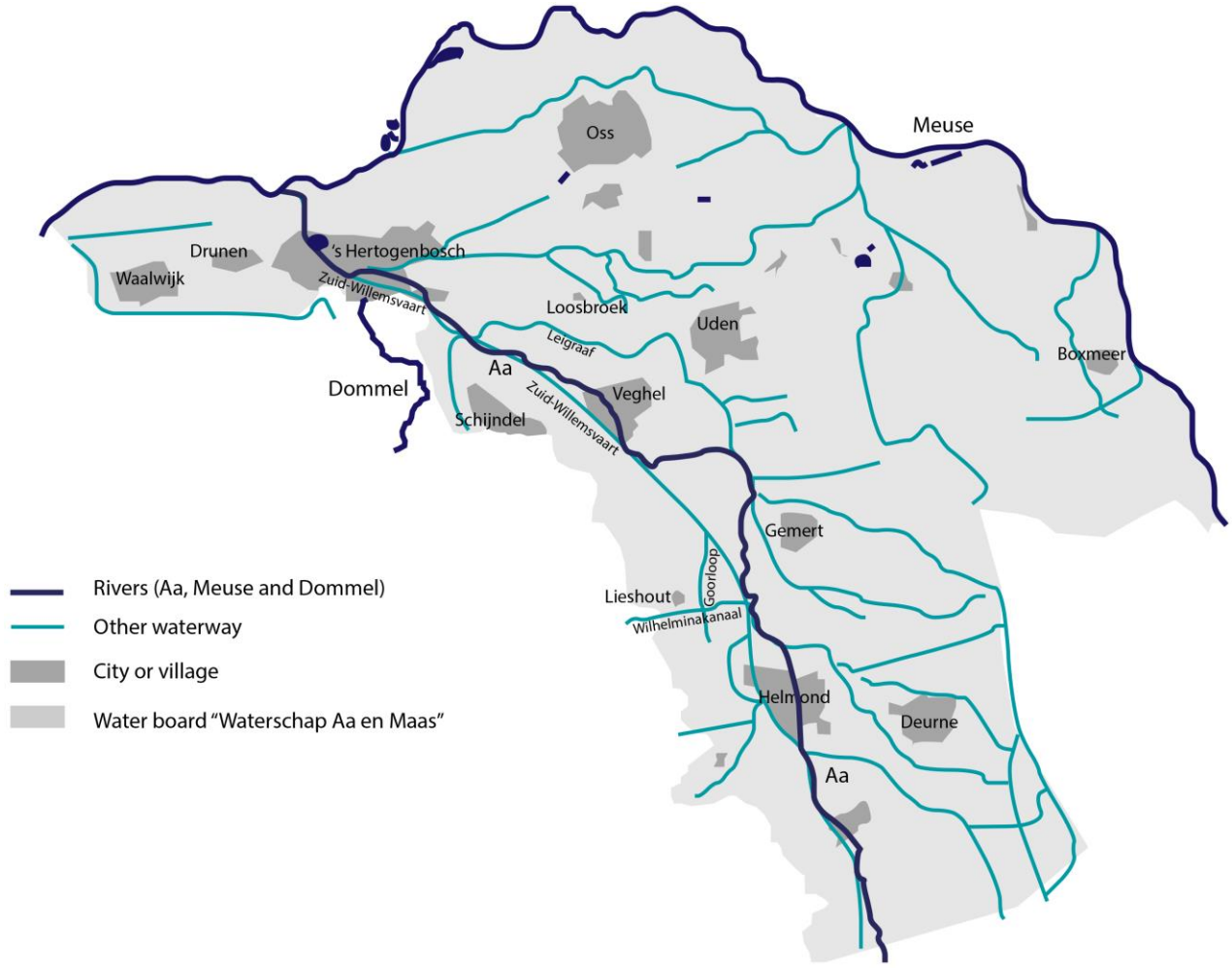


Figure 4.2 Management area water board Waterschap Aa en Maas

Managing water quality and water quantity
The water management consists of managing water quality and managing water quantity. Freshwater quality can be defined in terms of concentrations of nutrients, phosphates, metals, toxins and salt, visual appearances (transparency) and the effects on water organisms and plants. Differences in quality are influenced by a series of factors: the water composition changes depending on its origin and on the land use, soil type and groundwater flow resulting in seepage or infiltration in the area where the water originates from. Finally, water quality is closely linked to the quantity of water: pollution is less noticeable when highly diluted (Rijkswaterstaat, Ministry of Infrastructure and the Environment, 2011).
In the operational area of water board Waterschap Aa en Maas the goals on the subject of water quality are formulated in line with the Water Framework Directive. For each water body in the operational area, the ecological goals to be achieved have been defined. To this aim, the potential and goals are divided in terms of flora and fauna, and physical-chemical standards (Beekman, *et al.*, 2008).

Water quantity is related to the surface and ground water. The quantity can be considered too low (experienced drought) or too high (experienced flooding or waterlogging) differing in time and space. Managing water quantity consists of permanent anticipation and adaptation of gradual or abrupt changes.

4.3 Actors and organizations

The water management is a collective action of landowners and water authorities, supported by science. In the area of Waterschap Aa en Maas 69% of the total soil and land use is for agricultural purposes, 14% for nature conservation (mostly woods) and 17% for build-up areas

(industry and business, cities, villages and infrastructure) (Waterschap Aa en Maas *WBP*, 2009).
In the Netherlands, the access to fresh water resources is open for society via, and regulated by, the national government, provinces, municipalities and water boards, and drinking water companies.
In the next part of this section, actor groups related to the water management process will be discussed. For this purpose, for each actor group the 'stake in the problem' or interests , the fundamental nature, value or scope, and the resource they possess and embay into the governance process will be explored. These features refer to the theory of adaptive governance previously discussed in Chapter 2 Theoretical Framework.

Agrarians
The agrarian sector is the main land user. Agricultural activities in this area consist of animal husbandry (dairy and breeding), agriculture and horticulture.
In the past, the agricultural fields in this area were developed by grubbing heath and moor. The natural fertility of these sandy soils is poor. Because of the low humus percentage, the absorption capacity of these sandy soils is low, which in its turn results in a quick leaching of fertilizers.
In former times, farmers owned plots in both high and low locations. In consequence, water management issues could be solved within one farm. Due to land consolidation, this now has to be settled among landowners collectively.
In the seventies, agriculture was strongly intensified, resulting in environmental pollution in terms of carbon oxide emission, pollution of ground and surface water with residues of fertilizers (nitrates and phosphor) and residues of pesticides.
After a period of drought in 1976, agrarians massively turned to irrigation to save their crops. Since the mid-90's irrigation has become common practice. In the decision-making process, agrarians make a trade-off between revenues on the one hand and crop losses and production costs on the other.

Related to the agricultural activities, different tendencies can be observed. Firstly, between 2000 and 2012 the land use for agricultural purposes diminished by 8%. Continuation of this trend is to be expected. At the same time, a shift from less intensive cultures towards intensive cultures can be expected (e.g. a shift from agriculture towards horticulture). As a result, the water demand for irrigation will increase. Secondly, as a result of the implementation of innovative techniques and increasing costs for diesel fuel, water use will decrease. Finally, due to the new irrigation policy (increase of flexibility), the ground water demand will probably grow by 5% on average. It is to be expected that the overall use of ground water for agriculture will increase (Janssen, 2014).

The agricultural sector has access to financial resources via the Common Agricultural Policy 2014-2020 (CAP). The CAP formulates three long-term objectives; 1) viable food production, 2) sustainable management of natural resources and climate action and 3) balanced territorial development. The CAP formulates the joint provision of public and private goods. The policy enables to reward "the services they deliver to the wider public, such as landscapes, farmland biodiversity, climate stability even though they have no market value" (European Commission, 2013, page 5). The CAP budget is available for Direct Payments and market-related expenditure (Pillar 1) and for Rural Development (Pillar 2). Direct payments encourage introducing practices that are beneficial for the environment and climate in most of the utilized agricultural areas (European Commission, 2013).

Southern Agricultural and Horticultural Association
Most agrarians are united in the Southern Agricultural and Horticultural Association (in Dutch Zuidelijke Land- en Tuinbouworganisatie, abbreviated ZLTO). ZLTO was founded 110 years ago by farmers to defend their interests. Consequently, agrarians have a long tradition of cooperation. The agrarian association supports and stimulates agrarians in developing a sustainable position both in the market and in society. ZLTO participates in innovative and strategic projects, as the formal representative for agrarians in launching arrangements with the government, private parties and educational institutes. ZLTO is situated in the southern

provinces of the Netherlands, counts 17.000 members and is divided into to 64 departments, each connected to a specific area. Each department has its own board, formed by local farmers. Each board member has one or more specific topics in his portfolio. The departments form close-knit local networks for agrarians. The central board, project managers and staff, facilitate local departments in their activities (ZLTO, 2012).

Organizations for nature conservation
Active organizations for nature conservation in the province of North Brabant are the Institute for Nature Education and Sustainability (in Dutch abbreviated IVN) , the Forest Service (in Dutch Staatsbosbeheer) and North Brabant Landscape Foundation (in Dutch Stichting Brabants Landschap). The last mentioned organization is not involved in the cases of this study.
Parts of the area are indicated in the scope of the Natura 2000 policy (Ministry of Economic Affairs, 1998), and the Ecological Network. The Ecological Network consists of existing areas for nature conservation, including agricultural areas that offer the opportunity for agricultural nature conservation and 'robust linkages'.
The fragmented plots for nature conservation, spread throughout the area, are linked by a Wildlife corridor (In Dutch Ecologische Verbindings Zone abbreviated EVZ). The surface water system with streams and banks, because of their natural connectedness across spaces, is an obvious instrument for transition of species. Figure 4.2 illustrates the target picture of such a Wildlife corridor.
Organizations for nature conservation strive for good quality water and wet soils to maintain diversity of flora and fauna. Plots for nature conservation and agrarian plots many times lay side by side. This situation demands an ongoing balancing of conflicting goals and interests between both.

Figure 4.2 Target picture of the surface water system as a Wildlife corridor (Waterschap Aa en Maas)

Industry and business
Industrial and business activities in the area mainly comprise agro-food businesses and related services, and the supply industry. Many (industrial) businesses are united in business clubs. Companies provide employability and economic welfare in the region and are dependent on fresh water for the production process including the discharge of (polluted) process water. Especially the food industry urges good quality ground or drinking water for its production process. According to economic rules a positive return on investment is necessary for continuity and innovative reinvestments. As a result, the outcomes of the trade-off between costs and benefits (including image building) dominate in business. Nonetheless, based on a social responsibility, the mission statement of many companies claims to make an effort to contribute to a sustainable environment.

Citizen and build up areas
Fresh water is vital for a good living. Citizens use fresh water for consumption and flushing. Currently, the area of water board Waterschap Aa en Maas is inhabited by 700.000 people. A growth of its population and increased urbanization is to be expected (Waterschap Aa en Maas *WBP*, 2009). Water management in the buildup areas falls within the authority of the municipalities in cooperation with water board Waterschap Aa en Maas and the province of North Brabant. For these areas a separate water management plan is being developed. In the further discussion of this thesis the urbanized areas will be disregarded.

Directorate for Public Works and Water Management
The national government (Ministry of Infrastructure and the Environment) has the authority for making laws and legislation and manages the national water systems and waterways. This work is executed by the Directorate for Public Works and Water Management[1] (in Dutch Rijkswaterstaat).
The Meuse, the Wilhelmina Canal and the Zuid-Willemsvaart, are part of the state-owned and operated, main commercial waterways network (Rijkswaterstaat, 2011). The main waterways must always be passable and safe, and journey times by water must be reliable.
The mission of the Directorate for Public Works and Water is to protect (land) from flooding, provide sufficient and good quality water and the construction and maintenance of infrastructure for water transport (Rijkswaterstaat, 2011).
Water management of the canals in North Brabant is laid down in a water agreement that aims to ensure that the supply and discharge of water is distributed equally among the areas managed by the regional water boards. The Directorate for Public Works and Water uses a sequence of priorities in the water management. Safety and prevention for irreversible damage dominates over utilities for drinking water and power supply, which takes precedence over small-scale high-quality use (like process water and temporary irrigation of capital-intensive crops). The last category consists of other economic activities like shipping, agriculture, nature, industry, water recreation and lake fishing (Rijkswaterstaat, 2011).
The Directorate for Public Works and Water Management cooperates with national and international authorities in river catchment areas and seas in the management for ecologically clean and healthy water. To this end four aspects are focused on: chemical quality, physical-chemical quality, hydro-morphological quality, and ecological basic quality (Rijkswaterstaat, Ministry of Infrastructure and the Environment, 2011).

Drinking water company Brabant Water
Drinking water company Brabant Water is one of the regional water authorities. Brabant Water extracts, purifies and distributes fresh water at the lowest possible cost and with a high supply for consumption and production. Therefore, water extraction takes place in a safe, sustainable and healthy way. 100% of the drinking water comes from groundwater sources at deep levels. Main concern is the protection of these resources from pollution. Drinking water company Brabant Water cooperates with agrarians, businesses, municipalities and citizens for a sustainable and chemical-free management of groundwater extraction areas.
The company owns areas for nature conservation that are being used for groundwater extraction.
Brabant water compensates for financial losses due to drought damage caused by water extraction.
The Province of North Brabant and 60 municipalities in the province of North Brabant are shareholders of the company (Brabant Water, 2014).

Province
The province is the director of the regional water policy. As such the province sets frameworks and develops a strategic policy to create a robust water system while supporting a sustainable environment. To be specific, the province has the authority to:

1. protect surface and ground water from pollution;
2. diminish the desiccation of areas for nature conservation;
3. license ground water extraction;

[1] (Missie Rijkswaterstaat)

4. draw attention to the water management in spatial planning.

For a successful water management the province coordinates cooperation with international and regional water authorities, the agricultural sector, organizations for nature conservation and businesses. For an effective implementation of plans, the province links water management programs to spatial planning programs and strives for an integrated approach (Provincie-Noord-Brabant, 2013).
The province stimulates the distribution of knowledge by the Water atlas, a free web application with information about divergent policies and (geographic) characteristics of the water system.
The province deposits financial resources for the implementation of the Delta program on regional level; to support programs for the improvement of the water quality, for the remediation of contaminated sediments in water elements, for the reconstruction of the water system and for monitoring the quality and quantity of surface and ground waters.
The province is the licensing authority for ground water extraction for industrial use exceeding 150.000 m3 per year (Provincie Noord-Brabant, 2013).

Water board Waterschap Aa en Maas
In the Netherlands, traditionally water boards have the authority to govern the water system at regional level. The origin of water boards lies in the cooperation between farmers in the battle against the water. The water board's management is chosen through elections. The governing council (general administrative body) is in charge. The executive committee takes care of day-to-day affairs. In former days, agrarians were the dominant group in the board. As a result of the increasing importance for ecological interest on societal level, during the last decades the composition of the governing council and the Executive Committee of water boards has changed. Temporarily, the council includes representatives for nature interest. The dike-warden (in Dutch dijkgraaf) is the chairman of the governing council and the executive committee. The water board includes management experts, ecologists, hydrologists and other technical staff to provide expert knowledge. Water boards act repressively and have preventive supervision on the subject of water quantity, water quality and flood protection. Water boards are bound by the Water Board Act, a regime of public decision-making, characterized by consultation, consensus and compromise. In consequence decision-making procedures have a long lead-time.
At present, water boards still are a good example of the Dutch polder model, illustrating the cooperation between agrarians, citizens, organizations for nature conservation, and water authorities (Union of water boards, 2011).

Science
Scientific experts in the fields of social and technical sciences, are involved with and connected to the subject of (adaptive) water management. All strive to develop, collect, distribute and implement (applied) knowledge.
The Foundation for Applied Water Research (abbreviated in Dutch STOWA) is the knowledge center for regional water managers. Consultancy companies e.g. the Louis Bolk Institute, Centre for Agriculture and Environment Foundation[2] (in Dutch Stichting Centrum voor Landbouw en Milieu, abbreviated CLM) and Agricultural Advisory Services[3] (in Dutch Dienst Landbouw Voorlichting, abbreviated DLV) endeavors sustainable behavioral changes. DLV primary supports the introduction and implementation of measures that are already endorsed to be effective. Scientists connected to universities (e.g. Wageningen University) are involved with the projects of this study. The knowledge institutes that are involved in the network have a long-standing experience in fundamental and applied research, and in working together with stakeholders.

[2] CLM - About CLM
[3] DLV: Homepage

Steering committee Delta Program Upland sandy soils
Policy makers[4] in the upland sandy soils are united in the Steering committee Delta program Upland sandy soils. Collectively they are developing a Strategic and Implementation Program for Fresh Water Supply, including (governance) instruments to direct adaptive water management. In this plan, adaptation implies the acceptance of deficiencies and adjustment to circumstances and situations if necessary. The general goal is to create a sustainable water supply (sufficient and of good quality) for an economic vital and ecological healthy environment for future decades. Self-sufficiency is the starting point in this strategy (ZONDHZ, 2013). Funding for this project is sought in the Delta Fund, the financial source for the execution of the Delta program.

All actor groups involved in the water management of the subject of this study are listed in table 4.1.

Table 4.1 Actor groups

Actor groups	**Stake in the problem**	**Fundamental Nature/Value/Scope**	**Main Resource**
Agrarian (dairy, horticulture, agriculture)	Feasibility for irrigation, protection for waterlogging and flooding	Strive for a good living and welfare, to this aim making profit	Land
Southern Agricultural and Horticultural Association (ZLTO)	Representative Association for agrarian	Supporting and stimulating agrarians in developing a sustainable position both in the market and in society	Social capital, management and staff
Organization for nature conservation (IVN, Staatsbosbeheer)	Nature conservation	Protection of nature from degradation	Land
Industry and business (food processing industry, supply industry for agricultural sector)	Process water, discharge of process water	Making profit	Land, finances, social capital
Citizens	Living, leisure, flushing and consumption	Good living, welfare	Land, social capital
Municipalities	Groundwater management in build-up area, management and discharge of sewer water	Sustainable water management	Authority
Drinking water company Brabant Water	Distribution and supply of drinking water for society	Sustainable management of drinking water	Authority, finance
Province of North Brabant	Coordination of spatial programs, Licensing authority for abstraction of	Sustainable water management of ground and surface waters, water safety	Authority, finance, knowledge

[4] Policy makers from the Province of North Brabant, the Province of Limburg, water board Waterschap Aa en Maas, water board Waterschap Roer en Overmaat, water board Waterschap De Domme, water board Waterschap Brabantse Delta, water board Waterschap Peel en Maasvallei, Drinking water company Brabant Water, Directorate General for Public Works Sand Water Management South, ZLTO. Limburg Agriculture and Horticulture Association, and Forest Service

	groundwater for consumption and abstraction of groundwater for industrial use exceeding 150.000m3 per year		
Water Board Waterschap Aa en Maas	Preventive supervision on the subject of water quantity, water quality and flood protection, good livelihood (creation of natural and recreational water)	Sustainable water management, water safety	Authority, expert knowledge, finance
Directorate General for Public Works and Water Management	Water management of surface water of national waters and waterways	Sustainable water management, water safety	Authority, expert knowledge, finance
Science	Gathering and providing scientific knowledge supporting decision making processes	Develop, collect, distribute and implement, (applied) scientific knowledge	Scientific knowledge
Steering committee Delta Program Upland sandy soils	Gathering and sharing knowledge	Cooperation in adaptive water management	Knowledge, social capital

4.4 Policies and legislations

The management of the water system is heavily regulated and complex. Policies consist of programs and governmental agreements, legislation of directives, laws and regulations. Table 4.2 gives an overview of policies and legislations in force. In Appendix IV the same overview of policies and legislations in force and its original Dutch name is presented.

The general goal formulated in the water management policy and legislation is to contribute to safety, good health, prosperity, welfare and ecology. In the next part of this section the current policies and legislations ranging from European, to national, to regional and provincial, to water board level will be discussed.

Water Framework Directive

The European Union's Water Framework Directive (in Dutch kaderrichtlijn water, abbreviated KRW) sets goals for chemical and ecological properties of ground and surface water on European level. This policy is implemented at nation state level.

Water Act and Water Program

The national Water Act is framework legislation that is being implemented on the basis of the Water Decree (by governmental decree) and the Water Regulation (a ministerial regulation). The Water Act highlights 'integrated water management' based on the 'water system approach' addressing all relationships within water systems, e.g. the relationship between the quality and quantity of water, between surface and ground water, the relationship between water, land use and water users. And last but not least, integrated water management is characterized by its relationship with other policy areas such as nature, environment and spatial planning (Rijkswaterstaat, 2011).

The national Water Program is the official governmental water policy program. A key starting point is 'sustainable water management' (Rijkswaterstaat, 2011). The objectives to contribute to a good living, and to conserve biodiversity are formulated as: 1) taking care of effective

flood defenses, 2) the prevention of flooding, waterlogging and drought wherever possible and 3) good water quality as a precondition for prosperity and wellbeing (Ministry of Transport, Public Works and Water Management, Housing, Spatial Planning and the Environment and Agriculture, Nature and Food Quality, 2009).

Delta Act, Delta Program and Delta Program Fresh Water
Anticipating to climate change on 1 December 2011, the national Water Act (in combination with the law Fund Infrastructure) was transformed into the Delta Act and the Delta Fund. The Delta Act is the underlying law for the national Delta Program for water safety and fresh water supply. The program is financed by the Delta Fund. In addition to the objectives as formulated in the previously discussed Water Act, the Delta Act formulates the role of the Delta commissioner who presents an updated Delta program each year.
The national Delta Program prescribes for each year to come, the focus and goals for a robust water system design that facilitates spatial adaptation. For the customization of each area, the policy pursues proactive cooperation in the region between water authorities and private actors organized in social organizations such as The National Agricultural and Horticultural Association (Ministry of Infrastructure and the Environment, Ministry of Economic Affairs, 2013).

The national Delta Program comprises the Delta Program Fresh Water (in Dutch deelprogramma Zoetwater, abbreviated DPZ). In this paragraph the regions of the upland sandy soils together with the IJsselmeer area have been identified as fresh water providers. The objective of this new policy is to prepare the Netherlands for the future, aided by a new strategy that releases constraints and at the same time takes advantage of opportunities to be offered. To this aim, goals, measures and pathways have been formulated.
In this new policy the key goals are:

1. Protection of crucial societal functions;
2. Stimulation of competitiveness of the Dutch trade position;
3. To strive for a healthy and balanced water system;
4. To endeavor an effective and efficient use of fresh water;
5. To support water management knowledge, practices and innovation.

The water management focuses on greater levels of regional self-sufficiency and optimization of freshwater distribution in the main and regional water systems in favor of economy and livability. Related to the upland sandy soils, changes in the structure of the water system, the balance between the discharge and storage of surface and ground water, and acceptance of deficits will be examined.
The policy assumes that the current policy instruments are sufficient, but can be exploited better. More advantage can be found in the settlement of implementing agreements (Ministry of Infrastructure and the Environment, Ministry of Economic Affairs, 2013).

Administrative agreements
Administrative agreements cover arrangements between central and regional authorities (province, municipalities, water board and drinking water company) for the implementation of national water management projects. In the agreements responsibilities are assigned to increase effectiveness. Examples of agreements are: the National Administrative Agreement Water (in Dutch Nationaal Bestuursakkoord Water, abbreviated NBW) that agrees on cooperation across governmental levels to approach climate change, the Meuse Projects for flood protection, improving navigability with respect for nature conservation, GGOR AHS and GGOR Nature (Ministry of infrastructure and environment, 2012), (Provincie Noord-Brabant, 2013), (Rijksoverheid, 2008).

Optimal Ground and Surface Water Regimes
Optimal Ground and Surface Water Regimes (In Dutch Gewenst grond en oppervlakte water regime abbreviated GGOR) is a national policy that focuses on the management of water quantity.
The Optimal Ground and Surface Water Regime Agriculture (in Dutch Gewenst grond en oppervlakte water regime Agrarische Hoofdstructuur, abbreviated GGOR AHS) formulates the optimal water system for areas with agricultural activities. The water boards have the responsibility to develop a regional GGOR AHS.

Optimal Ground and Surface Water Regime Nature (GGOR nature) focuses on conservation of nature. In the Province of North Brabant, 35.000 ha out of 52.000 ha of areas for nature are designated as wet nature pearls (in Dutch Natte natuurparels) (Provincie Noord-Brabant, 2013), (Smit *et al.,* 2013).

Drinking water law
Drinking water companies are subject to the drinking water law. This law safeguards the production and distribution of good quality drinking water for society. By this law[5], drinking water companies are forced to protect the areas for drinking water extraction from pollution in order to guarantee the deliverance of good quality drinking water for consumers and other customers (Ministry of Housing Spatial Planning and the Environment, 2009).

Management program River Meuse Catchment basin
Management program River Meuse Catchment basin (in Dutch Stroomgebied beheerplan Maas) is a framework that regulates the quality of surface waters in the area of the Meuse river catchment basin.

Water program North-Brabant
Because the water system is located in the Province of North Brabant, the water management falls within the scope of the Provincial Water program North Brabant and the North Brabant Water Act. Latest development is a legislation that regulates the use of groundwater by a system of permits for groundwater extraction (Provincie Noord-Brabant, 2013).
The province of North Brabant's strategic framework, called the Provincial Water Program, links and coordinates different regional water management programs to spatial planning programs. In this context, the province focuses on the implementation of the Delta Program, de GGOR nature, GGOR AHS, and the Delta Program Upland sandy soils. In addition, the province assesses water management programs on the subjects of flood protection, water storage, groundwater protection, recovery of streams and nature to spatial planning programs (In Dutch the 'watertoets' a formal governance instrument). Finally, the province implements and collects taxes for groundwater extraction above 10 m3 per hour.
Since the introduction of the Water Act, the execution of the ground water management policy is delegated to the water boards. The water boards have the authority to regulate the ground water extraction, except the extraction for the public drinking water supply, high industrial use and soil energy systems. This still falls within the authority of the province (Provincie Noord-Brabant, 2013).

Water Management program water board Waterschap Aa en Maas
The policy of water board Waterschap Aa en Maas is formulated in the Water Management program. This policy aims to guarantee the water supply and water quality, to offer a safe and sustainable livelihood (flood protection and prevention of, or adaptation to waterlogging) and provide water for leisure and nature conservation.
For the current policy period 2010-2015, priority is given to the improvement of the quality of natural water elements and elements that are part of the Wildlife corridor (Waterschap Aa en Maas, 2009).
Related to agriculture on the subject of water quantity, the Water Management Program 2010-2015 strives for an increased reliable water supply for agriculture. To this aim, a preferred order has been formulated:

1. Reduction of water demand;
2. Optimization of use of regional water resource;
3. Supply of external water resources;
4. Extraction of ground water (Waterschap Aa en Maas, 2009).

The policy for the period 2016-2021 has already been formulated and presented. The policy launches management strategies for climate adaptation. For this purpose, four alternative decision models based on the environmental impact assessment (in Dutch milieueffectrapportage abbreviated m.e.r.) have been formulated. These alternatives define

[5] wetten.nl - Wet- en regelgeving - Drinkwaterwet - BWBR0026338,

the optional courses in prioritizing and will be the basis in the decision-making process for different aspects in the water management. Alternatives differ in the extent to which formal norms and standards for safety are to be met; costs of measures to be taken, and their effectiveness. Decision-making will be stepwise, based on effectiveness and legal obligation. The first option limits water management to the legal obligation of the water board. The second option formulates continuing implementation of the current program as far as feasible. Feasibility in this context depends on the tradeoff to be made between costs (to take measures or production losses) and benefits (economic or welfare); outcomes must be cost-neutral. The third option focuses on the region. Partners in the project collectively decide what goals have to be reached. In addition to the second option, with regard to adaptation of climate change, this option promotes active support of local initiatives (financial, workforce and administrative). The fourth option endeavors maximum execution of European, national and provincial policies and regulations, following a planned timetable.
Elaborating on national policy the water management program in particular formulates seven goals for climate adaptation:

1. Optimization of the water supply via the regional water system;
2. (Seasonal) water storage/buffering within the region;
3. Dynamic water level management;
4. Reconstruction of stream valleys;
5. Implementation of GGOR AHS;
6. Restoration of the ecological quality of streams;
7. Cooperation with municipalities and private actors (Waterschap Aa en Maas, 2013).

Keur (water board)
This policy aims to protect the water system. The regulation limits groundwater extraction, discharge of waste water on surface water and construction of e.g. dams, dikes, water works, building houses and planting vegetation affecting the water system.

Ground Water Management Program Waterschap Aa en Maas
Within the authority of water board Waterschap Aa en Maas, separate policy is formulated on the subject of ground water management. The extraction of ground water is delegated to the water board under the condition that the extraction for low grade use (e.g. irrigation) must remain at least constant and areas for nature conservation may not be negatively affected (Provincie Noord-Brabant, 2013) .
The Ground Water Management Program regulates:

1. protection of ground water for human consumption;
2. protection of ground water on deeper levels (below 80m);
3. avoiding abstraction below 30m, also for smaller amounts
4. reduction of ground water use for irrigation,
5. stimulation of use of surface waters instead of groundwater for low-grade use (Waterschap Aa en Maas, 2013).

Table 4.2 Policy and legislation in the field of water management

	Water safety	**Water logging and flooding**	**Sufficient Water**	**Soil and groundwater**	**Waste water**
European directives	Flood risk Directive		Ground water Directive; Water Framework Directive	Water Framework Directive	Urban waste water Directive IPPC
National legislation	Water Act; Delta act water safety and fresh water supply	Water Act	Water Act; Delta act water safety and fresh water supply	Water Act; Implementation law KRW, AWB; Soil protection law BKMW	Water Act

National Programs	National water plan; Delta program; Delta program fresh water; Program Ground and Surface water Regime agriculture	Delta program, Delta program fresh water; Program Ground and Surface water Regime agriculture; Program Room for the river	Delta program; Delta program fresh water; Program Ground and Surface water Regime agriculture; Program Room for the river	Delta program; Delta program fresh water; Program Ground and Surface water Regime agriculture; Program Room for the river	
National administrati -ve agreements		2001 WB 21st century 2003 NBW 2007 NBW topical		National agreement soil and spatial development; Administrative agreement Water	
Regional programs		Strategic and Implementatio n Program for Fresh Water Supply	Strategic and Implementatio n Program for Fresh Water Supply		
Provincial regulation	Water Regulation	Water Regulation Spatial Regulation	Water Regulation		
Provincial programs	Provincial Water program; Structural vison Spatial planning; Meuse Projects	Provincial Water program; Structural vison Spatial planning; Meuse Projects	Provincial Water program; Structural vison Spatial planning	Provincial Water program; Structural vison Spatial planning	Provincial Water program
Provincial administrati -ve agreements		2nd administrative agreement	2nd administrative agreement	2nd administrative agreement	
Water board legislation	*Keur*	*Keur*	*Keur*	*Keur*	
Water board programs and agreements	Water manageme nt program	Water management program; Ground water management program	Water management program; Ground water management program	Water management program; Ground water management program	Water manageme nt program; Waste water agreement; Waste water cooperation contracts

4.5 Strategic measures for climate adaptation

According to the Social Ecological System theory (point 2, page 8 of this thesis) the challenge is to make the management adaptable and flexible, and capable of dealing with uncertainty and surprise, and building capacity to adapt to change. For the adaptive governance of the water system, strategic measures can be used. Water authorities utilize a variety of policy instruments (laws, regulations, administrative agreements, cooperation with various stakeholders, licensing for irrigation and ground water extraction, and monitoring performances), financial instruments (subsidies, taxes, and pricing water), and technical measures.

In addition to these above mentioned governance measures used by the water authorities, the Implementation Program of the Steering committee Upland sandy soils advocates practical measures at source for climate adaptation. Starting point for these measures are two different climate scenarios, viz. W, and W+ formulated by the Royal Dutch Meteorological Institute (KNMI). The W-scenario, assumes winds mainly blowing from the west, resulting in wet summers and risk of waterlogging. The W+-scenario, assumes winds mainly blowing from the east, resulting in dry summers, with long periods of drought and decreased ground and surface water levels (in these scenarios W is for Weather forecast) (ZONDHZ, 2013), (Smit *et al.*, 2013).
In line with these two different scenarios, measures can be categorized in measures to adapt to effects of drought, and measures to adapt to effects of waterlogging. Currently most effort is made to explore measures adapting to drought.

Adapting to drought
In adapting to drought three approaches can be distinguished:

1. Improvement of the regional water supply through retention and buffering precipitation in the soil and ground water system. Buffering the water at source creates water reserves during periods of drought on the one hand, and reduces water discharge via the major rivers which in its turn relieves the pressure on these rivers' discharge capacity on the other. The benefits include: an increase in the moisture holding capacity of the soils by a growing amount of organic matter in the soil, more rain infiltration, and water conservation (higher groundwater level) during months outside the growing season.
2. Diminishing water use and vulnerability for drought. The strategy emphasizes alternative crop selection and the design of a robust water management system. Examples are:
    - Introduction of innovative cultivation techniques, improvement of soil structure by increasing the organic soil matter of farmland, new tillage methods, influencing pH-values, adding earthworms; introduction of an innovative irrigation system (e.g. use of drip system instead of sprinkler system for irrigation), link capital intensive crops to sustainable water availability, cultivation of (innovative selections of) corn; usage of innovative grass mixtures that include red clover, or grass species that have deeper roots;
    - Create a closed loop water management system on farm scale;
    - Create robust streams less vulnerable for incidents of drought with help of the introduction of new techniques that use satellites that send meteorological information so that the use of fresh water for irrigation can be reduced;
3. Developing smart solutions for efficient water use and water distribution. The benefits include:
    - Reconstruction of the technical water system in stream valleys;
    - critical zoning on water supply by implementation of water barrages (in Dutch knijpstuwtjes), if necessary combined with introduction of a level-sent drainage system (in Dutch peilgestuurde drainage);
    - Development of innovative (ICT) technologies that facilitate computerization of management systems providing the essential flexibility for optimal water management (e.g. an application to connect groundwater level, measured in for this reason installed groundwater monitoring wells, to weather forecasts and automated water barrages);

- Smart timing for intake of fresh water from the Meuse (if feasible combined with level-sent drainage);
- Buffering water from the Meuse via infiltration, dual use of water storage (higher groundwater level during months outside the growing season, so reserves are built up that can be used in dry periods);
- Smart irrigation regime (Waterschap Aa en Maas, 2009), (ZONDHZ, 2013).

Adapting to waterlogging
Although hot and dry summers are increasing, on an annual basis a surplus of precipitation still occurs.

1. The problem of waterlogging can be solved by controlling the groundwater level. The introduction of smart solutions like a level-sent drainage system on plot level, combined with a well-designed water level management of the surface water system on sub area level, can contribute to the essential water discharge,
2. An alternative approach is diminishing the vulnerability for waterlogging. This can be achieved by influencing the circumstances. For instance, a change in farm management by growing waterlogging resistant energy crops. The use of alternative tillage methods that improve the soil structure and load capacity of the fields despite the higher ground water level (ZONDHZ, 2013). All measures recommended are summarized (in Dutch) in Appendix V.

5 Case Descriptions

In this chapter the cooperative governance arrangements studied in this research will be described. The three cases studied are:

1. Project Farmer, Beer and Water, initiated by private actors and supported by water authorities;
2. Project Buffer Farmers, initiated by all stakeholders collectively;
3. Project GGOR AHS, in which the water board Waterschap Aa en Maas implements national policy for water management on regional level.

The description of cases is the result of the analyses of documents, the responds on interviews and the observations made. For each project separately the location, inducement, collective goals, stakeholders and their interests, the contributions to the governance process and finally the cooperative management process will be presented.

5.1 Case: Farmer, Beer, and Water

Table 5.1 summarizes characteristics of the project Farmer, Beer and Water. In the next part of this section, these characteristics will be explained.

Table 5.1 Characteristics of case Farmer, Beer and Water

Characteristic	
Inducement	Groundwater extraction; reduction of surface water pollution.
Location	Area just near the Bavaria Brewery in the village of Lieshout. See figure 5.1.
Goals	Development of closed-loop nutrient, residue and water cycle system, image building.
Stakeholders	Bavaria Brewery, agrarians, province of North Brabant, water board Waterschap Aa en Maas, Directorate for Public Works and Water Management, municipality of Lieshout, project management: CLM, DLV and ZLTO, financers: Network Practice Fund, LIB, NCB.
Contributions	Financial, personal time, personal effort, manpower, knowledge.
Cooperative management process	Roadmap to direct the management process, goals evolving in the course of the process, bottom up.

Inducement

Bavaria Brewery and agrarians share the idea that the current water management in the area is paradoxical. Bavaria Brewery abstracts each year 2,5 million m3 good quality groundwater for the brewery process of beer. This water is abstracted from the grounds near the factory. As a result of this abstraction of groundwater, effects of drought for about a hundred agrarians in the neighborhood will probably intensify. At the same time, Bavaria Brewery is discharging large amounts of waste water (1,5 million m3 per year) into the North Sea via the stream Goorloop, the river Aa and the Meuse. In addition, the province of North Brabant obliged Bavaria Brewery to reduce the surface water pollution caused by the discharge of waste water. Bavaria has a license until the 1 January 2015. Agrarians observed the discharge of process water as wasteful. They are interested in finding ways to reuse the waste water to combat drought. So far, agrarians have been financially compensated by Bavaria Brewery for production losses. However, financial compensation is far less than the actual losses and compensation doesn't solve the underlying problem. This situation motivated agrarians and Bavaria Brewery to create a win-win situation together. The resulting project to invent innovative solutions started in the spring of 2012.

Location

The project is situated in the area just near the Bavaria Brewery in the village of Lieshout. The area is situated in the stream valley of the stream Goorloop and is bounded on one side by the Wilhelmina canal. Figure 5.1 illustrates the area involved. The colored areas define the areas that suffer from drought or waterlogging during winter or summer.

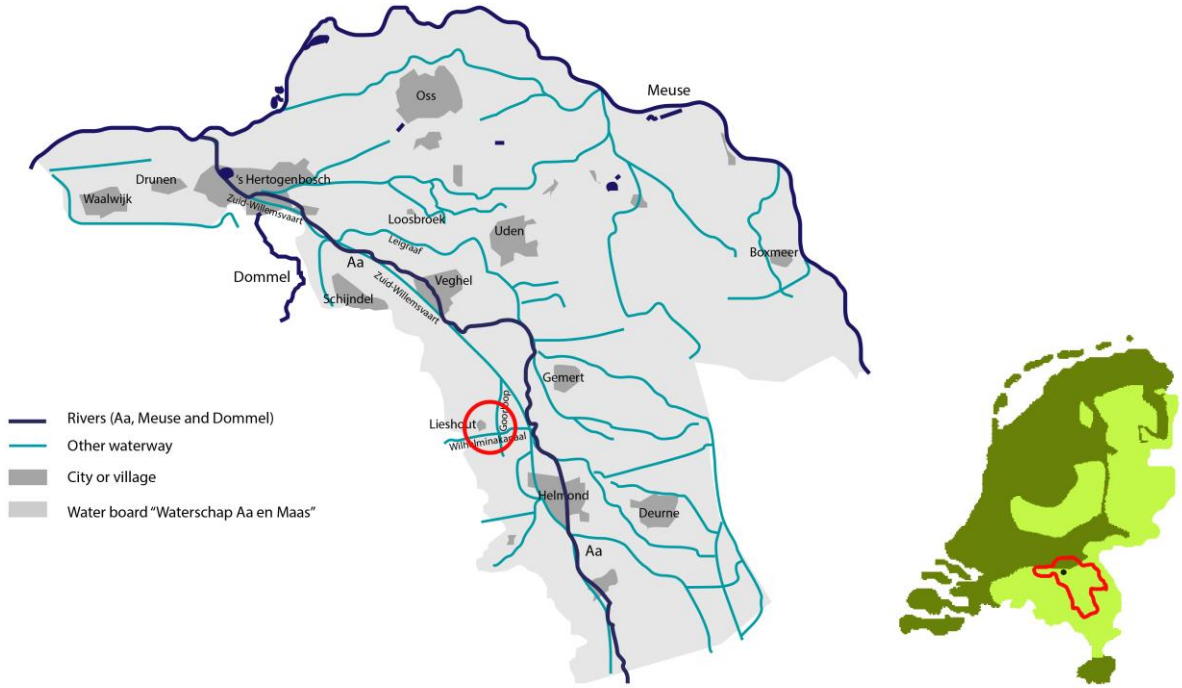


Figure 5.1. project area case Farmer, Beer and Water

Goals
Participants strive for a closed-loop nutrient, residue and water cycle system.
They agreed on four subprojects with different goals:

1. Reduction of drought effects for agriculture by reuse of waste water for irrigation. For this, six options to explore have been formulated:
   a) The possibility of indirect inlet of (waste) water through the Zuid-Willems canal (via drains) into the field (calculated benefit reuse of 500.000m3/year);
   b) Reuse of waste water via the stream Goorloop (calculated benefit 375.000m3/year);
   c) Reuse of waste water up north from the village of Lieshout (calculated benefit 100.000m3/year);
   d) Construction of a pipeline for the transport of process water to the highest location in the area, and from there the distribution of process water over agrarian fields (calculated benefit 1.000.000m3/year);
   e) Construction of a helophyte filter (calculated benefit 1.500.000m3/year);
   f) Optimization of the purification process and additional chemical phosphorus removal;
2. Improvement of the water quality (reduction of use of pesticides and fertilizers) by introduction of new production technologies for agrarians;
3. Implementation of soil measures to increase the buffering capacity of the soil;
4. Produce locally grown barley.

Stakeholders and their interests
Stakeholders in the project are Bavaria Brewery, agrarians (organized in ZLTO department Laarbeek); the province of North Brabant, water board Waterschap Aa en Maas, Directorate for Public Works and Water Management, the municipality of Lieshout, CLM, DLV and ZLTO, Network Practice Fund, LIB and NCB.

- *Bavaria Brewery* cooperates in the project because:
  1. Bavaria Brewery was ordered to build a sewage installation by the province of North Brabant. Total investment has been estimated at about € 10 million. Bavaria Brewery is currently exploring alternatives to avoid or at least reduce high investments;

2. Bavaria Brewery is dependent on pure quality groundwater in the area around the brewery;
3. Bavaria Brewery wants to contribute to a sustainable environment;
4. The importance of image building for(global) marketing purposes. Supporting local interests contributes to a positive image. In addition, the use of locally grown barley for the production of beer, contributes to an image of artisanally brewed beer.

- *Agrarians.* Goal is to eventually motivate about 15 to 20 agrarians for the pilot project. Agrarians cooperate in the project because:
  1. They want to develop new attitudes and techniques to relieve desiccation effects, in this project primarily by recycling process water coming from Bavaria Brewery;
  2. The project provides a good opportunity for a positive image building. After a period of intensive animal rearing resulting in environmental degradation, cooperation in this project demonstrates the concern for the natural environment.

- *The Province of North Brabant* is involved as the licensing authority for ground water extraction.

- *Water board Waterschap Aa en Maas*, has two main concerns to cooperate:
  1. It aims at creating a sustainable and robust water system that supports economic activities, while at the same time respecting ecological goals. For this reason they make an effort to facilitate and develop new governance arrangements;
  2. In the project the Goorloop (stream) is regarded as optional for the discharge of waste water. Related to this option, Waterschap Aa en Maas controls the level of pollution resulting from this discharge.

- *The Directorate for Public Works and Water Management* has the goal to protect the Willems canal from pollution.

- *The municipality of Lieshout* strives for welfare for its citizens and the creation of a favorable business environment.
  1. Bavaria Brewery and the agrarian sector offer employment and economic welfare to the region;
  2. The production of barley contributes to the development of nice sight spots in the rural landscape, attracting tourists;
  3. Joining the project solves problems with water retention in a business park to be developed.

- *Project management: The Research and Advice Centre for Agriculture and Environment Foundation, (abbreviated in Dutch CLM), Agricultural Advisory Services (*abbreviated in Dutch *DLV), and Southern Agricultural and Horticultural Association (*abbreviated in Dutch *ZLTO)* collectively manage and support the process, each based on its own specialism.

- *Financers: Network Practice Fund, Steering committee LIB, NCB*
  The project is financed by the Network Practice Fund, LIB and NCB. The Network Practice Fund (in Dutch Praktijk netwerk gelden), is run by the Ministry of Economic Affairs. This national fund stimulates sustainable innovation in agriculture. The Steering Committee Agricultural Innovation North Brabant (in Dutch Stuurgroep Landbouw Innovatie Noord-Brabant, abbreviated Stuurgroep LIB; fund of ZLTO and the province of North Brabant), and the North Brabant Christian Farmers Association (in Dutch Noord-Brabantse Christelijke Boerenbond abbreviated NCB; a collective fund of cooperatives linked to the agricultural sector, operating in the province of North Brabant), both support innovative projects in the agricultural sector.

Contributions
The contributions in the project comprise financial investments, personal effort, personal time, introduction of knowledge, and manpower.
For the execution of the project, financial resources have been supplied by the Network Practice Fund, LIB and NCB, Bavaria Brewery and agrarians themselves.
The expenses so far have been made for the consultancy work of CLM, DLV and ZLTOs' project management. ZLTO together with DLV provide knowledge about, for example, tolerable amounts of residues in the reusable waste water for crop production, calculations of production losses as opposed to losses due to investments on drainage systems etc..
During the early stages of the project it was difficult to motivate agrarians to invest in conservation techniques and production methods because this requires high investments. However, joining the experiments offered the opportunity to receive subsidies. In addition, the early adoption of new technologies in this case offered the horticultural agrarian the opportunity of gaining a sustainability label. In the horticultural sector this label is rather exclusive and therefore provides a market advantage.
In accordance with the regulations of the Network Practice Fund, the application for subsidies is submitted by eight agrarians collectively. The chairman of ZLTO department Laarbeek, by means of his personal company is main applicant. In consequence he is legally responsible for all financial flows. CLM checks all financial flows paid by the Network Practice Fund.
Bavaria Brewery invests a significant amount of money for the implementation of alternative management practices. The most prominent financial advantage for Bavaria Brewery is in finding an alternative solution for building a sewage installation. Because barley yields are lower than those of corn, Bavaria Brewery offers a price that equals at least the market price for corn. For Bavaria Brewery producing beer with locally produced barley is attractive for marketing reasons.
The Province, Water board Waterschap Aa en Maas and the Directorate for Public Works and Water Management donate manpower. Experts and authorities assess ideas for technical feasibility, tolerable standards, flexibility of laws and regulations and add to enhance solutions.
Donations by the municipality of Lieshout are limited. Temporary fallow plots are offered for rent for the production of barley.

Cooperative management process
Prior to the execution of this project water board and agrarians cooperated for addressing existing obstacles in the water system. That operation started with an estimate of the water system. After an inventory of constraints, adaptive measures were taken on operational level. The outcomes were evaluated by the participants and considered effective.
The cooperation between Bavaria Brewery and agrarians and water authorities in thís project is new. The common idea that the current water management is paradoxical, offers a common ground for cooperation and an intrinsic motivation for stakeholders to cooperate. Collaboration in this project started from a collectively predetermined road map, which describes the process to be completed. Directions, priorities and the time-path for solutions and linked activities are collectively chosen. Members communicate about the actors' interests, goals, experiences, values, policies etc., and find collective understanding of circumstances and measures. During meetings, along with fact finding and knowledge sharing, overviews with specific factual information are put on the table to be discussed, specialized knowledge is brought into the negotiation and decision-making process, optional solutions are stipulated, concerns and possible solutions are formulated collectively, the pros and cons of measures to be chosen are discussed, initiatives become assessed to active policy and regulations, and simultaneously goals are categorized and selected in terms of accomplishable, realistic and payable.
At the startup of the project, the senior manager of the ZLTO organization functioned as the 'constructor' of the project. He inspired and motivated participants to pick up initiatives. Because he disposes of a large social network he managed to bridge connections between different arenas (captains of industry, other projects in the country, government

organizations, agrarians, colleagues). Through this he stimulated the rearrangement of existing routines and the development of innovative management procedures. Once the project ran, he left the operational phase to the project manager ZLTO.
The project manager ZLTO who functions as the convenor in the project, leads the step-wise process management. He organizes meetings, and takes care of the administrative process management. He is dedicated and punctual; facilitates transparency by sharing information and knowledge; binds parties by leading meetings constructively. In this management arrangement the project manager ZLTO has the responsibility to keep the process going without having a 'stick to hit' to criticize all the time. In order to prevent the process from slowing down too much, and to get the project going again, the project manager ZLTO wrote a 'SMART[6]' formulated project plan and assigned tasks to the stakeholders with the highest interests.
Actors on operational levels contribute by bringing in local knowledge and by coming up with out-of-the-box solutions (reuse of process water, introduction of improved sensor spraying technics in horticulture, production of sustainable produced barley, use of film that covers the soil to prevent for evaporation and the development of weeds). The chairman of the ZLTO department Laarbeek is the 'engine' in the execution of the project. His input is crucial for bringing up new ideas, making new connections between people that are sensitive to each other, combining different sources of knowledge, recognizing opportunities, keeping an open attitude and a good understanding for the needs of his grass-roots supports, persuading fellow agrarians to join the experiments. Box 5.1 illustrates the advantages of positive experiences and local connectedness in the project.

Box 5.1 Advantages of positive experiences and local connectedness

The annual report of Bavaria Brewery describes the successful functioning of the local network: Farmer, Beer and Water runs until 2015. However, with regard to the results it is to be expected that activities in the network will continue afterwards (Bavaria NV, 2013).

"Bavaria is committed to the project for the long run, but especially in this area. This also applies to many horticulturists and other agrarians in the area. With the project Farmer, Beer and Water we create mutual understanding and we find interesting, practical ways to work together" (Bavaria NV 2013)

Box 5.2 Illustration of spill-over effect

Quote of a respondent expressing the spill-over effect: "Working together in this project makes it easier for high bureaucrats and captains of industry to get in contact on other subjects. Getting to know each other breaks down barriers not only for the water management itself, but also for subjects in other policy fields".

In this project so far two subprojects have been effectuated:

1. Production of barley: The first harvest of barley has been effectuated. Outcomes have been published. Although harvesting was considered to be a fruitful moment for promotion, participants remembered a clash of interests between professional PR-officials and the reservations of agrarians, that was caused by the timing and the costs of billboards to be placed in the fields. Participants discussed this friction and came to a satisfactory solution for all parties.
2. Introduction of innovative production techniques for horticulture. New methods (e.g. implementation of remote sensing and use of foil in the fields) have been developed and tested. Outcomes are proven to be successful and published.

[6] Specific, Measurable, Achievable, Relevant, Time-bound

Box 5.3 Goals for sustainable behavioral changes

Quote of a respondent mentioning goals for sustainable behavioral changes: "The challenge is to create a new irreversibility, so that it cannot fall back; accomplish a new mindset."

Members evaluate the outcomes of experiments and deliberate on the improvement of practices. The project management consciously organizes social activities to strengthen the relation between the stakeholders. To motivate agrarians on extended level, excursions to the brewery and farms are organized. The experiments for which innovative production techniques are tested, are monitored by CLM, and delegated to DLV. To generate adoption of measures, monitoring by DLV focuses on costs and benefits for end users. The successful results are taken as quick wins and communicated via local newspaper, *Nieuwsflits* and *Nieuwe Oogst* (both bulletins of ZLTO), and on the website of ZLTO itself. On a larger scale outcomes are presented as best practices via the ZLTO network and distributed by the DLV. On a wider scale, experiences in this project are shared in business clubs with other captains of industry. In accordance with this project, Coca Cola Company in the village of Dongen intended to start a similar project for the re-use of discharge water. Finally, the project is taken as an example of successful self-governance by Steering committee Delta program Upland sandy soils. In this context the director of Bavaria Brewery was invited to share his experiences during the symposium of Delta Program Upland sandy soils in Arnhem in 2012. Participants mentioned the advantage of emerging cross-level connections between private parties, policy makers and employees during the process. Box 5.2 illustrates this spill-over effect.
Despite the successful experiences, some remarks must be made:

1. However, continuation of sustainable behavioral changes is challenged. Box 5.3 presents the reservation that is made for the long term;
2. In consequence of the implementation of new technologies one agrarian changed his business plan. As a result of his effort to contribute to a sustainable environment, he had expected flexibility of the local government in granting permission for building additional storage. However, in his opinion both this flexibility and the understanding for his needs were lacking. Therefore, he felt constrained in running his business and was less inclined to cooperate in future experiments if not financial beneficial;
3. In the course of this project, national government and the province were developing plans for the construction of a new high way cross-cutting the water system. To prevent the project from getting stalled, project members chose strategically not to integrate these plans up front in the project, because anticipation on these plans would make the governance too complex.

5.2 Case: Buffer Farmers

Table 5.2 summarizes characteristics of the project Buffer Farmers. In the next part of this section, these characteristics will be explained.

Table 5.2 Characteristics of the Buffer Farmers case

Characteristic	
Inducement	Subtraction of ground water by drinking water company Brabant Water causing drought
Location	Loosbroek area
Goals	Stimulate the regional self-sufficient water system in which functions for drinking water extraction and agriculture activities are balanced. Pilot for adaptive water management for the Upland sandy soils.
Stakeholders	Agrarians, province of North Brabant, water board Waterschap Aa en Maas, drinking water company Brabant Water, STOWA, Steering committee Delta Program Upland sandy soils, project

	management: Louis Bolk Institute and ZLTO, financers: LIB, Dutch Dairy Board, NCB and Rabobank Bernheze,
Contributions	Financial investments, manpower, knowledge
Cooperative management process	Scientifically launched learning process with distribution of outcomes via a pre-established communication plan.

Inducement
The inducement for the project is the reallocation of groundwater extraction by drinking water company Brabant Water. It is to be expected that the intensified groundwater extraction at deep levels in the Loosbroek district will result in an additional reduction of the groundwater level of about 8 cm. This reduction of the groundwater level may affect the availability of groundwater for the crops of agrarians. These circumstances stimulated agrarians and water authorities to cooperate in the project Buffer Farmers. The project started in 2010, initiated by drinking water company Brabant Water.

Location
The location for this project is the water extraction area and the surrounding fields in Loosbroek district. Figure 5.2 illustrates the operational area.

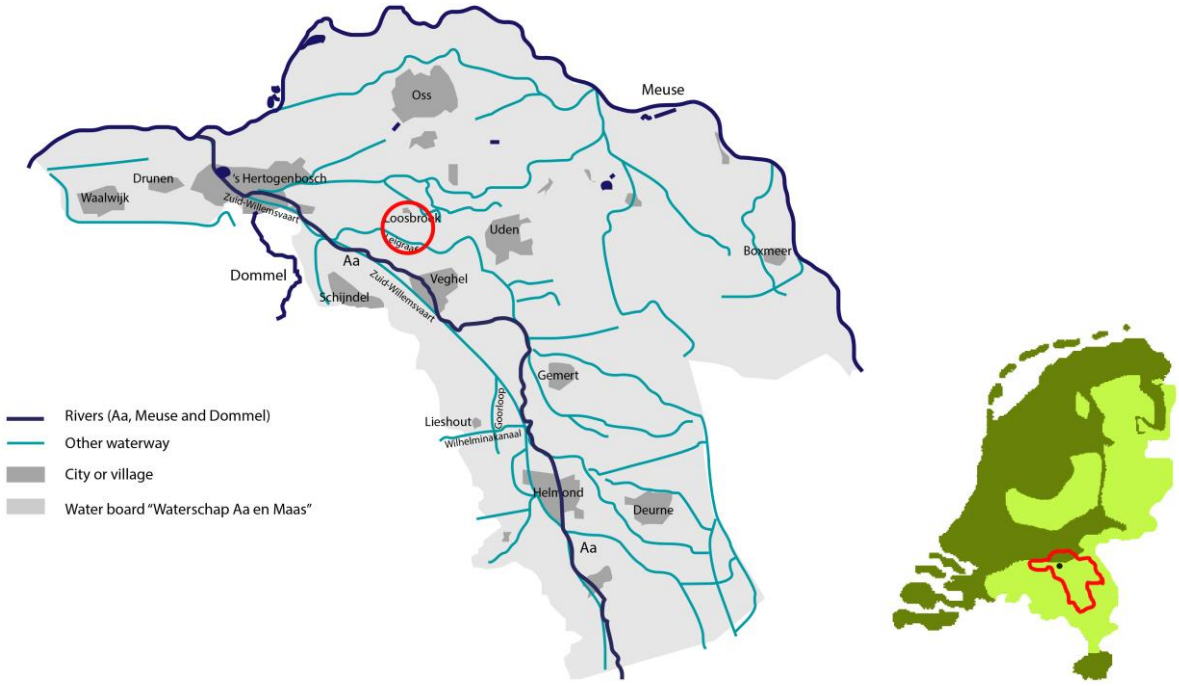


Figure 5.2. project area case Buffer Farmers

Goals
In the Steering committee Delta Program Upland sandy soils, the dike-warden of water board Waterschap Aa en Maas initiates partnership among actor groups, encourages to combine and endeavor to generate knowledge and so mobilizes broad support for new directions for management. The area is sensitive for drought. The objective of this project is to find practical measures to reduce effects of drought, while contributing to water quality and biodiversity. The Steering committee Delta program Upland sandy soils therefore indicated this project as a pilot to develop effective strategies for climate adaptation for the agricultural areas in the upland sandy soils.
The goals of the project are formulated as follows:

1. Develop a complete set of measures built up from: hydrologic measures (flexible water level management, irrigation management), increase of organic matter (water retention, water infiltration), measures affecting rooting (soil treatment, crop selection, fertilization);

2. Take this project as a pilot to develop effective strategies for climate adaptation for the agricultural areas in the upland sandy soils. For this reason, possible measures are considered and implemented, effects on soil and crops are monitored, and results are demonstrated.

The first year of the project was used to invent possible measures. In the current phase (2011-2014) these measures are being tested.

Stakeholders and their interests
In the project a wide consortium of organizations cooperate, viz., agrarians (organized in the ZLTO department Bernheze), Drinking water company Brabant Water, water board Waterschap Aa en Maas, province of North Brabant, STOWA, Steering committee Delta program Upland sandy soils, ZLTO, Louis Bolk Institute, LIB, Dutch Dairy Board, NCB and Rabobank Bernheze.

- *Agrarians.* The complete Loosbroek district comprises 24 farms. Most of them are dairy farmers. About 15 agrarians have joined the project. In the short term, these agrarians are more vulnerable for waterlogging than for drought, because waterlogging and resulting root rot cause irreversible damage to crops. On the other hand, short term desiccation problems can be solved by irrigation. However, within one water system climate circumstances may call for dissimilar water management between two adjacent farms due to diverging land altitudes (of for instance1,5 meters). Under such circumstances interests are protected and differences overcome, based on norms of 'good neighborhood'.
  Driven by economic motives, agrarians make a trade-off in which they compare investments costs and possible losses. For instance, agrarians calculate the trade-off taking into account investments for irrigation (the construction of a level sent drainage system, costs for diesel fuel, taxes and licenses for irrigation, costs and benefits of filling in ditches by 50%) versus costs of lower yields due to desiccation. Participation by agrarians in the project is voluntary, nevertheless agrarians observe adaptation of the effects of climate change as being necessary in the long run. In consequence agrarians are motivated to contribute to a sustainable environment. In this project agrarians strive for an adaptive water management on farm scale to:
  1. Obtain an autonomous water management;
  2. Pursue opportunities to prevent drought damage;
  3. Reduce irrigation costs.

Box 5.1 A call for sustainable behavior

Quote of a respondent calling for sustainable behavior: "Not only a good livelihood for future generations, but also a good livelihood for agrarians themselves depends on a sustainable environment. We must change our attitude towards environment and our water management practices in favor of this".

- *Province of North Brabant* wants to find out what results emerge from flexible use and reinterpretation of rules and regulations.

Box 5.2 Formulated target for participation

Quote from a respondent expressing the target for participation: "Contribution to this project provides useful points of reference for developing an adaptive water system".

- The objectives of w*ater board Waterschap Aa en Maas* are:
  1. To create a sustainable and robust water system that supports economic activities while at the same time respecting ecological goals. For this reason, the water board gives effort to facilitate and develop new strategies/measures;

2. To find out what degree of flexibility of water management is effective to balance goals.

Water board Waterschap Aa en Maas, facilitates the project with the investment of a policy advisor/research coordinator/ policy entrepreneur who makes connections inside and outside the project to collect and distribute knowledge.

- *Drinking Water company Brabant Wate*r has two objectives in the project:
  1. Strive for good quality ground water extraction in the Loosbroek area without causing environmental damage;
  2. Contributing to the project to compensate agrarians for suffered losses.

- *STOWA and Steering committee Delta Program Upland sandy soils* distribute and collect (applied) hydrologic knowledge, e.g. high technological solutions for water management.

- *Project management:* Driving leaders in the project Buffer Farmers are the consultant of *the Louis Bolk Institute and the chairman of the ZLTO department Bernheze.*

- *Financers: Steering committee LIB, Dutch Dairy Board, NCB, and Rabobank Bernheze* are financially involved. Steering committee Agricultural Innovation North Brabant (in Dutch Stuurgroep Landbouw Innovatie Noord-Brabant, abbreviated Stuurgroep LIB; fund of ZLTO and province North Brabant), and North Brabant Christian Farmers Association (in Dutch Noord-Brabantse Christelijke Boerenbond abbreviated NCB; a collective fund of cooperatives linked to the agricultural sector, operating in the province of North Brabant), both support this project in the agricultural sector because of its innovative character. The Dutch Dairy Board (in Dutch Productschap Zuivel) and Rabobank Bernheze contribute financially.

Contributions

The contributions in the project comprise financial investments, personal effort, personal time, introduction of knowledge and manpower.

To ensure enough funding, the implementation of the program was delayed deliberately; the duration of the project was extended with one year. This procedure offered financers the opportunity to contribute in the course of the project. Financers in the project and active stakeholders are partly different groups. The project is funded by subsidies coming from 9 different donors. The financial resources mostly coming from funds for innovative development, are granted by drinking water company Brabant Water, LIB, Rabobank Bernheze, and the Dutch Dairy Board. So far expenditures for project management and consultancy work have been covered by the funds.

Agrarians paid for implementation of adaptive measures on their own land. Most agrarians participating actively in the experiments, considered outcomes as profitable. However, some participants claimed that they had to 'pay the bill' of water management in favor of ecology.

Water board Aa en Maas and STOWA provide manpower by bringing in (hydrological) expert knowledge. In addition, the water board Waterschap Aa en Maas paid for technical adjustment of the water system. To influence the effectiveness of adaptive measures the water board Waterschap Aa en Maas maintains final control over drains and pumps to manipulate ground water tables.

ZLTO provides manpower paid by the NCB fund. This contribution is used for the project management.

Cooperative management process

In the project Buffer Farmers experiments are scientifically designed and focus on gathering and sharing knowledge. In advance measures to be taken and activities to disseminate results are formulated. The pre-established communication plan not only makes provisions for how and when outcomes must be distributed, but also aims to give room for discussion of constraints that hamper adaptation. Effectuated communication of

outcomes can be dispersed in communication inside and outside the research area. So far all pre-established actions have been effectuated in time. Actions as formulated in the pre-established communication plan are presented in Box 5.3.

Box 5.3 Text from the pre-established communication plan

> The project plan and linked communication plan announced the following actions: "Workshops will be organized for cognitive mapping. The researchers will assist stakeholders in translating research results to their specific conditions, and help them to design measures and strategies for climate change adaptation. For the dissemination of the research results/outcomes of experiments, the research results will be published in both international peer-reviewed journals and Dutch professional journals, and they will be presented at (inter)national conferences. The publications in Dutch professional journals aim at dissemination of the research results to those groups of professionals that work on planning, decision-making and implementation of climate change adaptation measures. We also aim at publishing in newspapers and news magazines for the general public. At the end of the research program we will organize an international conference to present and discuss the research results" (Eekeren *et al.*, 2012).

The consultant of the Louis Bolk Institute conducts experiments, monitors and communicates results. He has a strong bond with agrarians and water authorities. He is expected to take the agrarians' interests into account, while at the same time remaining scientifically credible for water authorities and others.
The local chairman of the ZLTO department Bernheze (an agrarian in daily business), is the representative of the local agrarians. His work is voluntary and, except for compensation for his expenditures, unpaid. His willingness to cooperate is based on the sense of urgency he feels for this project. Personal development is another motive to invest time and energy in the project. Although he operates low-profile, people in the network stipulate this man to be crucial in the project for establishing new connections. He is considered trustworthy and uses this feature to persuade agrarians to join activities.
The project manager of ZLTO is the administrative manager of the project in the interest of farmers.
Experiments carried out can be distinguished in measures linked to different domains:

1. Testing hydrologic measures (increase organic matter, reduce degradation of nutrients, direct seeding of maize; re-use of crop residues; use of green manure, optimization of the water supply with construction of small weirs, alternative methods for irrigation);
2. Testing alternative species of crops (introduction of plant varieties that are relatively drought-tolerant like red clover, sorghum, selected maize cultivars and tall fescues),
3. Testing rooting and soil improvement measures (for example sensor technology, mechatronics, durable applications and cultivation systems, e.g. reduction of soil tillage).

Dual monitoring (comparing effects of former practices and/or intensified water abstraction with observed results after implementing measures) sets results in the right perspective. Outcomes are processed in graphs and tables. Ecological system feedback is monitored on sub-area, farm and plot level. Not only the consultant of the Louis Bolk Institute monitors the outcomes, also agrarians themselves and hydrologists of the water board take measurements. Participants observe outcomes of different soil treatments and irrigation methods. During (thematic) meetings and demonstrations of experiments (field excursions), members discuss and inform each other about the entire process, problems to deal with, the experiments that are carried out, the observed results, problems that they are confronted with, and, finally, collectively decide on what can be considered to be suitable solutions. Field excursions are organized in a good atmosphere: participants enjoy to join. In the discussion local and scientific knowledge is combined. Lay experts are involved to qualify results. Discussions are open and respectful. Positive experiences in the

project shape the desired imaging and are taken as quick wins and best practices to encourage others to adapt. However, the cooperation process is also affected by former less fortunate experiences. For example, agrarians expressed the hinder they had experienced due to the actual water management policy (primary focus on ecological goals) causing effects of waterlogging for several agrarians with land along the watercourse Leigraaf. Others described the occasion in which the province selected an area for nature substitution. On the one hand, investments had been made to develop a toad pool on a high located sandy soil at the same time connecting farmlands had been put under restriction for the use of fertilizers. Agrarians were convinced that closer cooperation with other agrarians in this decision-making process would have led to more sustainable outcomes. In the execution of this project, conflicting estimations arose between agrarians and water authorities about the degree of autonomy and flexibility desired on the one side, and optimal operation to make the water system resilient on the other. In response to this obstructive situation water authorities intervened by bringing forward the implementation of GGOR AHS. In cooperation, experienced constraints in the water system were released. In the evaluation phase local circumstances are taken into account. Outcomes are communicated in the national magazine for people working or interested in the field of water management (*H2O*), the (digital) information bulletins of ZLTO (website and *Nieuwe Oogst*), the member magazine of the regional Rabobank, the professional journal for consultants in agri-business (*V-focus*), and in the network of Steering committee Delta program Upland sandy soils.

5.3 Case: Optimal Ground and surface water regime agriculture (GGOR AHS)

Table 5.3 summarizes characteristics of the case Optimal Ground and surface water regime agriculture. In the next part of this section, these characteristics will be explained.

Table 5.3 Characteristics case Optimal Ground and surface water regime agriculture (GGOR AHS)

Characteristic	
Inducement	Implementation on sub-area level of the National water policy
Location	Operational area water board Waterschap Aa en Maas, sub-stream area Loosbroek
Goals	Optimization of fresh water management
Stakeholders	Water board Waterschap Aa en Maas, agrarians, organizations for nature conservation
Contributions	18-20 mln in total, 10 mln until 2014, invested by water board Waterschap Aa en Maas, manpower, knowledge
Cooperative management process	Cyclic, stepwise, top down

Inducement
Implementation of the policy in the operational area of Waterschap Aa and Maas has started in 2011. The aim is to finish implementation of the program in 2018.

Location
The GGOR AHS regime directs water management on regional level for areas with agricultural activities to carry out national policy. Execution of the policy is delegated to the water boards. The operational area is linked to the river catchment basin, in this case the river catchment basin of the Meuse. Figure 5.3 illustrates the operational area of water board Aa en Maas.

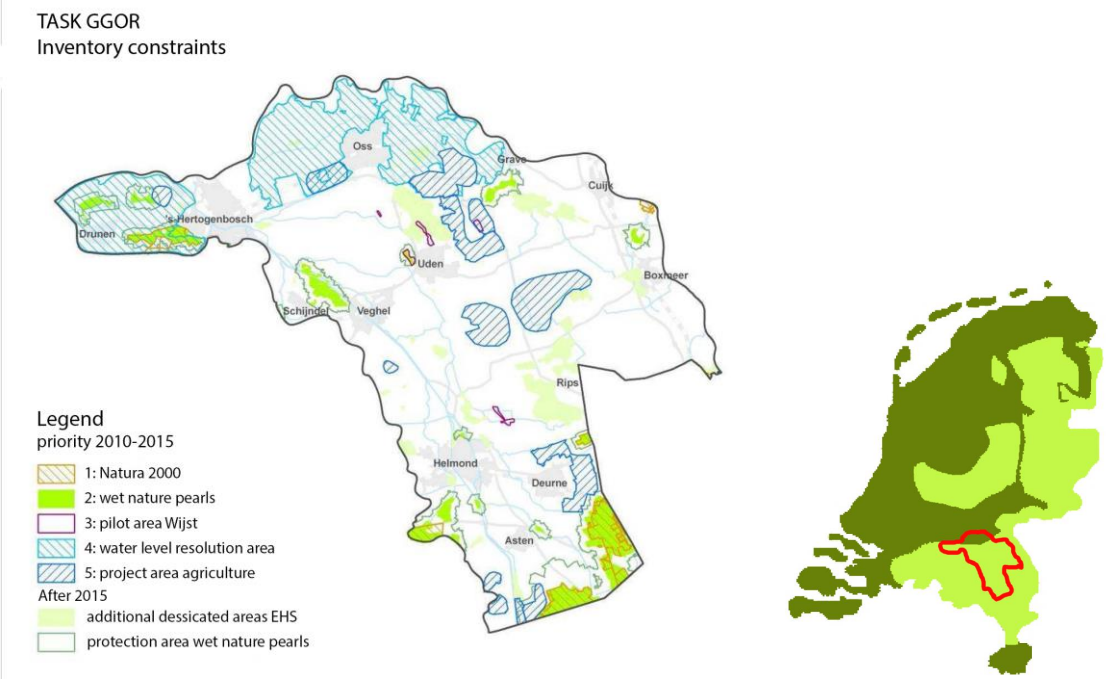


Figure 5.3 Task GGOR, inventory constraints (Waterschap Aa en Maas, 2009)

Goals

For the operational area of water board Waterschap Aa en Maas, the goal is to complete 40.000 ha of farmland with measures to optimize fresh water management before the end of 2018. To this end, in cooperation with landowners and land users, the water supply system and the ground and surface water levels will be adjusted.

The GGOR AHS policy defines two main tracks.

1. Expansion of water conservation on sub-area level (40.000ha);
2. Optimization of water supply in the current water system (of the Upland sandy soils as a whole 85.000 ha). To this aim, the following principles have been formulated:
   Principle 1: Focus on agriculture and secondary focus on opportunities for nature;
   Principle 2: Focus on current problems to be released, and secondarily anticipate on climate change;
   Principle 3: Focus on water quantity, however give if possible attention to water quality;
   Principle 4: Sustainable water system design (self-sufficient watersheds, adjustment of infrastructure, implementation of smart solutions to increase the ground water storage);
   Principle 5: Do not transfer problems to other spaces in time or place (good neighbor principle);
   Principle 6: Be careful of damage caused by flooding or water logging;
   Principle 7: Cooperation between water board and land owners;
   Principle 8: Sub-areas of the river catchment basin are taken as the project boundary;
   Principle 9: Agreements are being made for the duration of 10 years

(Smit *et al*. 2013).

Stakeholders and their interest

Stakeholder in the cooperation process, are agrarians, organizations for nature conservations and water board Waterschap Aa en Maas.

- *Water board Waterschap Aa en Maas*. The task of water authorities is to implement GGOR AHS policy. The water management program of water board Aa en Maas formulates implementation of the GGOR AHS program for the years to come. Assigned tasks for the period 2010-2015 are:
  1. Implement the GGOR AHS policy for 9000ha of leftover agricultural areas;

2. Dissolve constraints related to problems of drought (2500ha), water logging(130ha) or both (650ha);
3. Determine clear goals linked to functions per sub-stream area for the remaining 920ha

(Waterschap Aa en Maas, 2009).

- *Agrarians.* Agrarians strive for a flexible farm management in which water management is flexible too. In the governing process the board member ZLTO of the related department is the formal representative of the farmers.

- *Organizations for nature conservation*. IVN is the active organization for nature conservation in the area involved. IVN makes an effort to prevent nature from degradation and the possibility to restore. Their primary goal is the creation of wetlands and the prevention of drought damage.

Contributions
The total amount of costs for the process management, design and implementation of the GGOR AHS program in the operational area of water board Waterschap Aa en Maas has been calculated at 18 to 20 million euros. The governing council of water board Waterschap Aa en Maas budgeted 10 million euros for the execution of the program until 2014.
Agrarians invest manpower and knowledge in the form of participation during meetings.

Cooperative management process
The management of water board Aa en maas followed the stepwise cyclic process for an integrated management approach as formulated by the national GGOR AHS policy. The process is built from 4 ongoing phases, viz.:

Phase 1: framed by provincial regulations and policy of the water board, actual ground and surface water and optimal ground and surface water are defined;
Phase 2: goals linked to user functions (agricultural, industrial, private consumption, and ecological) are formulated;
Phase 3: after an inventory of constraints, measures are to be taken;
Phase 4: evaluation of results should eventually additional measures starting again from phase 1.

In the management process operational employees, administrative employees and hydrologists of the water board Waterschap Aa en Maas take an active leading role during which agrarians and organizations for nature conservation were invited to cooperate.
In advance water board Waterschap Aa en Maas mapped all features of the current and the optimal water system. For the inventory of constraints in the water system management and the selection of measures to be taken, kitchen table sessions with agrarians and meetings on the spot were organized. Where possible, observed constraints were immediately relieved. Subsequently, to prepare the decision making of measures to be carried out, during 'creative' workshop sessions an overview of the remaining observed bottlenecks was presented, and collectively by all stakeholders an inventory of possible, out-of-the-box, solutions was made and jointly categorized into:

1. highly promising solutions (realistic, affordable),
2. less promising solutions, though interesting to explore (less feasible),
3. solutions that must be regarded as dreams for the future, to prevent unrealistic expectations (no false hope).

Next, after the water board worked through technical consequences and calculations for financial consequences, during feedback sessions a selection of measures was presented and explained by the water board.

Figure 5.4 Pictures of the workshop session GGOR AHS

During these successive meetings participants discussed their mutual dependencies, the interests and responsibilities of stakeholders, and finally, proposed solutions. In this phase of the process, dormant existing distrust between agrarians, the water board and the organization for nature conservation hampered the progress of the cooperation process. In the minds of different stakeholders, different causes provoked the failure of a former project. Some explained this as the result of non-commitment and the long duration of administrative procedures, others attributed the lack of effectiveness to incomplete information about local circumstances and feasibility of measures, and the lack of understanding for specific needs. To overcome experienced and observed barriers, process managers (working at the water board) intervened immediately and adequately by rearranging the day program of the workshop sessions. To do so, during meetings space was made for expressing doubt; in response authorities expressed to be sensitive for the needs of agrarians and promised to improve. The IVN, however, chose at this point to avoid confrontation. Instead, this organization used its formal position in the governing council to secure ecological interests. Figure 5.4 illustrates the way of working during the workshop sessions.
During the cooperation process leaders in the process have consciously sought for adoption of measures, but the final decision was made by the governing council itself.

6 Results

Based on the theory of adaptive governance of social ecological systems and the institutional design principles of self-governance of common pool resources, the assumption is, that flexible cooperation between water authorities and local (private) stakeholders contributes to a successful adaptive governance of the fresh water resource. In chapter 5, three cases have been evaluated.
In the aim to find out to what extent cooperation between water authorities and local (private) stakeholders makes the governance adaptive, social memory, leadership, learning and congruence between costs and benefits are regarded as the driving forces behind adaptation of ongoing change. For the purpose of the analysis of the results, strong and weak points of these features affecting the governance process in each project will be distinguished and summarized in a table. In the subsequent paragraphs I will draw preliminary conclusions to what extent the results contribute to the adaptiveness of the governance arrangements.
For each case, first the content and existence of the social memory and the embeddedness of the shared mental maps in social networks will be described. The research focuses on how and if the shared mental maps provide a context for social response in the governance process, and how 'best practices' help or hinder the social ecological systems to prepare for change.
Next, leaders and their types of leadership will be identified. Accordingly, leadership actions and how these help to navigate the project through turbulent times will be reflected upon. Furthermore, the relation between gathering knowledge and adequate governance will be presented. For this purpose, the ongoing process of 'learning-by-doing' passing through the phases of testing, monitoring ecological system feedback, evaluation and adaptation of outcomes will be identified. The support of the available infrastructure that facilitates communication of outcomes and the role of scientists in the cooperation process will be highlighted.
Finally, the observed congruence between costs and benefits will be presented. The trade-off people decide on, depends not only on financial costs and benefits, but equally so on experienced softer social incentives.

6.1 Results and analysis of the case study Farmer, Beer and Water

Table 6.1 summarizes the findings of the case study Farmers, Beer and Water.

Table 6.1 Strengths and weaknesses of the case Farmer, Beer and Water

Criteria	Strengths	Weaknesses
Social memory	• The former cooperation between agrarians and water board contributed to the prevailing common idea of fruitful cooperation; • Early obtained quick wins on a small scale (the results in the barley project and the positive experiences with the introduction of innovative technologies) add to speed up the process; • Linkages and exchange of experiences (best practices) within and with other networks facilitate embeddedness of experiences on an extended scale; • The conscious exchange of information between	• Bavaria Brewery and agrarians had no former experience in cooperation; • A misunderstanding in the PR of the barley harvesting almost jeopardized the relationship of mutual trust.

	participants about interests, norms, values, etc. contributes to the perception of mutual dependency for welfare in the region.	
Leadership	• The use of road maps and a stepwise management approach offer leaders the opportunity to fine-tune and adjust leadership actions along the way; • Different leaders (senior manager ZLTO, project manager ZLTO, local chairman ZLTO department Laarbeek) with different expertise, roles, tasks, work complementary; • Leaders have strong connections in the networks and make linkages across spaces (governance level and spatial places); • In the governance process water authorities search for flexible interpretation of rules, however, formal rules and regulations are not put aside; • Formal governance instruments (permits, pricing) are 'stick to beat' to progress in the process.	• Leadership is heavily dependent on personal skills, competences and commitment; • Leaders miss moral support and feedback; • Contribution of leaders is often voluntary and, except for compensation for expenditures, unpaid; • The process operating between formal lines affects effectiveness of project managers' actions and the flexibility to manage.
Learning	• Management actions are taken as experiments to test hypotheses, and outcomes support the development of new policies; • Inclusion of expert knowledge increases liability and supports decision-making based on factual information; • Inclusion of local knowledge leads to creative out-of-the-box solutions; • Outcomes are discussed and evaluated in the newly formed governance arena; • Best practices are spread between interlinked networks.	• Commercial interests make private actors reluctant to share knowledge.
Congruence between costs and benefits	• Funding with private financial sources secures continuity; • Mutual advantages (like compensation for the price for the production of barley, the flexible interpretation of rules by the water board Waterschap Aa en Maas and Directorate for Public work and Infrastructure, and the development of new	• Project is highly dependent on the financial contribution of Bavaria Brewery; • If the deadlines for finding solutions are not met, incentives for the industry to contribute to the governance process, will disappear; • As long as irrigation, limited by certain restrictions, is

	attitudes and techniques to solve desiccation problems) provide a constructive basis for cooperation; • Consciously organized social activities are regarded a social incentive to cooperate; • The agrarians are persuaded by subsidies to invest in innovative technologies that are less pollutive; • The local connectedness and consequent social mechanisms (feeling of social concern and moral responsibility, social control and peer monitoring) provide a social incentive to commit; • Participation in this local project is regarded a 'vehicle' to discuss other issues in other arenas.	allowed and proven to be profitable, agrarians will have no incentive to change their business plans; • Managing financial flows is predominantly the responsibility of one farmer; • Cooperation with profit-driven entrepreneurs creates reciprocal expectations that cannot, or will not always be fulfilled. As a result, the motivation for further cooperation is negatively affected; • Stakeholders at times act strategic. If an item on the agenda is of no interest for one stakeholder, the representative decides not to contribute in the collaboration process; • Lack of coordination between actions of the national, provincial and local government threatens the project and can undermine all efforts so far; • The limited number of agrarians that participate in the project negatively affects the critical mass to create an adaptive water system.

Social memory
Through former experiences of successful cooperation, agrarians and water authorities knew that cooperation offered appropriate strategies to adjust the water system management. However, cooperation between this combination of stakeholders was new and a social memory had to grow. Use of quick wins and best practices aided to bind and map a collective memory. Nevertheless, an unexpected (minor) misunderstanding almost subverted the willingness to cooperate. The distribution of experiences on extended scale prepared stakeholders in other areas to introduce adaptive water management.
Although transparency about the actors' interests, goals, experiences, values, and policies supported their collective understanding and contributed to a basis of trust, analysis of the cooperative management process in this governance arrangement makes it clear, that in the decision-making process the collective choice for adaptive co-management is primarily driven by the experiences that show its benefits.

Leadership
The management based on a road-map and the step-wise management approach incorporates the flexibility to make the governance adaptive for change. To support flexibility in the governance, water authorities search for a flexible interpretation of regulations.
Inclusion of different leaders with diverging skills, competences and roles strengthens the quality of the project management. However, in this governance arrangement the position of leaders is vulnerable. On the one hand, the water authorities have the power to control effectiveness with rules and regulations. On the other, the lack of formal

authority of its operational leaders, undermines the effectiveness of leadership actions. Formal governance instruments (permits, pricing) are a 'stick to beat' to progress in the process.

Learning
The management approach based on a roadmap and subsequent organized trials and management practices are taken as a quest to develop robust adaptive management strategies for the water management on operational and administrative levels. In this governance arrangement the newly formed governance arena offers space to evaluate the outcomes of experiments and deliberates on adjusting practices (on extended scale). The inclusion of local stakeholders and actors on an operational level yields a broad range of adaptive measures. However, the merger of commercial interests in the governance process hinders dissemination of knowledge.

Congruence between costs and benefits
This governance arrangement demonstrates, that inclusion of a solvable company with high interest in the governance process secures the continuity of the process. Related to the effectiveness of measures, investments in the project are rather low. However, despite the mutual advantages, funding of the project with private money or granting subsidies on a personal basis also makes the project vulnerable and instable. In addition, the decision making of private actors is predominantly based on a commercial trade-off. Due to the inclusion of market driven stakeholders, the willingness to invest in adaptive measures is influenced by the (market) advantage to be gained. The diverging interests and sense of urgency bring about the risk of strategic behavior. For instance, if finding alternatives takes too much time, or if parties do not come to an agreement, financial incentives for further cooperation will be strongly reduced. Moreover, participants may benefit from slowing down the process. Also, because not all adopters of adaptive measures can be first and ,therefore, exclusive, later followers will have lower financial benefits when they adopt new technologies.
So far, the number of agrarians that participate is limited. The voluntary character makes it difficult to force agrarians to participate. Lack of coordination between actions of the national, provincial and local government jeopardizes the adaptive co-management in the project and may reduce the resilience of the water system. Finally, participation of private parties leads to reciprocal expectations towards the local government. If reciprocity is not met, the willingness to cooperate will be diminished. On the other hand, positive image-building and the spill-over effect to other (social) networks can be considered as social incentives for cooperation, and an aspect that strengthens compliance.

6.2 Results and analysis of case study Buffer Farmers

Table 6.2 summarizes the findings of the case Buffer Farmers.

Table 6.2 Strengths and Weaknesses case Buffer Farmers

Criterion	Strengths	Weaknesses
Social memory	• The exchange of information and debate between members in the project (for instance during field excursions) actualizes mental maps of experiences with adaptive management measures on extended scale and on a deeper level of values; • Best practices, generated on small scale, enthuse people on extended scale (other spaces in the upland sandy soils) to develop and adopt adaptive measures;	• The current water policy (focusing on ecological values) causing waterlogging for some agrarians is seen as a lack of understanding for individual needs; • Some agrarians have the feeling not to be heard or to be taken seriously.

	• A basic feeling/idea of local connectedness boosts agrarians to add to sustainable and adaptive water management.	
Leadership	• Inclusion of scientists to guide and monitor experiments, increases liability and, consequently, acceptance of innovative measures; • (Local) leaders, who have strong connections and respect in the (local) area, link actors, persuade agrarians to join activities and initiate participation; • Leaders make connections across spaces (governance level and spatial places); • Intervention by water boards to bring forward implementation of GGOR AHS policy restored confidence and gave positive impulse for further cooperation; • The dike-warden of water board Waterschap Aa en Maas is a driving person in the network who charts new management directions; • Water authorities still have the formal power to intervene if outcomes move into a direction they do not appreciate.	• Project management has no formal authority; • Management process heavily depends on personal skills and efforts of (voluntary) leaders.
Learning	• A pre-established plan for activities enables a quick start for the execution of experiments and thus facilitates quick wins to learn from; • The pre-established plan for activities offers the possibility to control the progress of the complete project and induces monitoring effects of measures; • The introduction of scientific knowledge and objective monitoring, set back barriers; takes away feelings of suspicion, fear, doubt and insecurity, and increases transparency and thereby adoption of innovative measures; • Collective evaluation of system feedback and discussion of outcomes by both scientists, agrarians ánd hydrologists, and inclusion of an experience expert mobilizes broad support of adaptive measures; • The communication of outcomes planned via a pre-established plan, expressed in time, actions and place directs the distribution of knowledge;	• Limited duration of the project endangers the continuous updating of knowledge.

	• The existing infrastructure of STOWA, ZLTO, the Louis Bolk Institute, Steering committee Delta program Upland sandy soils provides a well-functioning platform for the communication of outcomes; • The broad consortium of involved stakeholders stimulates adaptation of management practices on extended scale.	
Congruence between costs and benefits	• Participants recognize the advantage of developing new attitudes and techniques to relieve desiccation and waterlogging problems for now and in the future. In consequence, stakeholders are convinced they can benefit from new ideas and expanded knowledge; • Effective knowledge development for the complete area of the Upland Sandy soils; • Much effort is given to find a solid funding for the execution of the project; • The current water management that balances water demand between adjacent farms implicitly based on reciprocity is beneficial; • Water authorities use permits, pricing and final control over drains and pumps to control effectiveness; • Agrarians themselves benefit from the investments they make. • Joining activities and meetings appeal to social incentives.	• The autonomous water management on farm scale, limits effectiveness of management for the regional water system; • The limited number of agrarians that participate in the project negatively affects the critical mass to create an adaptive water system; • The origin of financial resources and the way the project is financed, limit the duration of the project and so the ongoing updating of knowledge and the long-term effectiveness; • Balancing water demand based on the idea of reciprocity is vulnerable in case economic interests become more dominant.

Social memory
This project takes advantage of the (local) connectedness of stakeholders and the idea to be dependent on and responsible for a sustainable environment. The exchange of information and social activities strengthen the social engagement of stakeholders. Sharing best practices over a broad range of stakeholders, entails a positive and stimulating dynamic that supports the cooperation, the compliance and the continuation of the governance process on small scale and initiates activities on extended scale. However, this project also illustrates that the memory of former experiences must be taken into account. Different recollections about the importance of certain interests, and the considered lack of respect for individual needs, hamper the trust relations and in consequence the willingness of stakeholders to contribute.

Leadership
In this case the project manager with scientific background is a 'sense-maker' and directs opportunities. The inclusion of leaders who speak the same language contributes to the mutual understanding, a basis of trust and the willingness to cooperate. The expertise and strong commitment of the leaders produce reliability and enthusiasm to cooperate. Lack of formal authority for operational leaders and voluntary participation of agrarians make the cooperation vulnerable for carelessness and the continuation of the project heavily

depended on the competences of leaders to persuade, make others comply, to adapt, and so on.

Learning
This governance arrangement illustrates how management actions are considered experiments to test hypotheses and how system feedback is measured and evaluated for the updating of knowledge. The pre-established plan for activities and the scientific design of the experiments offer the possibility to control the project's progress and effects of measures on an operational level.
The introduction of scientific knowledge and objective monitoring, sets back barriers, takes away feelings of suspicion, fear, doubt and insecurity, increases transparency and thereby adoption of innovative measures. The collective monitoring, evaluation and discussion of outcomes and inclusion of experience experts make the outcomes reliable. The communication of outcomes following the pre-established plan for activities forms a basis for quick wins. The broad consortium of involved stakeholders stimulates introduction of adaptive management practices on extended scale. However, the limited duration of the project, endangers the desirable ongoing updating of understanding after the project has been formally ended.

Congruence between costs and benefits
In this governance arrangement stakeholders are bound by a common problem perception. Cooperation appeals to moral, economic and ethical reasons. The pre-established action and communication plan facilitates the effectiveness of actions. However, the origin of financial resources and the way the project is financed, limit the duration of the project and, as a result, its long-term effectiveness.
Agrarians make a trade-off between short term costs and benefits . Participating agrarians state that the investments they make on farm scale are beneficial. Social incentives (social engagement, social pressure) that can be observed during social activities, contribute to persuade other agrarians to participate in the project. The limited number of agrarians that participate and the autonomous behavior of agrarians on farm scale undermines the effectiveness of the adaptive measures on the regional water system. The water authorities' governance instruments help to control the effectiveness of adaptive measures.

6.3 Results and analysis of the case study GGOR AHS

Table 6.3 summarizes the findings of the case GGOR AHS.

Table 6.3 Strengths and Weaknesses case GGOR AHS

Criterion	Strengths	Weaknesses
Social memory	• Because first the current constraints in the water system were relieved, quick wins were realized, that could be used as best practices to form a positive memory on experiences with cooperation; • The positive social memory on cooperation was restored by actualizing information about interests, needs, (granted) responsibilities and mutual dependency through debate during workshop and feedback sessions.	• Due to its top-down approach, the cooperation process is not experienced as a collective initiative; • Cooperation process is hindered by former experiences of non-compliance to the contract by the authorities and agrarians (caused by a strong feeling of autonomy).
Leadership	• Water authorities still have the formal power to enforce outcomes;	• Due to the top-down approach that restricts and directs and in which the

	• Leaders benefit (quick start, clear directions for management procedures) from the pre-described stepwise procedure that directs the process management; • Leaders recognize the importance of and take conscious actions to find common ground for cooperation; • Leaders are sensitive to constraints and resistance of members; • A successful intervention during the workshop sessions and careful handling during the feedback session restored the trust provisionally; • IVN consider the elected governing council to be an appropriate body to ensure and balance ecological and economic interests.	water board takes the final decision, the cooperation is not primary based on intrinsic motivation to participate; • Formal authority is considered a common enemy that has to be opposed; • In consequence of the former two points, the success of the cooperation process heavily depends on the sensitivity of leaders for constraints and the capacity to anticipate and intervene (use of communication techniques); • The formal nature and the long-term cyclical management procedure allow little space for intermediate interventions; • The success of the leaders' actions depends on the composition of the group and the inclination of the participants to cooperate.
Learning	• The management approach that has a cyclic character of 10 years is based on knowledge of adequate governmental action and reveals a continuous updating thereof; • During meetings members make efforts to learn from each other about observed constraints, needs, interests and responsibilities, but also about expertise and possible solutions; • Water board Waterschap Aa en Maas endeavors to search for adaptive technologies that meet the desired flexibility and autonomy needed for the optimal ground and surface water management; • The method that is used during meetings appeals to and combines local and scientific knowledge; • The results of newly implemented measures are monitored and evaluated.	• Pre-determined step-wise procedure discourages the introduction, discussion and evaluation of innovative measures by all stakeholders; • The duration of the cyclic management process is rather long, and so gives little room for intermediate adjustments; • The step-wise procedure does not include directions for the exchange of experiences with the implementation of this policy between different arenas.
Congruence between costs and benefits	• Private parties and NGO's make a positive trade-off for financial expenses for the	• Due to the top-down approach, private parties and NGOs lack a feeling of control over the outcomes.

	implementation of adaptive measures; • The use of control instruments like bans, permits, licensing, pricing water increases the effectiveness of measures; • The careful approach of the water board Waterschap Aa en Maas in the search for flexible measures, to understand social incentives for participants to join, and to gather knowledge of adequate governmental actions, is regarded by other stakeholders as an aspect that weighs positively in the trade-off for decision-making to adopt adaptive measures; • The long-term policy prevents electoral pressure and secures there is enough time left to carry out the project.	Agrarians feel limited in their autonomy; • The expenses for the implementation of the policy, the adjustment of the technical elements in the water system, and the facilitation the process are to be paid entirely by the water board Waterschap Aa en Maas.

Social memory
This project has been initiated by the formal authorities. Because the cooperation between stakeholders is not based on a common sense of urgency but initiated by the water board, common ground for cooperation has to be built. The clearly defined boundaries of involved groups and areas and the clearly formulated goals and stepwise approach (that first relieved the current constraints) secure that the involved stakeholders collectively build memories along the way. Despite this conscious procedure, this case also demonstrates how trust in current management practices is affected by former experiences. The open atmosphere with mutual respect, in which transparency was given about needs and interests, helped to build a positive social memory and, as a result, a relationship of trust.

Leadership
The top-down approach for implementation of national policy on a regional level is a significant feature in this governance arrangement. Leaders benefit from the pre-described stepwise procedure that directs management practices. However, the top-down approach lacks up front the intrinsic motivation of participants to cooperate. Moreover, the top-down approach makes the formal authority vulnerable to be regarded as a 'collective enemy' that may bind others and can be battled. In this cooperative management process the acceptance of actions depends on the sensitivity and competences of its leaders. But also less influenceable circumstances like the group's composition and the nature or culture of its participants determine whether leadership actions will be effective. Conscious actions to find common grounds for cooperation (transparency about granted responsibilities, stakeholders' interests and mutual dependencies), and the use of formal authority (direct the procedure, final decision-making, control over outcomes, the use of control measures like bans, permits, licensing, pricing water) offer an appropriate system to ensure and balance ecological and economic interests.
Although the governing board is constituted by elections and so represents all involved stakeholders, the long-term cyclical procedure makes the procedure static and less accessible for adjustments. Despite the fact that stakeholders are consulted to provide information and thus contribute to the governance process, the unbalanced distribution of power makes the relationships and in the end the cooperative management process vulnerable for objections.

Learning
In this governance arrangement learning focuses on 'reading' environmental system feedback and understanding social incentives to support adequate governmental actions. The pre-described, stepwise, cyclic procedure for the management approach ensures the ongoing learning process, and appeals to combine local and scientific knowledge. Organized meetings offer the opportunity for knowledge exchange (expertise and understanding). Development and implementation of innovative (automated) technologies based on unbiased parameters creates a constructive basis for cooperation that meets the desired flexibility and autonomy that are necessary for the optimal ground and surface water management, supported by all stakeholders.
However, the introduction of this governance arrangement by the government and formal water authority and pre-determined step-wise procedure tempt other stakeholders to sit back. In consequence, the brainpower of other stakeholders is not optimally exploited. In addition, because of its long-lasting cyclic character, the procedure leaves little opportunity for the intermediate adjustment of measures. In consequence, the necessary flexibility to adapt to sudden changes must be found above all in the introduction of automated measures. Finally, the pre-described procedure does not include directions for the dissemination of experiences resulting from the implementation of the GGOR AHS policy in other (operational) areas and networks. As a result, the desired positive dynamic for 'ongoing learning-by-doing' on extended level is imperfect.

Congruence between costs and benefits
Despite the top-down approach, the acknowledgement of mutual dependency is a basic principle for fruitful cooperation. The policy and management approach enables the formal authority to enforce outcomes that cover the water quality and quantity of the ground and surface water system for the entire area! The expenses for the implementation of the policy are entirely on behalf of the water board, that has the ultimate responsibility for adaptive water management in the interest of all stakeholders. However, to balance costs and benefits additional water pricing might be a fitting instrument.
Although private parties and NGOs make a positive trade-off for financial expenses, active cooperation in this governance arrangement is based on the advantages of experienced social incentives like the degree of autonomy, the extent to which stakeholders are tempted, persuaded or compelled. The top-down approach of the formal authority that restricts and directs, hinders the perception of management practices as a collective and flexible initiative. Due to the long-term policy cycle, private parties hardly have any opportunity to intervene. Moreover, the limited autonomy regarding their own property makes agrarians dependent on the performance of the formal authority. In this case good management has proven to be a decisive factor for the experienced congruence between costs and benefits.

7 Discussion and Conclusion

The aim of this thesis is to learn and benefit from gained experiences in the case Farmer, Beer, and Water, the case Buffer Farmers and the case GGOR AHS in which cooperation between water authorities and private parties takes place, and to verify the theories of Adaptive Governance of common pool resources in these embedded cases of water management.
For that purpose the general research question has been formulated as: "to what extent do cooperative governance arrangements with local (private) stakeholders contribute to adaptive water management?" In this chapter the research questions will be answered and commented. For the analysis of results the main focus is laid on social memory, leadership, learning as sources of resilience selected from the theory of Adaptive Governance of Social Ecological Systems and the 'congruence between costs and benefits' selected from the institutional design principles of enhancing self-governance of common pool resources.

Social memory
In the cooperation processes of the study cases the interests of stakeholders diverge strongly. Social engagement, a collective framing of the problem, a shared sense of urgency, an awareness of mutual dependency or an appeal to the moral responsibility of the group of stakeholders provide a common ground for cooperation. The social memory, however, governs the trust relation which is fundamental for the willingness to cooperate and for the factual adoption of measures. Fruitful cooperation is determined by the existing social memory of the stakeholders. Past experiences construct the social memory of the participants in the cooperation process. Social memory evolves along the way. Collective efforts to give transparency over interests, needs, responsibilities and mutual dependencies actualize the mapping of past experiences. Successful experiences in smaller sub-projects can be used as stepping stones to achieve larger goals. Quick wins and best practices add to positive experiences and therefore a social memory that unfolds the fundament for adaptive co-management. A pre-described project plan incorporating a specified plan for management actions, facilitates to realize quick wins. The study cases of Buffer Farmers and GGOR AHS, in contrast, illustrate that (former) negative experiences will sooner or later subvert the cooperation process. For adaptive governance, management practices must take advantage of the acknowledgement that changes of social memory shape the trust relation, which is the basis for the willingness to cooperate and the adoption of measures.

Leadership
Traditionally, the water boards have a leading role in the water management on regional scale. The development of a robust water system requires a critical mass of contributors. Agrarians, who form the largest group of landowners, have a strong desire for autonomous water management on farm scale. The cases Buffer Farmers and Farmer, Beer and Water meet the conditions as formulated by Dietz *et al.* (2003) for effective self-governance of common pool resources. In the projects the activities of the self-organizing agrarians, or self-organizing agrarians united with private industry are based on voluntary participation and therefore are prone to the risk of laxity. Voluntariness and non-commitment affect the effectiveness of management actions on extended scale negatively. The GGOR AHS case does not meet the condition for effective self-governance that 'users support effective monitoring and rule enforcement' as formulated by Dietz *et al.* (2003). The top-down approach with consultation of stakeholders in the GGOR AHS case illustrates, that this method makes it easier to adjust the water system covering the complete area involving all landowners and water users. In this governance arrangement the water boards can take advantage of the democratic constitution of the governing council and can boast of a history of cooperation with agrarians. However the bureaucratic character and the long-lasting policy cycle make the governance static and offer few options for mid-term adjustment interventions. In addition, actions not initiated by internal motivation, invite participants to lean back or resist.
Under these terms, leadership is challenged to tempt, persuade or compel stakeholders to contribute to the governance process. Notwithstanding which management approach is

chosen (bottom-up or top-down), the results of this research demonstrate that under all conditions, personal competences and informal power of leaders are decisive for successful leadership and governance outcomes. A pre-described, systematic step-wise (cyclic) approach used for top-down leadership or self-governing actions, guides leaders to proceed. Leadership based on a pre-described roadmap gives room for common ground in finding goals and actions to be reached. The cases demonstrate that leaders of the self-organizing groups are crucial to activate participants to come up with ideas, make strong connections with their grassroots and other networks, and are well able to seduce and persuade. Consequently, the inclusion of nested leaders provides a wider range of solutions and promotes adaptive measures to become adopted on extended scale. However, because also in the self-governance process the water authorities retain formal authority and final control, at times nested leaders lack power to make others comply to the arrangement. With the aim to make the governance of the water system more effective, the reallocation of authority in favor of the self-organizing communities is required. For this reason, it is important to know that the delegation of authority must be seen as an incremental learning process. Lessons can be learned from the ideas of Arnstein, as described in his article *A ladder of citizen participation* (Arnstein, 1969). Citizen participation grows in a stepwise process. Positive experiences in which the delegation of power is effectuated, contribute to building trust and lead to the redistribution of power. This process climbs from the first step on the ladder of information and consultation towards the highest step on the ladder, namely delegation of power and citizen control (Arnstein, 1969).

Learning

Because climate change causes unpredictable gradual or sudden changes, the creation of a robust and adaptive water system demands the continuous updating of understanding. In all cases management practices are regarded experiments that can be used to test hypotheses and to learn how to interpret environmental system feedback and to understand social incentives to support adequate governmental actions. The evaluation of the study cases brings about features that facilitate or constrain the ongoing learning dynamic.

Scientifically designed and executed experiments succeeding all phases (testing, monitoring, discussing and evaluating) set back barriers and contribute to trust building. A pre-described action plan for experiments to carry out and disseminate outcomes, ensures a steady proceeding through the learning cycle. The demonstration of outcomes (quick wins and best practices) in their turn speed up the adoption of measures on extended scale. Inclusion of a broad range of stakeholders (scientists, local users, organizations for nature conservation and experts) to carry out experiments, for collective monitoring, evaluation and discussion of outcomes, mobilizes broad support for adaptation. Inclusion of scientists catalyzes the development and dissemination of knowledge on extended scale. Inclusion of local stakeholders (with entrepreneurial minds) and people working on operational levels (with local knowledge) contributes to address feasible but also out-of-the-box solutions. The development and implementation of automated measures offer a worthy prospect for the necessary flexibility to fine-tune management practices. In the governance arrangement Farmer, Beer and Water in which self-organizing actor groups have a dominant role, the dissemination of knowledge is hindered by commercial interests and short term market advantage. Despite all good initiatives and intentions in the case studies Buffer Farmers and Farmer, Beer and Water, the funding of the governance arrangements is critical for ongoing learning.

Congruence between costs and benefits

Social and financial incentives determine the perceived congruence of costs and benefits. The continuity of the adaptive governance process depends on the affordability of the development, implementation, monitoring and evaluation of adaptive measures. Inclusion of solid private parties with high interest entails funding for activities. However, investments made by private parties lead to reciprocal expectations. The case study Buffer Farmers reveals, that the autonomic behavior of agrarians on farm scale endangers the effectiveness of measures. Subsidies support the development of innovative measures. An experienced market advantage or commercial interests make early adopters reticent to

share knowledge. In the decision-making process of profit-driven parties, short-term financial incentives prevail over goals for long-term sustainability. Additional advantages like positive image-building, spill-over effects and social engagement are considered to be positive experiences, but not sufficient to commit to the governance process in the long-run.
The evaluation of the study case Farmer, Beer and Water reveals that in case the governance process includes high financial interests and contributions of private parties, diverging interests and a sense of urgency give rise to strategic behavior and therefore make the governance process vulnerable and instable. Management instruments of the water authorities like water pricing and licensing secure the balancing of ecological and economic goals.
To increase effectiveness, lessons can be learned from the experiences with Dutch farmers' association "the Northern Frisian Woodlands", an environmental cooperative for nature conservation in the governance of natural resources. Termeer *et al.* (2013) conclude that an adequate self-governance arrangement, including agreements on tasks, competences, responsibilities and conditions, between governmental authorities and the regional association contribute to the reallocation of power, meanwhile securing increasing effectiveness of management practices (Termeer *et al.*, 2013).

The results of this research are based on the data collected from three cases, retrieved in a limited period, while the execution of the projects still continues. The number of respondents for interviews was limited and their selection was based on recommendation. The participative character of observations and the interaction during interviews might have affected the outcomes of the governance process. Much effort has been given to make the interpretation of data objective. However, the approach of this in-depth case study implicates a possible bias of results.
Under these restriction some general conclusions can be drawn:

- The evolving social memory governs the trust relation, that forms the fundamental for a fruitful cooperation.
- Inclusion of scientists strengthens the objectivity of outcomes and therefore makes experiments more trustworthy. Collective learning sets back barriers and provides confidence for the implementation of adaptive measures. To increase the resilience of the governance arrangement, learning to live with change focuses on (1) reading the ecological system feedback, (2) the understanding of incentives for actor groups to cooperate, (3) renewed social memories that are the fundament for adaptive co-management, (4) the reallocation of power crossing governmental and ecological levels and spaces and (5) the reorganization of rules to strengthen leadership of self-organizing groups.
- The competences of the leaders determine the quality of leadership. For adaptive governance, leaders are sense-makers, who seduce, persuade, or compel to participate and comply, and manage the social memory and learning dynamics. Key individuals have a leading role in sense-making (having vision and commitment) for renewal and in setting up remedial actions (determine the trajectory of management practices and convene the process).
- Adaptive co-management, in which cooperation between local and regional private actors and governmental authorities takes place, makes it possible that ecological and institutional spaces and scales are crossed.
- For adaptive governance of the water system, cooperation with landowners like agrarians and organizations for nature conservation and water users like the industrial companies contribute to provide practical solutions 'at source' and to develop strategies and measures that offer chances for expansion and adjustment of an adaptive water system. The inclusion of self-organizing communities in the governance arrangement increases the diversity of ideas and solutions and the variety of management responses.
- The distribution of power between water authorities and project management is ambiguous. The formal water authorities have the power to control the effectiveness of the water management with rules and regulations. Lack of formal authority linked to nested leaders, undermines the effectiveness of management

actions. Reallocation of power must be considered to strengthen the effectiveness of leaders.
- To balance economic and ecological goals, the governance of the fresh water resources cannot be left to the self-organizing community alone. In the decision-making process private parties make a trade-off in which financial incentives prevail. The constitution of water boards offers an encouraging platform for more guiding and the introduction of complementary incentives.
- To make governance arrangements adaptive, innovative technology and advancing knowledge provide a good opportunity to delegate power, meanwhile controlling the effectiveness of adaptive measures.

The social aspects in the social ecological system involve the capacity of actors to cope with change and uncertainty. Social memory, leadership and learning play a significant role to make the fresh water system robust to adapt to climate change. In order to strengthen the capacity of the social ecological system to be resilient the social system should be carefully approached in the construction of governance arrangements.

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Appendix I Interview guide

Interview guide inspired by the topic list as constructed by Yaffee *et al.*, (1997). Previously used by Olsson *et al.*, (2007) to analyze the (adaptive) governance of the Kristianstads Vattenrike Biospere Reserve and in this thesis used as a source to generate questions for the interviews

Factors that determine adaptive governance	Linked to subject in case description*	Linked to subject in analysis of results **
1. Situation-Specific Factors		
• Perceived interdependence of stakeholders	G, ST, CP	SM, CCB
• Shared and superordinate goals	G	SM, LS, LN, CBB
•		
• Sense of crisis	I, CP, G	
• Sense of place	L, ST	SM, LS
• Personal relationships	ST, CP	LS, SM, CCB
• Trust and respect	ST, CP	SM, LS
• Public interest/pressure	I, CP	SM, CCB
2. Process-Related Factors		
• Use of an inclusive problem-solving process	G, CP	LS, LN
• Information sharing and joint fact finding	CP	LN
• Process management/interpersonal skills	ST,C	LS
• Individual leadership and dedication	ST,C, CP	LS
• Early small successes	CP	LN
• Sense of fairness, equity, and burden sharing	I, CP	CCB
3. Institutional Context		
• Opportunities for interaction	CP	LS
• Incentives	CP	CBB
• Resources	C	CBB
• Technology	C	CBB

*
I: Inducement
L: Location
G: Goals
ST: Stakeholders
C: Contributions
CP: Cooperative management process

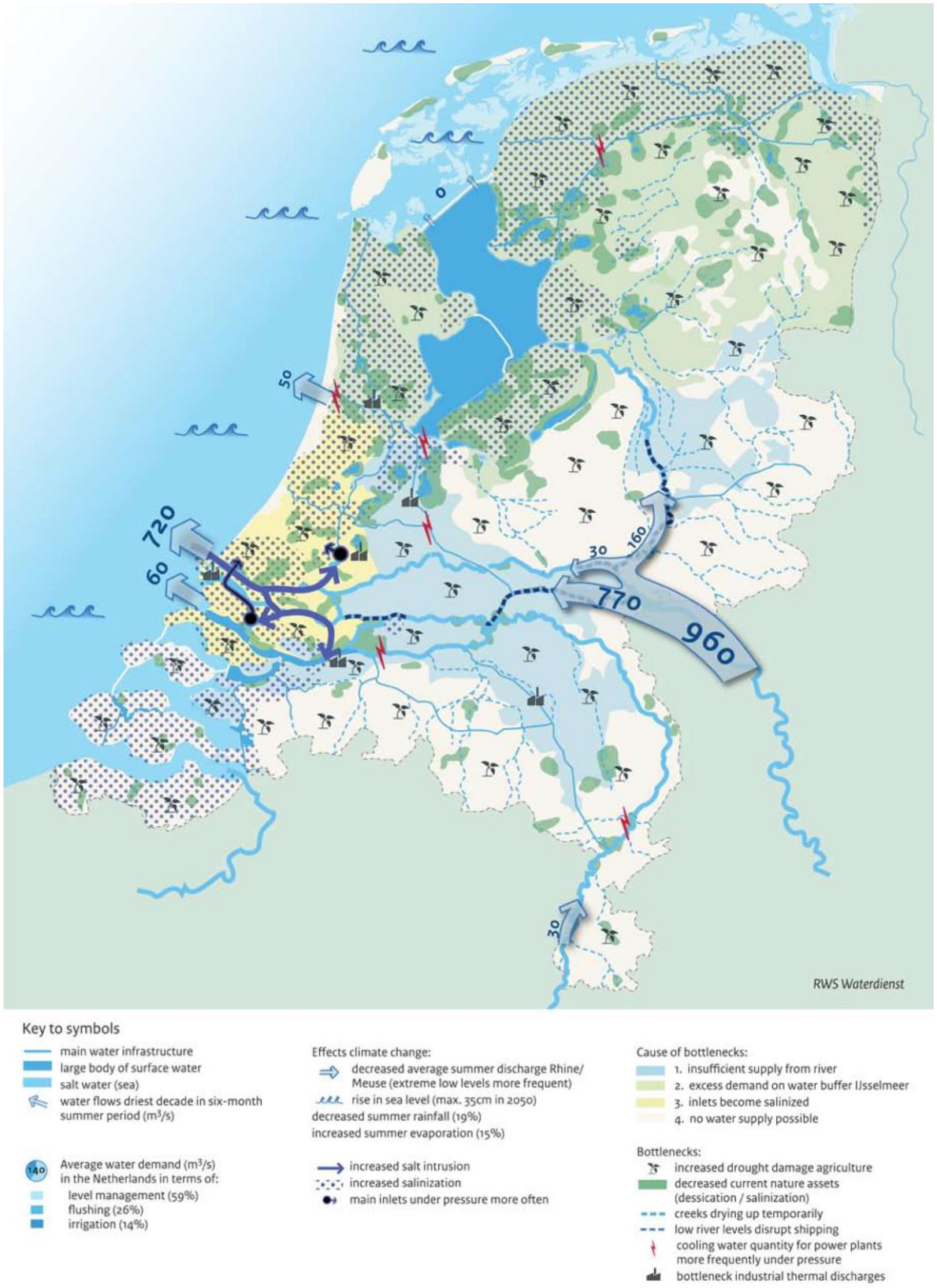
**
SM: Social Memory
LS: Leadership
LN: Learning
CCB: Congruence between Costs and Benefits

Appendix II Overview of interviews and meetings for data collection

	projects			
	Buffering Farmers	**Farmer, Beer and Water**	**GGOR AHS**	**General**
Participants for interviews	Project manager ZLTO (Stephanie Gerdes)	Project manager ZLTO (Bart Bardoel)	Interim project manager water board Waterschap Aa en Maas (Tonny Steenakkers)	Senior advisor ZLTO (Johan Elshof)
	Committee member ZLTO section (Mark van Lieshout)	Committee member ZLTO section (Paul Sneijers,)		Adviseur water board Waterschap Aa en Maas (Chris van Rens)
	Local farmer joining the project Arnoud van der Wijst,	Local farmer joining the project Pieter Verschuren		Knowledge manager water board Waterschap Aa en Maas (Maarten Verkerk)
	Local farmer joining the project Martijn Tolen	Bavaria Brewery (Martijn Junggeburth)		Province North Brabant, Policy officer (Frank Van Lamoen & Carla Niggebrugge)
	Researcher Louis Bolk Institution (Nick van Eekeren)	Municipality of Laarbeek (wethouder Theodoor Bumans)		STOWA (advisor Rob Ruytenberg)
	Expert agrarian (Ad van Iersel)	Project Manager water board Waterschap Aa en Maas (Liesbeth de Theije)		Interview water board Waterschap Aa en Maas; general information, Policy officer Mrs. Sara de Boer Dijkgraaf Mr. Lambert Verheijen
		CLM/DLV project meeting (Erik Hees, CLM) (John Rongen, DLV Plant)		
Meetings joined	Field excursion (visiting farms of Jan Ketelaar; Eric Dortman	In-dept meeting at Bavaria Brewery, Lieshout	Creative workshop session Leigraaf (meantime area of Buffering Farmers)	Feedback session / unroll vision Termeer, De Boer, Verkerk
			Feedback session on former Creative workshop session Leigraaf	Meeting co-creation KvK

Appendix III Maps of fresh water situations

*Map Freshwater **Current situation**, scenario warm and dry year (once every ten years) (Ministry of Infrastructure and the Environment, Ministry of Economic Affairs, Agriculture and Innovation (2011)*



*Map Freshwater **2050**, scenario warm and dry year (once every ten years) (Ministry of Infrastructure and the Environment, Ministry of Economic Affairs, Agriculture and Innovation (2011)*

Appendix IV Overview Policies and legislations in the field of water management

	Water safety ***Waterveiligheid***	**Water logging and flooding** ***Wateroverlast en overstroming***	**Sufficient Water** ***Voldoende water***	**Soil and groundwater** ***Bodem en grondwater***	**Waste water** ***afvalwater***
European directives *Europese richtlijnen*	Flood risk directive *Richtlijn overstromingsrisico's*		Ground water directive, Water Framework Directive *Grondwaterrichtlijn, Kaderrichtlijn water*	Water Framework Directive *Kaderrichtlijn water*	urban waste water directive IPPC *Richtlijn stedelijk afvalwater IPPC-richtlijn 96/61 (niet-stedelijk afvalwater*)
National legislation *Nationale wetgeving*	Water Act, Delta act water safety and fresh water supply *Waterwet, Deltawet waterveiligheid en zoetwatervoorziening*	Water Act *Waterwet*	Water Act, Delta act water safety and fresh water supply *Waterwet, Deltawet waterveiligheid en zoetwatervoorziening*	Water Act, Implementation law, KRW, AWB, Soil protection law, BKMW *Waterwet, Implementatiewet KRW, AWB, Wet bodembescherming, BKMW*	Water Act *Waterwet*
National Programs *Nationale plannen*	National water plan, Delta program, Delta program fresh water, Program Ground and Surface water Regime agriculture *Nationaal waterplan, Nationaal Delta programma, Nationaal Delta*	Delta program, Delta program fresh water, Program Ground and Surface water Regime agriculture, Program Room for the river *Nationaal Delta programma, Nationaal Delta*	Delta program, Delta program fresh water, Program Ground and Surface water Regime agriculture, Program Room for the river *Nationaal Delta programma, Nationaal Delta*	Delta program, Delta program fresh water, Program Ground and Surface water Regime agriculture, Program Room for the river *Nationaal Delta programma, Nationaal Delta*	

	programma zoet water, Programma GGOR AHS (Gewenst Grond- en Oppervlakte water Regiem Agrarische hoofdstructuur)	*programma zoet water, Programma GGOR AHS landbouw (Gewenst Grond- en Oppervlakte water Regiem Agrarische hoofdstructuur), Programma Ruimte voor de rivier*	*programma zoet water, Programma GGOR AHS (Gewenst Grond- en Oppervlakte water Regiem Agrarische hoofdstructuur), Programma Ruimte voor de rivier*	*programma zoet water, Programma (Gewenst Grond- en Oppervlakte water Regiem Agrarische hoofdstructuur), Programma Ruimte voor de rivier*	
National administrative agreements *Nationale bestuursakkoorden*		2001 WB 21st century 2003 NBW 2007 NBW topical *2001 WB 21e eeuw 2003 NBW 2007 NBW actueel*		National agreement soil and spatial development, Administrative agreement Water *Landelijk convenant bodem-ontwikkelingsbeleid Bestuursakkoord water*	
Regional programs *Regionale plannen*		Strategic and Implementation Program for Fresh Water Supply *Strategische en implementatie programma zoet water*	Strategic and Implementation Program for Fresh Water Supply *Strategische en implementatie programma zoet water*		
Provincial regulation *Provinciale verordeningen*	Water Regulation *Verordening Water*	Water Regulation *Verordening Water Verordening Ruimte*	Water Regulation *Verordening Water*		
Provincial programs *Provinciale plannen*	Provincial Water program North Brabant, Structural vison	Provincial Water program North Brabant, Structural vison Spatial planning,	Provincial Water program North Brabant, Structural vison Spatial planning	Provincial Water program North Brabant, Structural vison Spatial planning	Provincial Water program *Provinciaal Water plan*

	Spatial planning, Meuse Projects *Provinciaal Water plan Noord-Brabant Structuur visie ruimtelijke ordening, Maas werken*	Meuse Projects *Provinciaal Water plan Noord-Brabant Structuur visie ruimtelijke ordening, Maas werken*	*Provinciaal Water plan Noord-Brabant Structuur visie ruimtelijke ordening*	*Provinciaal Water plan Noord-Brabant Structuur visie ruimtelijke ordening*	
Provincial administrative agreements *Provinciale bestuursakkoorden*		2nd administrative agreement *2de bestuursovereenkomst*	2nd administrative agreement *2de bestuursovereenkomst*	2nd administrative agreement *2de bestuursovereenkomst*	
Water board legislation *Waterschaps verordeningen*	'Keur' *Keur*	'Keur' *Keur*	'Keur' *Keur*	'Keur' *Keur*	
Water board programs and agreements *Waterschaps plannen en bestuursakkoorden*	Water management program *Waterbeheerplan*	Water management program, Ground water management program *Waterbeheerplan, Grondwaterbeheerplan*	Water management program, Ground water management program *Waterbeheerplan, Grondwaterbeheerplan*	Water management program, Ground water management program *Waterbeheerplan, Grondwaterbeheerplan*	Water management program, Waste water agreement, Waste water cooperation contracts *Water beheer plan, Afvalwaterakkoorden, Samenwerkings contracten Afvalwater*

Appendix V Maatregelen management watersysteem

Maatregelen uit 'Concept strategie en uitvoeringsprogramma zoetwater Hoge Zandgronden 0.3, toelichting maatregelen concept uitvoeringsprogramma zoetwater Zuid Nederland', zoals deze ook voor de bij dit onderzoek betrokken pilot projecten worden gehanteerd.

1. **Seizoensberging in wateraanvoergebieden** (niet in beekdalen), stuwtjes plaatsen in detailwatergangen. In de detailwatergangen in de wateraanvoergebieden (niet in de beekdalen) worden stuwtjes geplaatst. Het ontwerp moet in combinatie met maatregelen ter voorkoming van piekafvoeren/ wateroverlast zoals peilgestuurde drainage worden gehanteerd. Om wateroverlast of natschade te voorkomen zullen in de lager gelegen gebieden waarschijnlijk aanvullende maatregelen genomen moeten worden zoals de aanleg van peilgestuurde drainage, dammetjes of knijpstuwtjes om tijdelijke berging op maaiveld te faciliteren.
2. **Peil optimaliseren** (niet in beekdalen) door een slimmer ontwerp en een slimmere sturing van het regionale watersysteem kan er een dynamisch/flexibel peilbeheer gevoerd worden in de wateraanvoergebieden.
3. **Conservering in vrij-afwaterende gebieden** (niet in beekdalen), drainagebasis verhogen in detailwatergangen. Door deze maatregel toe te passen in combinatie met maatregel 3 zal de grondwaterstand gemiddeld met ongeveer 20 cm worden verhoogd. Bij diepe grondwaterstanden (tot 2 meter diep) zal er daardoor per groeiseizoen ongeveer 14 mm extra capillaire nalevering zijn naar de wortelzone van de gewassen (bron: Cultuurtechnisch Vademecum). Om wateroverlast of natschade te voorkomen zullen in de lager gelegen gebieden waarschijnlijk aanvullende maatregelen genomen moeten worden zoals de aanleg van peilgestuurde drainage, dammetjes of knijpstuwtjes om tijdelijke berging op maaiveld te faciliteren.
4. **Vergroten grondwatervoeding** (niet in beekdalen) op perceelsniveau. Het doel van deze maatregel is om op perceelsniveau meer water vast te houden en de detailafvoer te verminderen. Dit wordt bereikt door het plaatsen van knijpstuwtjes en dammetjes en regelbare klimaatadaptieve drainage.
5. **Beekdalen robuust herinrichten**: verhogen drainagebasis, aanpassen peilbeheer en tijdelijke berging op maaiveld. Door het verhogen van de drainagebasis met 40 cm wordt de grondwaterstand aan het begin van het groeiseizoen met 20 cm verhoogd. Daarnaast wordt in natte perioden tijdelijk water geborgen op maaiveld. Hierdoor is er meer water beschikbaar in droge periode voor natuur, landbouw en recreatie en neemt de piekafvoer af. Tijdelijke wateroverlast op de percelen dient wel ingepast te worden in de bedrijfsvoering van landbouw en natuur.
6. **Tijdelijke peilopzet ten behoeve van de landbouw**. Bij deze maatregel worden de peilen in het oppervlaktewater van de wateraanvoergebieden voor het begin van een droge periode met 20 cm opgezet, onder de aanname dat er dan nog voldoende water in het hoofdwatersysteem beschikbaar is en/of dat er dan regenbuien vallen die kunnen worden vastgehouden. De 20 cm extra waterschijf is vervolgens beschikbaar voor beregening en voor het aanvullen van de grondwaterstand.
7. **Optimalisatie gewaskeuze**, droogteresistentere gewassen/soorten.
8. In de gebieden met de hoogste droogteschade zou de gewaskeuze geoptimaliseerd kunnen worden door het toepassen van droogte resistentere gewassen.
9. **Verbeteren bodemstructuur/ verhogen organisch stofgehalte akkerbouw**. Met deze maatregel wordt het organische stofgehalte in de wortelzone met 3% verhoogd. Dit kan bijvoorbeeld met groenbemesting. Deze maatregel kan toegepast worden op de akkerbouwgronde
10. **Verbeteren bodemstructuur/ verhogen organisch stofgehalte grasland door niet-kerende grondbewerking**. Ook met deze maatregel wordt het organische stofgehalte in de wortelzone met 3% verhoogd. Door deze maatregel wordt het vochttekort structureel (elk jaar) met 11 mm verlaagd. Deze maatregel vergt een andere bedrijfsvoering van de agrariër (niet meer ploegen).

11. **Efficiënter beregenen, druppelirrigatie i.p.v. beregenen**. Door de efficiëntie van beregening te verhogen van 75% naar 90% kan in een gemiddeld jaar 11 mm water bespaard worden.
12. **Efficiënter beregenen, slimmer beregenen op basis van veld- of satellietwaarnemingen**. Bij slimmer beregenen worden op basis van veld- of satellietwaarnemingen continu de vochttekorten in de bodem en de watertekorten van de gewassen gemonitord. Op basis van deze gegevens kan gericht worden beregend. Deze maatregel is met name toepasbaar voor grasland en akkerbouw waar in de huidige situatie al beregend wordt.
13. **Uitbreiden beregening uit oppervlaktewater in wateraanvoergebieden**. In de gebieden waar in de huidige situatie de droogteschade van akkerbouw groter is dan 10% en grasland groter dan 20% wordt de beregening uitgebreid. Het doel van deze maatregel is om het gemiddelde jaarlijkse vochttekort van 57 mm te compenseren.
14. **Uitbreiden beregening uit grondwater in vrij-afwaterende gebieden**. In de gebieden waar in de huidige situatie de droogteschade van akkerbouw groter is dan 10% en grasland groter dan 20% wordt de beregening uitgebreid.
15. **Toename bestaande beregening met 5%.**
16. **Optimalisatie gewaskeuze, meer gras minder mais**. In gebieden met een groot risico op verdroging wordt geen mais meer verbouwd.
17. **Waterbuffers lokaal op percelen bij agrariërs**. Water kan ook worden opgeslagen in waterbassins in hellende landbouwgebieden. Per bedrijf kan water worden vastgehouden in kleinschalige waterbassins (concept van de waterhouderij).

(Bron: ZONDHZ, (2013) Concept strategie en uitvoeringsprogramma zoetwater Hoge Zandgronden 0.3, toelichting maatregelen concept uitvoeringsprogramma zoetwater Zuid Nederland)

Appendix VI Terms and abbreviations

English	Dutch
Administrative agreement Water	Bestuursakkoord water
Agricultural Advisory Services	Dienst Landbouw Voorlichting (DLV)
Centre for Agriculture and Environment Foundation	Stichting Centrum voor Landbouw en Milieu (CLM)
Decree quality standard and monitoring water	Besluit kwaliteitseisen en monitoring water (BKMW)
Delta Act water safety and fresh water supply	Deltawet waterveiligheid en zoetwatervoorziening
Delta program	Nationaal Delta programma
Delta program fresh water	Nationaal Delta programma Zoet water
Directorate for Public Works and Water Management	Rijkswaterstaat
Drinking water company Brabant Water	Brabant Water
Dutch Dairy Board	Productschap Zuivel
Ecological Network	Ecologische hoofdstructuur (EHS)
environmental impact assessment	milieueffectrapportage (m.e.r.)
Flood risk directive	Richtlijn overstromingsrisico's
Forest Service	Staatsbosbeheer (SBB)
Foundation for Applied Water Research	Stichting Toegepast Onderzoek Waterbeheer (STOWA)
Ground water directive	Grondwaterrichtlijn
Ground water management program	Grondwaterbeheerplan
Implementation law KRW	Implementatiewet KRW
Institute for Nature Education and Sustainability	Instituut voor natuur educatie en duurzaamheid (IVN)
Meuse Projects	Maas werken
National administrative agreements	Nationale bestuursakkoorden
National agreement soil and spatial development	Landelijk convenant bodem-ontwikkelingsbeleid
National water plan	Nationaal waterplan
Natura 2000	Natura 2000
Network Practice Fund	Praktijknetwerk gelden
North Brabant Christian Farmers Association	Noord-Brabantse Christelijke Boerenbond (NCB)
North Brabant Landscape Foundation	Stichting Brabants Landschap
Optimal Ground and Surface water Regime agriculture	Gewenst Grond- en Oppervlaktewater Regime Agrarische Hoofdstructuur (GGOR AHS)
Program Room for the river	Programma Ruimte voor de rivier
Provincial Water program North Brabant	Provinciaal Water plan Noord-Brabant
Public Administration law	Algemene wet bestuursrecht (AWB)
Soil protection law	Wet bodembescherming
Southern Agricultural and Horticultural Association	Zuidelijke Land- en Tuinbouworganisatie (ZLTO)
Spatial Regulation	Verordening Ruimte
Steering Committee Agricultural Innovation North Brabant	Stuurgroep Landbouw Innovatie Noord-Brabant (Stuurgroep LIB)
Steering committee Delta program Upland sandy soils	Stuurgroep Delta plan Hoge Zandgronden (stuurgroep DHZ)
Strategic and Implementation Program for Fresh Water Supply	Strategische en implementatie programma Zoet Water
Structural vison Spatial planning	Structuur visie Ruimtelijke ordening
Waste water agreement	Afvalwaterakkoorden
Waste water cooperation contracts	Samenwerkings contracten Afvalwater
Water Act	Waterwet
Water board legislation	Waterschaps verordeningen
Water Framework Directive	Kaderrichtlijn water (KRW)
Water management program	Waterbeheerplan
Water Regulation	Verordening Water